Citizen Involvement and Just Adaptation To Flood Risk: A Q-Methodology Study of Amsterdam Weerproof

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Abstract

The governance of adaptation to urban flood risk is transforming. One major trajectory of this transformation is towards the co-production of adaptation strategies. In the context of urban flood adaptation, co-production refers to the active involvement of non-state actors - such as citizens and private organisations - in implementing flood-proof measures on private property to improve soil permeability and mitigate stormwater runoff. This responsibility shift in the provision of flood security deserves further scrutiny under a climate justice lens. If a city's flood security becomes dependent on citizen action, the benefits of adaptation may become unevenly distributed depending on who has the resources to implement such measures. In particular, research is yet to address how the different state and non-state actors involved in the co-production process subjectively frame climate justice and responsibility for flood adaptation. To address this gap, this research employs an original Q-Methodology study to map the perceptions of stakeholders involved in the Amsterdam Weerproof programme. The study identifies three main diverging visions of what co-produced adaptation should look like in Amsterdam: 1) private-led, market-driven; 2) community-led, justice-driven; 3) individual-led, participation-driven. From the analysis of dissensus statements (those areas where participants most strongly disagreed), two main nodes of tension emerge: a) the role of the state and b) considerations of justice. Alongside these tensions, the consensus statements reveal three possible areas of convergence, namely: 1) a shared sense of urgency, 2) a shared appreciation for nature-based interventions, and 3) a focus on voluntary actions. These findings highlight how underlying disagreements about justice and responsibility can make or break the potential of co-production for equitable climate adaptation, a critical contribution as cities increasingly rely on citizens' involvement.

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Note: unless otherwise specified, all photographs are my own, taken in Amsterdam between 2024 and 2025.

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1 Introduction

View of Nieuwe Keizersgracht through a tram window.

At the same time as climate change intensifies extreme weather events, humans are living in more dense, paved and unequal cities (Anguelovski et al., 2020; Planas-Carbonell et al., 2023). This sets the stage for increased and uneven urban flood risk. In cities, where soil is mostly sealed by built-up infrastructure and permeability is limited - up to 80% of urban surfaces in Europe are impervious (European Environmental Agency [EEA], 2021) - flash floods endanger the lives and livelihoods of millions of people (Cea & Costabile, 2022).

Considering the Intergovernmental Panel on Climate Change (IPCC)'s predictions [1], as well as recent devastating floods, such as the ones that claimed the lives of 193 people in Western Germany in 2021 or devastated the region of Valencia in 2024, cities across the world are implementing more flood adaptation measures (Eriksen et al., 2021; Fekete & Sandholz, 2021). Traditional approaches to flood management have typically relied on centralized and grey solutions implemented by public authorities, from flood walls to stormwater basins (Nye et al., 2011). However, faced with limited resources, fragmented land ownership, and the need for widespread implementation of adaptation measures, many cities are now turning to the co-production of flood adaptation - a governance framework that distributes responsibility for flood adaptation across different actors, including urban residents, businesses, and civil society organizations (Mees et al., 2016).

Originally, the term co-production was defined by Elinor Ostrom (1996) as "the process through which inputs used to produce a good or service are contributed by individuals who are not in the same organisation" (p.3). In the case of flood risk management, this translates into actors other than public authorities taking up responsibilities for reducing the risk of flooding by, for example, installing property-level measures that mitigate rainwater runoff. In this thesis, co-production of flood adaptation is used to mean the active involvement – together with the Municipality - of NGOs, private businesses and homeowners in urban flood adaptation. Following the definition provided by Mees et al. (2018), co-production is defined as

> The relationship between a governmental or public organization and (groups of) citizens that requires a direct contribution from these citizens to the delivery of a public good or service. The public service in this context refers to the avoidance and mitigation of harmful consequences of flooding at a societal level. (p. 331)

Amsterdam, a city with a long history of flood management but currently unprepared to deal

[1] The IPCC states with "high confidence" that damages from water-related hazards are increasing in Europe due to global warming (Hartmann et al., 2019).

with future climate scenarios (Sharma, 2023a), exemplifies this shift toward co-production in urban flood adaptation (Willems & Giezen, 2022). Through its "Amsterdam Weerproof" programme (formerly “Amsterdam Rainproof”), the municipality and Waternet (the local water authority) have established a “Local Climate Adaptation Network” (Willems & Giezen, 2022). This network includes 114 partners across public, private and civil society sectors that committed to collectively help making the city more climate-proof and permeable. At the same time, Amsterdam Weerproof strongly promotes the involvement of residents, in particular of homeowners, by providing them with practical tips and subsidies to adopt property-level measures. Amsterdam Weerproof complements the Municipality’s own Climate Adaptation Strategy, which is limited to the work of municipal departments in public space.

The programme was set as a response to increasingly intense rainfall events (such as the 2014 cloudburst) and future precipitation scenarios. It was also a reaction to the need to count on other stakeholders as a large share of land in the city is privately owned. This last point means that strong citizen involvement is required to intervene at the property-level, with measures such as the implementation of green roofs and rainwater harvesting systems (Dai et al., 2018). Intervening on public land was not enough to meet the programme’s ambitious goal - to “manage 60mm of hourly rainfall without damage” (Sharma, 2023a).

While co-production approaches have the potential to expand the scope of flood adaptation efforts and enable the inclusion of residents towards this goal, they also raise critical questions about climate justice. If a city’s flood resilience mostly depends on residents’ actions, the benefits of adaptation may become unevenly distributed based on who has the resources and capacities to implement such measures. The emerging literature on urban climate justice highlights that adaptation interventions, if implemented without explicit consideration of equity implications, can lead to what Anguelovski et al. (2016) defined as "acts of commission" - creating protected climate-proof enclaves for privileged groups - and "acts of omission" - neglecting climate-vulnerable communities.

Despite growing scholarly attention to both co-production and justice in urban climate adaptation, limited research has examined how these two dimensions interact in practice. Therefore, the extent to which co-produced adaptation can contribute to climate (in)justices deserves further scrutiny. In particular, no research so far has addressed how the different actors involved in co-production, including local governments, private businesses, and individual residents, frame climate justice and responsibility in the context of flood adaptation. Their own subjective beliefs about what just climate adaptation might look like are an essential element to understand how climate policy

plays out in the city. These subjectivities can be studied through the analysis of “discourses”. Discourses are the explicit manifestation of the underlying narratives and sets of beliefs that guide our action. As Wamsler et al. (2020) argue, "subjectivities are as important as power structures when managing climate adaptation" (p. 248), yet these subjective dimensions remain understudied.

This thesis addresses this gap by examining the case of Amsterdam Weerproof. Using Q-methodology, it identifies and analyses the different discourses related to climate justice and responsibility that are most prevalent among stakeholders involved in the programme. By doing so, it aims to enhance our understanding of how co-production approaches to urban climate adaptation navigate the tensions between distributed responsibility and equitable outcomes. The research is guided by two specific research questions:

- What are the main discourses around climate justice and responsibility among the different actors involved in Amsterdam Weerproof?
- What are the main tensions and possible areas of consensus between the different discourses?

The thesis is structured as follows: Chapter 2 provides a review of foundational theoretical frameworks in urban flood adaptation, co-production approaches, and climate justice. Chapter 3 introduces the case study of Amsterdam Weerproof and describes the methodological approach, with a focus on Q-methodology as a tool for analysing discourses. Chapter 4 presents the findings, identifying three distinct discourses on justice and responsibility within the Amsterdam Weerproof network. Chapter 5 discusses these findings in relation to existing literature and explores the tensions and convergences between the identified discourses. Finally, Chapter 6 concludes with implications for both theory and practice, highlighting how cities can navigate the complex terrain of justice and responsibility when implementing co-production approaches related to flood adaptation.

2 Review and Theoretical Framework

Board floating on the Dijksgracht.

2.1 Focus, Rationale and Structure

This literature review aims to describe current approaches to the study of citizen involvement in the implementation phase of climate adaptation. The focus is on the co-production of adaptation by the municipality and other urban stakeholders. This approach goes beyond mere participation in decision-making, often termed "collaborative planning". In co-production, citizens take action towards the implementation of a service, such as climate adaptation, regardless of their involvement in the planning phase (Mees et al., 2018).

This focus excludes other forms of adaptation, such as purely bottom-up initiatives (for example, grassroots movements experimenting with climate-proof housing) or top-down approaches (for example, large-scale flood barriers implemented by public authorities). While still present, blurred at the margins, these are beyond the scope of this work. This focus is justified by a prevailing shift towards citizen involvement in flood adaptation strategies, which will be expanded upon later, and a paucity of studies that have addressed this new form of adaptation governance from a critical perspective.

The selection of the urban scale is a result of two interlinked considerations. First, according to the IPCC, cities face heightened pluvial flood risk due to the combination of density and impervious surfaces (IPCC, 2023). Second, as the principal nodes of capital accumulation, cities present stark spatial inequalities. Hence, Urban climate adaptation becomes a crucial policy arena in the fight against social disparities: its outcomes can either curb or exacerbate existing inequalities.

The first part of the literature review addresses the "engagement turn" in flood risk management. After describing the reasons for municipal authorities to involve citizens in flood adaptation, I turn to the consequences of such responsibility shift, and the main academic approaches in the field of Adaptation Governance. In the second part, I bring in Climate Justice as a lens to understand the social justice outcomes of co-production in flood adaptation. I build on the three pillars of environmental justice – as first articulated by Schlosberg (2007) as distributive, procedural and recognitional - as well as on emerging alternative approaches that complement the original framework.

2.2 Transformations in Flood Adaptation Governance

The most widely used definition of climate change adaptation is the one given by the IPCC (2022): "In human systems, [adaptation is] the process of adjustment to actual or expected climate and its

effects, in order to moderate harm or exploit beneficial opportunities" (p. 3).

This definition serves as a starting point to distinguish adaptation from two other concepts: mitigation and resilience. As these will come up throughout the thesis, it is important to draw clear boundaries between them. Mitigation refers to efforts aimed at reducing or preventing the emission of greenhouse gases, thereby addressing the root causes of climate change. According to the IPCC (2022), mitigation involves "technological change and substitution that reduce resource inputs and emissions per unit of output" (p.4). While adaptation focuses on coping with the impacts of climate change, mitigation seeks to limit the extent of those impacts by slowing or halting climate change itself.

Resilience, on the other hand, is the “ability of a social or ecological system to absorb disturbances while retaining the same basic structure and ways of functioning, the capacity of self-organization, and the capacity to adapt to stress and change” (Tyler & Moench, 2012, p. 312). In the context of the impacts of climate change on urban settlements, resilience has gained popularity as a concept that summarises the ambition of cities to make their infrastructure and institutions ready to cope with increasingly intense and unpredictable extreme weather events. Although distinct, these three concepts often overlap and intersect in practice. Adaptation and resilience both deal with managing climate risks, but adaptation is more proactive and targeted at specific climate impacts, whereas resilience is broader, encompassing the overall robustness and flexibility of systems. Mitigation complements these by addressing the underlying causes of climate change, ultimately reducing the need for adaptation and enhancing resilience over the long term.

For urban flooding specifically, the IPCC (2022) defines adaptation as follows: "The set of processes and actions taken to adjust urban environments to mitigate the impacts of flooding" (p. 4). As such, urban flood adaptation is not new. Humans have a long history of adjusting their environment to protect themselves from floods. The Romans built embankments on the Danube to protect Vienna from flooding in the 1st century BCE. Even before that, Indus Valley civilisations protected their settlements with flood walls. In parallel, people have always taken measures in their daily life to protect their livelihoods from flood risk, a dimension of adaptation known as “everyday adaptation” (Castro & Sen, 2022).

However, scholars have pointed to a recent transformation in flood adaptation. Some authors call it “social turn” (Nye et al., 2011), others “civic model in flood risk management” (Huttunen et al., 2022), or “co-production of adaptation”(Mees et al., 2018): in brief, flood adaptation in the 21st century is a policy field in which public authorities give non-state actors an increasingly important

role (Connelly et al., 2020; Plummer, 2013). The chronology of this trend is complex, but Hügel and Davies (2020) identify the Rio Declaration in 1992 as a starting point towards citizen involvement in environmental and climate strategies. In particular, Principle 10 of such declaration stated: "Environmental issues are best handled with participation of all concerned citizens at the relevant level" (Antrim, 2019, p. 2).

With more actors involved in flood adaptation comes what Mees et al. (2019) call the "responsibilisation" of citizens. The term indicates a form of "transferring the burden of risk and responsibility [for flood management] to citizens" (Mees et al., 2019, p. 199). This can come in the form of explicit mandates – for example, mandatory rainwater harvesting as pursued in cities like Bangalore, India. Or implicit discourses that invite citizens and the private sector to take up responsibility for their own flood security and that of their neighbours – as in the case of the "tile tipping" programme in the Netherlands, where homeowners are encouraged to green their backyards to increase soil permeability.

While this trend towards increased participation is common to other policy fields, identified by the notions of "urban governance" or "the participation society" (Connelly et al., 2020), it is of particular interest in flood adaptation, since this field has been historically relegated to state intervention within the paradigm of "flood defence" (Connelly et al., 2020).

2.2.1 From flood defence to flood risk management

The increasing shift of responsibility to citizens in adaptation efforts stems from broader societal processes. These include the retrenchment of the welfare state; the re-scaling of the state (Brenner, 2004); or the transition from urban government to urban governance (Harvey, 1989), with the consequent inclusion of multiple actors in policy domains previously under full public control. However, there are drivers specific to flood adaptation. In particular, adaptation scholars talk about a paradigm shift: from flood defence to flood risk management (Hartmann et al., 2019).

The paradigm of flood defence (also called flood protection) focused on publicly funded, large-scale hydrological infrastructures such as dams and levees, with the goal of reducing the probability of flooding (Tuihedur Rahman et al., 2021). This approach was based on the premise that such engineered-based measures could deliver absolute flood protection.

Yet, as both urbanisation and global warming progressed, the limitations of flood defence became apparent. In the words of Connelly et al., "there has been an increasing acceptance that

large-scale flood defences cannot be the sole response to flooding" (2020, p. 4). According to Mees et al. (2018), academic scholarship too has acknowledged the shortcomings of flood defence, giving way to the new paradigm of flood risk management. Flood risk management brings about two innovations: a) an inclusion of "exposure" and "vulnerability" in flood risk assessment (Nye et al., 2011); b) An holistic approach which not only involves traditional protection measures, but also aims to reduce flood damage through prevention (e.g. installation of permeable surfaces), preparedness (e.g. early warning systems) and recovery (e.g. insurance schemes) (Mees et al., 2018).

2.2.2 Drivers of citizen involvement in urban flood adaptation

Multiple factors have catalysed this transition towards civic engagement in urban flood adaptation. According to Connelly et al. (2020), austerity measures have triggered a shift away from costly flood defence infrastructure towards "cheaper" social measures such as awareness and preparedness. Other authors go beyond economic considerations. Mees et al.(2016) identify three possible rationales behind the adoption of co-production in flood risk management: resilience, efficiency, and legitimacy. First, local governments may be prone to promote co-production for flood security purposes, especially when faced with novel threats such as extreme precipitation for which traditional flood defence infrastructure is less effective. Under this light, co-production is pursued, for example, as a way to promote initiatives on private land to foster soil permeability. Secondly, co-production can serve the purpose of efficiency. As Mees et al. (2016) state, "co-production is a governance concept that flourishes in times of austerity" (p. 1). Involving citizens and private organizations can be a way for public authorities to reduce costs and shift responsibility onto individuals. Finally, the authors contend that co-production can be adopted in the pursuit of more legitimacy for climate policies. With more people involved and responsibility diluted, there should be less conflict and dissensus around interventions for climate adaptation.

In the case of urban pluvial flood adaptation, as Wamsler et al. argue (2020), citizen engagement has become "inevitable", for two main reasons:

- Private land ownership: pluvial flooding calls for the implementation of small-scale measures to increase the permeability of the land. Examples include tile-tipping, rain gardens, rainwater harvesting systems, green roofs or other small scale NbS. This requires the participation of private landowners, since a substantial percentage of land in many cities is privately owned (or privately managed) (Wals, 2020). This calls for strong collaboration between local gov-

ernments and private individuals, real estate developers or homeowners associations. This collaboration, as highlighted before, can take multiple forms, ranging from voluntary to coercive(Hegger et al., 2017; Wamsler & Brink, 2014).

- Expertise: as climate change evolves rapidly, cities must rely on the expertise of public, private, civil society and individual actors. Other authors support this claim that no single institution can (Archer et al., 2014).

Moreover, the shift towards NbS in urban climate adaptation specifically enables greater citizen involvement. In order to mainstream NbS and increase their effectiveness, there is a growing recognition of the need to implement them on private land (Hartmann et al., 2019). While municipalities have more control on installing green infrastructure on public buildings and public land, many cities are experimenting with new governance models that allow for the implementation of NbS on private land, and these often hinge on the involvement of residents (Land 4 Climate, 2024). As Hartmann et al. (2019) point out in their book on this topic, "land is the critical factor that determines whether NBS can be implemented to deal with water-related risks" (p. 6). As a consequence, in cities, where much of the land is privately owned, the involvement of and collaboration with homeowners becomes an integral part of adaptation strategies.

The increased popularity of citizen involvement in urban flood adaptation can be seen in the proliferation of what Willems and Giezen (2022) term "Local Climate Adaptation Networks" (LCAN). Examples of such networks include, among others, Brusseau, Amsterdam Weerproof, Climate Ready Boston, and Water Sensitive Rotterdam. In an LCAN, local governments promote citizens-led actions for adaptation, providing institutional support to bottom-up initiatives. LCANs contribute to frame climate adaptation as a "joint responsibility of urban actors" (Willems & Giezen, 2022, p. 1). The increased participation of citizens in climate adaptation on the ground is reflected in the conclusion of Hügel and Davies' (2020) review of literature at the intersection between citizen participation and climate change adaptation. They found that it was absent until the year 2000 and increased dramatically from 2011 onwards (Hügel & Davies, 2020).

2.2.3 Adaptive Capacity

The drivers discussed above explain why municipalities increasingly seek to involve citizens in flood adaptation. A key concept to complement this analysis is that of "adaptive capacity", as it sheds light

on why specifically some citizens, under certain conditions, may become involved in adaptation. Adaptive capacity recognizes that some individuals or systems are better positioned to adapt than others: they have more capacity to adapt. Initially, adaptive capacity was understood merely as the availability of a series of assets (Mortreux & Barnett, 2017). In this vein, adaptive capacity was used to calculate and map indexes of adaptation that would serve to indicate areas that needed intervention.

From the early 90s, trust in these indicators started to fade (Gifford et al., 2011). More and more studies showed that some communities with high adaptive capacities were reluctant to adapt, while the opposite was true as well. Adaptation was not happening where it was predicted to (Mortreux & Barnett, 2017). Multiple studies pointed to the "mobilisation issue" (Jones et al., 2019, p. 4): the assets that are key to adaptation need to be effectively mobilised. As an analogy, owning a bike will not make you a biker, unless the context in which you live, and your personal inclination will motivate you to bike. Thanks to behavioural sciences, the concept of adaptive capacity was refined to include the socio-psychological factors that influence the mobilisation of certain assets (Gifford et al., 2011). The more modern definition of adaptive capacity thus includes the "preconditions necessary to enable adaptation, including the ability to mobilise these elements" (Mortreux & Barnett, 2017, p. 5). This understanding of adaptive capacity as both having and mobilising resources has important implications for the co-production of flood adaptation. It suggests that simply providing opportunities for citizen involvement or creating governance structures that enable participation may not be sufficient (Amorim-Maia et al., 2024). These concerns become particularly relevant when considering how the changing role of the state, discussed in the following section, may interact with different adaptive capacities across the population.

2.2.4 Changing role of the state

An increase in the number of actors involved in flood risk management adds a layer of complexity to our understanding of adaptation governance. In particular, it brings about new institutional arrangements in cities that are bracing up for the effects of global warming. The IPCC itself emphasises the need for “new governance structures” (IPCC, 2023, p. 7).

These governance structures are needed because citizen involvement does not mean that the state leaves the stage: rather, it transforms its role. In their analysis of the changing role of governments in flood adaptation in The Netherlands, Mees et al. (2019) identify a shift away from

"regulating" adaptation towards functions of networking, stimulating, and facilitating citizen initiatives. In the same vein, Dai et al. (2018) point to a transition from the state as "initiator" to the state as "facilitator". Many authors highlight the fact that while local governments maintain legal responsibility for flood protection [2] (Hegger et al., 2017; Wamsler et al., 2020), the way they fulfil their "duties of care" varies widely, and there is ample room for sharing that responsibility with citizens (Dai et al., 2018). Mees et al. (2014) highlight that since private actors have become relevant stakeholders in flood risk management, governance frameworks that "cross the public-private divide" are needed. In this context, a useful notion is that of "mosaic governance" (Buijs et al., 2019) which defines this new arrangement in urban adaptation policies where local governments coordinate a plethora of hyperlocal, bottom-up initiatives as a new way to keep protecting their citizens from climate hazards.

This section explored the recent engagement turn in urban flood adaptation. A paradigm shift from flood defence based on traditional hydrological infrastructure to flood risk management, increasingly focused on NbS, community participation, and local expertise. As a result, new governance models have emerged, positioning the state as an orchestrator among various public and private actors. To address the complexities of this governance challenge, scholars have used diverse approaches, often collectively termed "adaptation governance research" (Bisaro & Hinkel, 2016).

2.3 Adaptation Governance Research and Co-production

The field of "adaptation governance research" (Bisaro & Hinkel, 2016) was born to unravel the complexity of multi-stakeholders adaptation governance. According to Bisaro and Hinkel (2016), adaptation governance aims to "understand the role of institutional arrangements in adapting to climate change" (p. 5). Many studies cite Sherry Arnstein's "Ladder of Citizen Participation" as a starting point towards understanding citizen engagement. Arnstein (1969) had elaborated an 8-steps ladder ranging from "non-participation" to full citizen control. Adaptation governance research is rooted in this understanding of the different levels of participation, but has developed much more sophisticated analysis of stakeholders' involvement in adaptation (Hügel & Davies, 2020).

[2] For example, municipalities in The Netherlands have a constitutional obligation to protect their citizens from flooding (Dai et al., 2018).

2.3.1 Co-production

Co-production has emerged as a key concept to describe those climate governance arrangements where public authorities involve citizens in the delivery of a certain service [3]. The first to introduce the term was Elinor Ostrom in her 1996 widely influential work titled “Crossing the Great Divide” (Ostrom, 1996). The "Great Divide" she was trying to cross was the one between the government and its formal institutions on one side, and the “recipients” of public services, which should not be seen just as recipients but as active part in service delivery. This theoretical reconfiguration of the relationship between state and people echoes Gramsci’s theory of the integral state. In his Notebooks, Gramsci had elaborated a notion of the state that overcame the separation between “political society” and “civil society” (to stick with his terminology), instead highlighting the central role of civil society in the functioning of the state (Gramsci, 1975).

Ostrom defined co-production as “the process through which inputs used to produce a good or service are contributed by individuals who are not in the same organisation” (Ostrom, 1996, p. 1). In Ostrom’s thought, the effectiveness of public service delivery lies in the synergies between public authorities and the community. She illustrated this with two case studies of co-production of public services, first in water and sanitation in Brazil and then in the provision of education in Nigeria. In both cases, public officials actively stimulated citizen engagement in the planning and delivery phase of the public services, leading to better outcomes for all actors involved. However, Ostrom is also cautious on the effectiveness of co-production, which depends on institutional contexts and especially power dynamics.

In the domain of flood risk management, co-production has become increasingly relevant as governments transition away from state-driven approaches towards decentralised models (Mees et al., 2016). This shift from government to governance implies the necessity of involving multiple stakeholders and funding schemes. As an example, Geaves et al. (2015) show that between 2010 and 2015, flood risk management in the UK transitioned from a 98% of interventions being fully state funded, to 90% of them requiring “partnership funding” and being co-funded by the private sector.

Mees et al. (2016) make explicit use of the concept of co-production to analyse the involve-

[3] It is important to note that climate adaptation is not only a “public service”, as opposed to – for instance - road maintenance or water supply. Adaptation involves actions that residents take to protect themselves and their own livelihoods from climate risks, which do not necessarily represent a service to the wider community. However, actions such as those object of this research, which include greening efforts on private land, contribute to the safety of the whole city by pairing up with efforts on public land to increase overall soil permeability, and it is in that sense that they can be understood as public services.

ment of non-state actors in climate adaptation in Europe. They explore how homeowners, volunteer groups, NGOs and businesses are involved by the municipalities in adaptation. They highlight how in countries like England and The Netherlands there is a tendency towards devolving responsibility for adaptation onto non-state actors, both in discourse and, gradually, in practice. The authors note that there is abundance of research over what they termed co-planning – referring to the involvement of residents in decision-making - while less is known about residents and the private sector being involved by public authorities in delivering adaptation, which is becoming progressively more common.

2.3.2 Co-production in flood preparation and response

An important distinction within flood adaptation, which is relevant for co-production too, is between flood preparation and flood response. The two phases are clearly interconnected, but each has its own goals and attributes. Flood preparation concerns proactive measures taken before a flood occurs in order to minimise risks. Preparation measures can vary from large-scale flood protection systems - including flood barriers such as Danube Island in Vienna or the MOSE flood walls in Venice - to creating emergency plans or stockpiling items like sandbags or electric pumps. Flood preparation also involves public awareness campaigns, early warning systems, risk maps and evacuation plans (Elum & Lawal, 2022).

In contrast, flood response refers to the immediate actions taken during a flood event. In this phase, while some cities have pre-established flood response plans, actions are often less coordinated as residents (both as individuals and as organised groups) strive to construct temporary defences, provide emergency shelters, evacuate their dwellings or take other hurried actions to protect lives and property (McClymont et al., 2020).

Co-production plays a significant role in both flood preparation and response. In terms of flood preparation, the most common example is that of residents adopting property-level measures to reduce flood risk (such as increase permeable areas on private land) or to address vulnerability (such as sandbags or emergency kits). An often-cited case is that of the UK, where in the last two decades public awareness campaigns have pushed for widespread adoption of property-level measures such as window guards and flood doors (Connelly et al., 2020). Local Climate Adaptation Networks, such as the case of Amsterdam Weerproof analysed in this thesis, reflect this approach. Co-production has historically been more important in flood response, as residents are on the frontline through

self-organization or in synergy with local authorities. Voluntary-based programs such as the "Flood Leaders" in Poland or "Flood Wardens" in England maintain a crucial role in disaster response. These initiatives recruit and train local volunteers who can help coordinate community responses during emergencies. In England, flood wardens are explicitly promoted by the Environment Agency and city councils (Mees et al., 2016).

2.3.3 A typology of co-production

If we adopt Ostrom's definition, co-production is distinct from "self-governance", where citizens independently contribute to the provision of a collective good. Co-production involves both the citizens and authorities, crossing the boundaries between public and private in terms of rights and responsibilities.

These boundaries can be arranged in different ways within a co-production framework. One categorisation of such differences comes from Mees et al. (2018). After analysing cases of citizen involvement in flood risk management in five European cities, the authors produced a typology of co-production in adaptation (Mees et al., 2018). This refers to the "type of interaction" between government and citizens, and it identifies:

- Hierarchical Co-Production: the government legally requires inhabitants to adopt flood risk measures. That is the case with amendments to the building code, such as the recent introduction of mandatory rainwater harvesting systems in new-built developments over a certain surface area in Amsterdam;
- Incentivised Co-Production: the government encourages citizens through incentives that can be financial (as in the case of subsidies) or non financial (awareness campaigns);
- Deliberative Co-Production: the government engages citizens in the decision-making process to co-plan and co-deliver adaptation. As an example, the Community Flood Action Groups in England bring together residents and local authorities to develop local flood response plans (Hartmann et al., 2019).

This typology blurs the distinction between "top-down" and "bottom-up" approaches. Indeed, as the authors themselves state, this line is easy to define in theory, but hard to draw in practice. It is often the case that so-called "bottom-up" initiatives receive some form of governmental support (or hindrance), and in the same way "top-down" measures build on active citizens participation and

uptake. Going beyond this dichotomy is thus necessary to understand the co-production of public goods or services.

2.3.4 A typology of citizens' roles

In the context of co-produced adaptation, the role of citizens becomes increasingly relevant. Individuals' initiative or acceptance is a crucial element of adaptation policies, especially those that involve property-level measures. Starting from this premise, Hegger et al. (2017) set out to offer a conceptualisation of the different roles that individuals can perform in flood adaptation. They identify three possible roles for residents:

- Residents as citizens. In their role as citizens, residents act towards adaptation by uptaking measures mandated by local governments, such as by abiding to requirements for property-level measures. In some cases, citizens are deemed responsible for rainwater retention on their own premise.
- Residents as consumers. Flood adaptation also goes through the role of residents as consumers. Residents act as consumers on the market for adaptation goods such as flood insurance schemes, protection devices or barriers (e.g. sandbags), property-level greening, rainwater harvesting systems.
- Residents as civil society actors. As members of civil society organisations, residents can contribute to adaptation, both in the preparation phase, such as by contributing to greening interventions, and response phase, by providing volunteer help in the case of flooding. Civil society organisations are also protagonists of flood-adapted urban development projects such as cooperative housing or eco-villages. This role is distinct from the first one as it requires active and often voluntary involvement of residents for the wellbeing of the community.

2.3.5 Relationship between providers and beneficiaries of adaptation

With more and more stakeholders involved in adaptation efforts, it becomes necessary to investigate the relationship between providers and beneficiaries of adaptation. In a seminal paper, cited multiple times across the literature on adaptation governance, Tompkins and Eakin (2012) elaborate a first basic typology of "adaptation goods". The typology is based on whether those goods are privately

or collectively provided, as well as privately or collectively enjoyed. The following matrix illustrates the four types of adaptation goods that result from this categorisation.

Table 1: Domains of adaptation, from Tompkins and Eakin (2012, p. 4)

		Beneficiaries	
		Private	**Public**
Providers	**Private**	e.g. buying sand bags to limit home flood damage	e.g. urban flood risk reduction via intentional rural flooding
	Public	e.g. grants for house insulation to reduce cold / heat stress	e.g. global climate models; "Em-dat" hazards database

What Tompkins and Eakin show in their matrix is that private individuals are crucial providers of adaptation goods. On one side, they can do so for themselves - "privately provided private adaptation goods". On the other, for the rest of the community - "privately provided public adaptation goods". At the same time, public adaptation efforts can benefit selected individuals (such as in the case of subsidies for property-level measures) or the public as a whole (public stormwater reservoirs, for example).

2.3.6 Privately-provided public adaptation goods

Among the four kinds of adaptation goods identified by Tompkins and Eakin, "privately provided public adaptation goods" are of particular importance for the co-production of adaptation (Wilson et al., 2020). That is because it is in these cases that the costs of adaptation are borne by the individual, while the benefits accrue to the community and may not be so relevant for the provider (Tompkins & Eakin, 2012). As such, these private actions contribute to "co-produce" the adaptation of the whole community. Hegger et al. (2017) cite the example of reducing rainwater runoff by unsealing impervious surfaces on one's own property as a case of privately provided public adaptation good (Hegger et al., 2017, p. 337).

While these instances of adaptation are desirable, according to Hegger et al. (2017), they present some complexities:

- There is cognitive and physical distance between the adaptation action and the outcome, in terms of both space and time. This induces disconnection and may discourage uptake.
- The adaptation benefits may be dependent on the actions of other actors. The efforts of one farmer reducing water for irrigation to prevent drought will be effective only if other farmers in the watershed reduce their consumption. This is what Bisaro and Hinkel (2016) refer to as "joint adaptation". As opposed to "additive adaptation", where every single action generates incremental benefits (such as the planting of one tree to reduce urban heat), joint adaptation requires multiple individuals to act together.
- The interests of individuals, groups and the wider public might diverge. Individual rationality might produce outcomes that are not advantageous from the perspective of the group.

Given these complexities, it is hard to find the right incentives to encourage individuals to provide public adaptation goods. Tompkins and Eakin (2012) reflect on the institutional mechanisms that can foster the private provision of public adaptation, depending on the kind of provider. They distinguish between "altruists", who can be targeted through "soft" measures such as awareness campaigns; and "profit-seekers", who are more likely to be persuaded through financial incentives. However, as the authors point out in the example of UK's "Making space for water" initiative, the provision of public funding for individual property measures raises concerns: "there is public resistance to the idea that public money be provided for individual-scale measures, particularly if such measures enhance individual property values in at-risk areas" (Tompkins & Eakin, 2012, p. 8).

Building on Tompkins and Eakin's work, Bisaro and Hinkel (2016) focus on the interdependence between providers and beneficiaries of adaptation. On one hand, they identify "one-way interdependence", where the "adapting" actors are different from those who receive the benefits of adaptation. That is the case, for instance, of long-term conservation efforts, where the provider of adaptation is not the same as the beneficiary. On the other hand, two-way interdependence occurs when the providers and beneficiaries of adaptation are the same group. As an example, property owners adopting a green roof for rainwater retention will benefit from the intervention themselves, while these actions also benefit the wider urban area.

2.3.7 Adaptation Commoning

Citizen action in adaptation raises "social dilemmas", as Bisaro and Hinkel (2016) call the issues brought about by shifting responsibility towards citizens. In order to overcome such dilemmas, they propose to see adaptation as a commons.

The notion of the commons, popularised by Elinor Ostrom, refers to the collective management of resources. It supports the idea that communities are capable of creating their own rules for the sustainable control of shared goods (Ostrom, 2015). Ostrom's work countered Hardin's assumption - the "Tragedy of the Commons (Hardin, 1968) - by illustrating the existence of effective commons. By doing so, she defined a governance model distinct from both private property and state control. This has inspired movements to manage resources as commons in various fields, from housing to food production (Ostrom, 2015).

"Adaptation commoning" is proposed as a way to navigate the complexities of the co-production of adaptation. According to Wamsler and Raggers (2018), adaptation commoning is "the process of developing joint actions to meet shared goals through solutions and systems that can benefit everyone" (p. 3). Understanding adaptation as a commons "opens up new avenues for intervention" (Cowen & Delmotte, 2020, p. 585), especially relevant in cases where adaptation measures require continuous collaboration between public and private actors on private land. Commoning adaptation leads to collective solutions that stand in between fully public interventions and fully private initiatives.

This section explored citizen engagement in flood adaptation, revealing its complexity and evolving nature. It showed how the paradigm shift from flood defence to flood risk management has transformed the relationship between citizens and the state in adaptation efforts. Co-production has emerged as a key framework for understanding these new arrangements, with various typologies describing how citizens and governments interact, the roles citizens play, and the relationship between adaptation providers and beneficiaries. The Commons perspective offers a valuable lens for addressing the social dilemmas that arise when responsibility shifts toward citizens. However, while all these are useful frameworks to describe modern approaches to flood adaptation governance, they often overlook a critical dimension: power. The governance approaches discussed thus far largely present citizen involvement as a technical solution to adaptation challenges, without sufficiently examining how existing social inequalities might influence who participates, who benefits, and who bears the costs. This power blindness creates a gap that climate justice perspectives can

help address. The following section introduces climate justice as a critical lens to re-politicize our understanding of citizen engagement in adaptation.

2.4 Adaptation Governance through the lens of climate justice

2.4.1 Power blindness

Research in adaptation governance has promoted a deeper understanding of citizen involvement in adaptation efforts: the different types of co-production, the diverse roles of citizens in co-delivering adaptation, the complex relationships between providers and beneficiaries, as well as ways to navigate between public and private measures in a commons framework.

What remains largely underexplored is the potential for co-production of adaptation to challenge - or reinforce - existing power structures. For example, when Mees et al. (2018) elaborate their typology of co-production, they do not distinguish between social groups, as if all had equal access to participation. Similarly, when Hegger et al. (2017) describe the different roles of citizens, they overlook who has the economic resources and capacities to perform those roles. In their review of scholarship on citizen involvement in climate adaptation, Hügel and Davies (2020) highlight that many studies acknowledge the relevance of power structures only in their conclusion.

This power blindness stems from what Turnhout et al. (2020) refer to as the "de-politicisation" of citizen involvement. Rather than being viewed as a mechanism for justice and democratic participation, citizen involvement is often framed as a neutral, technocratic tool for improving the outcomes of adaptation. This technocratic framing reduces citizen participation to its instrumental value—focusing on what citizens can contribute to making adaptation more efficient, such as by providing the time and financial resources that are missing from public authorities, instead of making it more just. As an example, Persson et al. (2021) frame the incorporation of local perspectives in adaptation planning as follows: "Knowledge of what people think will be of great help for increasing the social acceptability of climate change adaptation" (p. 2).

Here, the people's opinion is positioned as a resource to be used to enhance acceptability, rather than a legitimate expression of democratic will. This approach treats citizen involvement as a means to reduce resistance and smoothen implementation. When citizen involvement is primarily valued

for its efficiency gains—whether through accessing private capital, building social acceptance, or reducing implementation conflicts—the fundamental questions of power and justice become secondary considerations. As a consequence, making sure everyone has equal access to participation becomes an exceptional side-effect, instead of a central goal. In this way, citizen involvement is turned into a politically neutral practice.

2.4.2 Re-politicising citizen engagement in adaptation

Since Cooke and Kothari (2001) raised their provocative question, "Participation, the new tyranny?", more scholars have questioned the neutrality of participation. These critiques point out the inherent political aspects of participatory approaches (Hughes, 2013; Turnhout et al., 2020). Issues such as who gets to participate, whose knowledge is prioritised in decision-making, and who has access to the benefits of co-production have begun to emerge. Cooke and Kothari's concern - that participation may legitimise and solidify uneven power relations - remains relevant, with more cities undertaking participatory approaches especially in environmental governance (Turnhout et al., 2020). Inspired by these insights, a few studies have explored the political nature of citizen engagement in climate efforts. For instance, Archer et al. (2014) observe that "citizen engagement in adaptation is embedded within an institutional system which may have particular goals" (p. 346). Similarly, Bujis et al. (2019) highlight:

> Community participation cannot be considered in isolation from issues such as an uneven distribution of power and resources. As such, the current change in paradigm where governments outsource the delivery of public services such as urban greenspace to businesses and communities has significant impacts on democratic values, including equality, transparency and environmental justice. (p. 60)

However, in the literature on citizen involvement in adaptation, there is a lack of consensus on the social justice outcomes of such governance models based on co-production (Anguelovski et al., 2020; Juhola et al., 2022; Wamsler et al., 2020). While some authors point to the potential adverse "social impact" of citizen involvement in flood risk management, with reference to the exacerbation of inequalities between social groups (Adger et al., 2006; Mees et al., 2018), others maintain that involvement can reduce social disparity by democratising and spreading out more equally adaptation interventions. Several authors, for instance, favour bottom-up/collective/deliberative co-production

forms (Mees et al., 2014; Ostrom, 1996). As Anguelovski et al. (2020) put it: "The clear line between participatory processes and increased justice is not direct" (p. 1750).

In light of this unresolved debate, this thesis aims to bring a climate justice lens into the study of co-production of climate adaptation, to highlight its justice implications. The following sections will sketch the contours of climate justice and then explore its application to the study of adaptation.

2.4.3 Climate Justice

The notion of climate justice stems from the environmental justice movement, bringing the focus specifically on the effects of climate change. With the widespread uptake of climate adaptation strategies, the application of climate justice has expanded to include the effects of climate policies too. The original principle - that the populations least responsible for global warming are the ones most impacted by its effects - is still there, but the focus has broadened from the impacts of climate change to include the consequences of adaptation and mitigation policies (Hughes, 2013; Shi et al., 2016).

At first, climate justice scholarship was concerned with global, inter-country or North-South inequalities in relation to global warming. A decade ago, Bulkeley et al. (2014) showed that climate justice had mostly been studied at the international scale, with nation states being the primary actor. According to a more recent review by Mohtat and Khirfan (2021), the application of climate justice at the urban scale began with a handful of papers in 2011 and picked up pace in the following years. Both in academia and in activism, the term “urban climate justice” has become more and more established, highlighting the application of climate justice principles to urban contexts of inequality (Hügel & Davies, 2020).

2.4.4 The three dimensions of justice in adaptation

Multiple scholars trying to apply climate justice to the study of concrete cases have adopted a three-dimensional framework consisting of distributive, procedural and recognition justice (Juhola et al., 2022; Meerow et al., 2019). This section attempts to explain how these three classic dimensions, first introduced by Schlosberg (2007) apply to the context of climate adaptation.

- Distributive justice: a fair distribution of the benefits and burdens of adaptation benefits. This first pillar is concerned with the fairness of the outcomes of adaptation. This builds

on Rawls' understanding of justice as the distribution of goods so that the marginalised are prioritised (Mohtat & Khirfan, 2021), but as Bulkeley et al. (2014) point out, the term has now blurred boundaries, pertaining to the equitable distribution of the "social advantages and disadvantages" of adaptation among different groups and across time and space. Importantly, distributive justice has been used to highlight the risks of displacement linked to climate interventions, as well as to the prioritisation of affluent - but not more vulnerable - neighbourhoods (Anguelovski & Connolly, 2022; Anguelovski et al., 2020).

- Procedural justice: a decision-making process in adaptation that is transparent and that includes participation and citizens' input. The second pillar focuses on the fairness of the process of adaptation. To use the words of David Harvey, "a just distribution [must be] justly achieved" (Harvey, 1973, p. 6). This "justly achieved" relates to the considerations of different necessities, opinions, interests and voices in the planning of climate adaptation. This may take the form of participatory planning, citizen engagement, and specific outreach to marginalised communities (Wang & Palazzo, 2021).

- Recognition justice: an acknowledgement of the different needs and vulnerabilities of different groups in society and measures to correct historical, rooted injustice. The third pillar complements the other two as it adds a corrective dimension to injustices that may have developed over time and that can influence vulnerability and adaptive capacity (Juhola et al., 2022). In a way, it provides a more transformative take on simply "just adaptation justly achieved", recognising the need for adaptation to address entrenched vulnerabilities and promote a new culture of equal legitimisation of all social identities (Mohtat & Khirfan, 2021). This translates into adaptation measures that empower vulnerable populations, and it also connects to the legitimisation of different sources of knowledge for adaptation (epistemological justice).

The lack of consideration of one of these three (very much interconnected) pillars can lead to unjust outcomes in adaptation strategies, sometimes referred to as "maladaptation". To use the original definition by Barnett and O'Neill (2010), maladaptation is defined 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". The concept of maladaptation is key in the discussion of just adaptation because it summarises the adverse outcomes of adaptation measures taken without explicit justice considerations. In particular, Barnett and O'Neill (2010) identify

five maladaptive outcomes: increased greenhouse gas emissions; high opportunity costs that drain resources from more effective solutions; negative repercussions that burden future generations; disproportionate impacts on the most vulnerable populations; and reduced incentives for more comprehensive adaptation measures.

2.4.5 Alternative approaches beyond the three pillars

Alternative approaches have extended beyond this "trilogy", looking at more relational and flexible ways to operationalise climate justice. Bulkeley et al. (2014) understand justice as a pyramid with 5 faces represented by distributions, procedures, recognition - and importantly - rights, and responsibilities. The main takeaway from visualising climate justice as a pyramid as opposed to resting on the three pillars is the interconnectedness of these dimensions, as if by looking at one face one could see the reflection of the others in the prism (Bulkeley et al., 2014). Their addition of "rights" and "responsibility" to the three pillars of climate justice helps connect the pillars to the reality of urban climate policy. With "rights", the authors mean the legally constituted expectations that residents, the private sector and public authorities can have of each other. For example, who has the right to emit greenhouse gases, or who has the right to be protected from climate impacts. With "responsibility", they refer to obligations of certain actors to fulfil such duties and respect those rights. The authors note that while responsibilities related to climate change and adaptation are being defined at the international scale, the urban scale raises the level of complexity. At the level of the city, deciding who has responsibility for fulfilling mitigation and adaptation is "highly contested" (Bulkeley et al., 2014, p. 32). To unravel this complexity, the authors rely on their pyramid framework which has "recognition" as a base through which to look at all the other dimensions. In the original paper, they then show the application of the framework looking at climate justice through the lens of recognition in Bangalore, Monterrey, Hong Kong, Philadelphia and Berlin. They find that the perspective of recognition, while never explicitly addressed in any of the climate policies they analysed, offers a valuable lens for examining the kinds of rights, responsibilities, distributions, and processes needed to ensure a just response to climate change.

In their effort to express the conditions of climate injustice as experienced by urban residents, Anguelovski et al. (2020) propose three alternative justice principles for greening practices - which can be also applied to adaptation measures:

- Emancipatory and antisubordination greening. Starting from the premise that a large part of

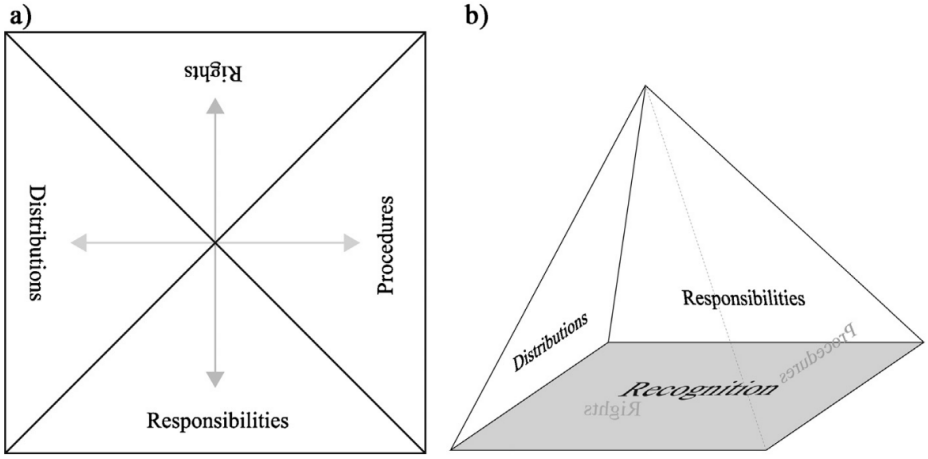

Figure 1: The five dimensions of justice in urban climate policy as a pyramid. Source: Bulkeley et al. 2014.

environmental inequalities rests on racial capitalism and white supremacy, greening can serve an emancipatory role, securing access to resources (land, high quality public space, security) to marginalised populations.

- Intersectional Greening. A focus on people's sense of place can reveal how multiple environmental injustices occur at the same time. It forces to consider how people with multiple, intersecting identities experience environmental inequalities and injustice

  ]item Relational Greening. By bringing relationships between people, places and nature to the centre, relational greening can promote new ways of valuing spaces that are beyond mere cost-benefit considerations. This demands a focus on care, and the dimension of the everyday plays a central role.

Amorim-Maia et al. (2022) argue that current conceptualisations of justice lead to fragmented approaches, where individual dimensions are pursued separately. In light of this, they propose intersectional climate justice as a framework to assess the interconnectedness of the various dimensions of justice in urban climate adaptation. The framework identifies five sub-components of intersectional climate justice: a) Tackle gender and race inequalities; b) Redress drivers of differential vulnerabilities; c) Develop ethics and politics of care; d) Adopt place-based and place-making approaches; e) Operationalise climate action and community resilience. What is particularly innovative about intersectional climate justice is that it calls for considering multiple vulnerabilities at the same time, as they reinforce each other, and as experienced by individuals with intersecting identities.

Figure 2: The intersectional climate justice framework. Source: Amorim-Maia et al., 2022.

In recent years, multispecies justice has surfaced as a critical lens to expand the traditional boundaries of climate justice by de-centring humans and acknowledging the co-dependence of all living beings. Starting from a critique of conventional anthropocentric approaches to sustainability - what Davies and Riach (2019) refer to as "Manstream" - multispecies justice scholarship aims to consider the needs of all species in climate policy (Celermajer et al., 2021). As Chao et al. (2022) point out, multispecies justice is not only an ethical imperative, but a more effective approach in the long-term. Recent research on regenerative agriculture (Newton et al., 2020) or on integrated landscape management (Neyret et al., 2023) demonstrates that human stewardship of the land translates into a more stable and safer ecosystem for humans and non-humans alike. In the context of flood adaptation, multispecies justice would translate into interventions that prioritise protecting wildlife habitats alongside human settlements and enhance biodiversity and connectivity in the implementation of green spaces.

2.5 Climate justice in the co-production of adaptation

The previous sections have presented the current approaches to the study of citizen involvement in adaptation and introduced climate justice frameworks. This section brings these two strands of literature together. In doing so, it explores ways to apply a climate justice lens to re-politicise the

co-production of adaptation by citizens and the local governments.

As Hughes (2013) suggests, "most cities do not include justice criteria in their climate change planning efforts" (p. 2). Even more recent studies point out that in many cases justice is not a concern for cities engaging in climate adaptation (Mohtat & Khirfan, 2021; Ruiz de Gopegui Aramburu et al., 2024; Wang & Palazzo, 2021), in particular in the implementation of urban green infrastructure, which represents an important share of urban adaptation strategies (Anguelovski & Corbera, 2023; Planas-Carbonell et al., 2023). This exclusion is based on the widespread assumption of "green trickledown effects" (Anguelovski et al., 2020, p. 1744): climate adaptation - eventually - benefits all citizens, regardless of who they are or where they live. Interestingly, the same kind of assumption has been made for participatory planning. As highlighted before, citizen participation is often seen as an unproblematic win-win tool to guarantee inclusivity.

There is a growing literature on the injustices in conventional climate adaptation, as well as on the exclusionary character of many participation programmes. Less attention - also due to the recent emergence of this trend - has been given to examine the justice implications of climate adaptation strategies that rely on citizen involvement (Turnhout et al., 2020). As Anguelovski et al. (2016) point out, "scholars are beginning to question how adaptation planning strategies – even those designed to be participatory – may be exacerbating unequal outcomes (p. 334). To demonstrate how climate justice can re-politicize the co-production of adaptation, I refer to Anguelovski et al.'s (2016) framework of Acts of Commission and Omission, and apply that to co-production.

2.5.1 Acts of Commission

With Acts of Commission, Anguelovski et al. (2016) refer to adaptation measures that overburden marginalised groups and lead to their increased vulnerability or at times to displacement. Displacement is sometimes direct - they identify as Acts of Commission large-scale flood adaptation interventions in Medellin and Manila which physically displaced informal settlements - or indirect, and they refer here to climate gentrification.

In the context of co-production, where responsibility for adaptation is outsourced to private businesses and/or residents, Acts of Commission often take the form of indirect displacement, or climate gentrification. This is because Acts of Commission in co-production will translate in resources being destined to, for example, homeowners, without explicit justice considerations, allowing them to use climate adaptation as a pretext to raise the value of their property. The concept of

climate gentrification exposes the displacement risks embedded in the implementation of climate adaptation measures within a free market-dominated housing landscape (Best & Jouzi, 2022; Kaika, 2017). The recent book "The Green City and Social Injustice" collects 21 examples of gentrification in urban climate efforts (Anguelovski & Connolly, 2022). Some of these authors argue that, for many cities, climate adaptation is yet another way to generate market pressure and keep capital in motion (Rodgman et al., 2023; Shi et al., 2016). In such contexts, adaptation interventions such as green resilient infrastructure are deployed with the goal of promoting economic growth rather than protecting citizens (Kaika, 2017).

2.5.2 Acts of Omission

On the opposite side of the very same coin, Acts of Omission refer to adaptation plans that prioritise protecting privileged groups at the expense of marginalised communities. This takes the form of adaptation strategies that apply one-size-fits-all solutions without taking into account different vulnerabilities within the city, essentially denying low-income groups the extra considerations that they need. Further, Acts of Omission include cases in which wealthier communities are granted additional protection due to their location in at-risk areas, such as coastal settlements, as well as adaptation programmes who actively exclude marginalised groups from participation in decision making (Anguelovski et al., 2016).

A clear example comes again from the realm of green infrastructure for climate adaptation. In a co-production setting the responsibilisation of citizens, in the absence of proper equity mechanisms, can lead to the formation of "green enclaves" (Planas-Carbonell et al., 2023). Resources such as subsidies are captured by elites, forming green enclaves of protected affluent residents in a sea of deprived communities. As an example, Connelly et al. (2020), in their analysis of property-level flood interventions in the UK, find that such interventions are "spatially blind": they are deemed successful when there is enough overall uptake, without considering where in the city those measures are implemented. They conclude that such forms of urban greening can become led by residents from higher socioeconomic status and educational backgrounds (Connelly et al., 2020).

2.6 Summary and Knowledge Gap

This chapter brings together two streams of research. First, it parses through the most recent approaches to the study of citizen involvement in flood adaptation. Starting by outlining the shift from flood defence to flood risk management, it expands on the drivers and forms of citizen engagement, focusing on what this means for the role of the state, the concept of co-production, and understandings of adaptation as commons.

Second, it explores research on climate justice in adaptation. It sketches the contours of the notion of climate justice, its traditional tripartite framework and its most recent extensions towards intersectional and multispecies justice. In doing so, it unveils the power blindness of much co-production research, and it proceeds to apply climate justice as a lens to re-politicise citizen engagement in adaptation.

In general, this review highlights a lack of attention towards the engagement turn in urban climate adaptation policy and practice. The justice implications of Local Climate Adaptation Networks, where the state takes the role of facilitator of adaptation measures that rely on the action of private stakeholders, have been explored in less depth than those of top-down adaptation. Given the predominant trend towards such co-production approaches, and their image as neutral and inclusive tools to achieve adaptation, more research from a critical climate justice angle is called for. Existing research has thoroughly documented the shift toward citizen engagement in adaptation but has predominantly taken an instrumental approach focused on implementation success rather than equity outcomes. The typologies of co-production presented by Mees et al. (2018) and other frameworks are useful to understand co-production arrangements but lack explicit consideration of how they impact vulnerable communities.

Furthermore, most studies examining co-production approaches focus on analysing policies, with limited attention to how stakeholders themselves understand justice and responsibility. This represents a significant knowledge gap, as the subjective dimensions of adaptation governance remain underexplored despite their critical role in shaping (un)just adaptation. While studies like Anguelovski et al. (2020) and Wamsler et al. (2020) have begun examining the justice implications of participatory approaches related to urban climate adaptation, their work has primarily focused on outcomes rather than the underlying narratives that shape these processes.

Specifically, no research has so far addressed stakeholder perceptions of justice in the co-production of adaptation. The role of discourses around climate justice and responsibility among stakeholders

involved in co-producing climate adaptation remains largely unexplored. This oversight is significant, as these beliefs about what constitutes just adaptation ultimately guide stakeholders' actions. Hügel and Davies (2020) conclude their review calling for research that looks beyond material adaptation and into the psycho-social dimensions of adaptation. This is the knowledge gap that this thesis aims to bridge: to explore the underlying discourses of what constitutes just (flood) adaptation among the various actors involved in a co-production programme."

Discourses and beliefs are the deepest leverage points to intervene in a system. In the words of Meadows (1999):

> The shared idea in the minds of society, the great big unstated assumptions — unstated because unnecessary to state; everyone already knows them — constitute that society's paradigm, or deepest set of beliefs about how the world works. (p. 1)

These "paradigms", if changed, represent the most fruitful entry points for transformative change. With this thesis, I aim to uncover the dominant narratives around justice and responsibility for climate adaptation among different stakeholders in the Amsterdam Weerproof program. Amsterdam Weerproof, as a leading example of participatory flood adaptation in a city facing increasing pluvial flood risk, is an ideal case study to understand the narratives underpinning the consideration of climate justice in such initiatives.

3 Methodology

Ferry station on the IJ river.

This thesis aims to uncover discourses around climate justice in urban flood adaptation. It does so through a single-case study approach. This section explains how I decided to tackle the research questions, and why that way. I start with a description of the research perspective on which this thesis is grounded. I then move on to the contextualisation of the case study and end with a detailed presentation of the method adopted for data collection and analysis.

3.1 Research Paradigm

My research perspective is rooted in post-structuralism. Post-structuralism challenges fixed meanings and stable structures. It emphasizes how discourses and power shape our understanding of the world, arguing that what we take as "truth" is always contingent, constructed, and open to contestation.

What post-structuralism does to climate adaptation research is that it turns it into an inquiry into the discourses around what (just) adaptation may look like, rather than simply looking at the material conditions from which it arises. Of course, there are geological forces (including human activity) at play in determining climate risks and societal responses to such risks. However, these forces are interpreted and re-constructed in a language that is dependent on power relations. Climate adaptation thus cannot be understood outside of the discourses through which it is talked about and enacted.

Ontologically, this means seeing climate adaptation policy as part of a "dispositive". In Focault's thought, a dispositive is a set of discourses and measures that becomes the dominant way for society to think and act about a certain issue (Focault, 1977). In this way, adaptation as it is carried out today is not merely a "natural" material response to a defined threat, but one of the ways of doing it, and a way that is deeply connected to whose "truth" and whose voice become accepted.

Epistemologically, post-structuralism allows us - or rather forces us - to take a step back from climate predictions and vulnerability assessment. From this stance, it is possible to apply an interpretivist approach to the analysis of climate adaptation, and focus on its language, its priorities, and its discourses. The questions that arise from this position then have to do with the narratives that underpin climate action, the set of beliefs about how the world works, of which adaptation interventions are only the material manifestation.

Seeing the world under the lens of post-structuralism inevitably stimulates research into deep leverage points. In the case of co-production of climate adaptation, these are represented by the un-

derlying discourses guiding the approach of authorities and private partners to the complex task of future-proofing a city. It is at those discourses that this work looks, choosing Amsterdam Weerproof as a case study.

3.2 Case study

This thesis adopts a single-case study approach. As maintained by Flyvberg (Flyvbjerg, 2006), despite criticism over the generalisation of their results, case studies are uniquely positioned to promote the understanding of complex phenomena that are deeply contextual. That is the case of flood adaptation policy, which is embedded in legal, environmental, and cultural contexts that need to be thoroughly considered. While choosing multiple cases would have shone light on contextual differences - and was indeed considered in the first stages of the thesis development - a single case allowed for a deep exploration of the perspective of different actors. This required the establishment of connections, and a thorough understanding of the policy landscape, which could be developed only for one case.

Before zooming in on the case of Amsterdam Weerproof, the flood adaptation program of the city of Amsterdam, it is useful to sketch the contours of flood management in The Netherlands, to then draw the line from national to local policy.

3.2.1 The "Low Lands"

> "Malaysia to seek dutch expertise in flood mitigation" (Anis, 2023)
>
> "Floods as shapers of dutch cultural identity" (Jensen, 2021)
>
> "How the Netherlands became the biggest exporter of resilience" (Chu, 2013)

As these news headlines suggest, flood management, and particularly a successful one, is a defining character of the Netherlands. The very name of the country hints at a history deeply marked by the fight against water. On the delta of the Rhine, the Meuse and the Scheldt River, the Dutch have reclaimed land starting from the 14th century (Jak & Kok, 2000). Over 26% of the country's surface lies below sea-level. The proximity to water and its excesses has given rise to solid governance structures for water management. Even the well-established tradition of spatial planning is linked to the necessity of managing flood risk (De Vries, 2015; Heuvelhof & Nauta, 1997).

The goal of coordinating local dyke building efforts gave rise to national institutions such as the Rijkswaterstaat (the Dutch ministry for water management) and national strategies such as the Delta Programme. This national commitment to safety from natural hazards is exemplified by Article 21 of the Dutch constitution, which reads: "It shall be the concern of the authorities to keep the country habitable and to protect and improve the environment." (Dai et al., 2018, p. 662).

The process that in the 19th century led to the creation of the Rijkswaterstaat was somehow reversed towards the end of the 20th century. In the 1990s, flood management in the Netherlands transitioned from a national priority to a local policy issue (Sharma, 2023b). The country, and its flood management policy, was not immune to the wave of neoliberal reforms that hit Western Europe, resulting in the retrenchment of the welfare state. Flood management was "downscaled" to the local level: the Rijkswaterstaat gradually devolved water risk responsibilities to lower tiers of government (Sharma, 2023a; Uittenbroek et al., 2014).

Today, while provinces and regional water boards are in charge of large-scale flood defences to protect from riverine flooding and sea level rise, municipalities are responsible for rainwater management. Section 3.5 of the Dutch Water Act states that municipalities bear "duties of care" concerning the collection and processing of rainwater (Dai et al., 2018). It is up to cities to specify their duties of care, their way of maintaining the pledge of protecting citizens from hazards outlined in the article 21 of the constitution mentioned above.

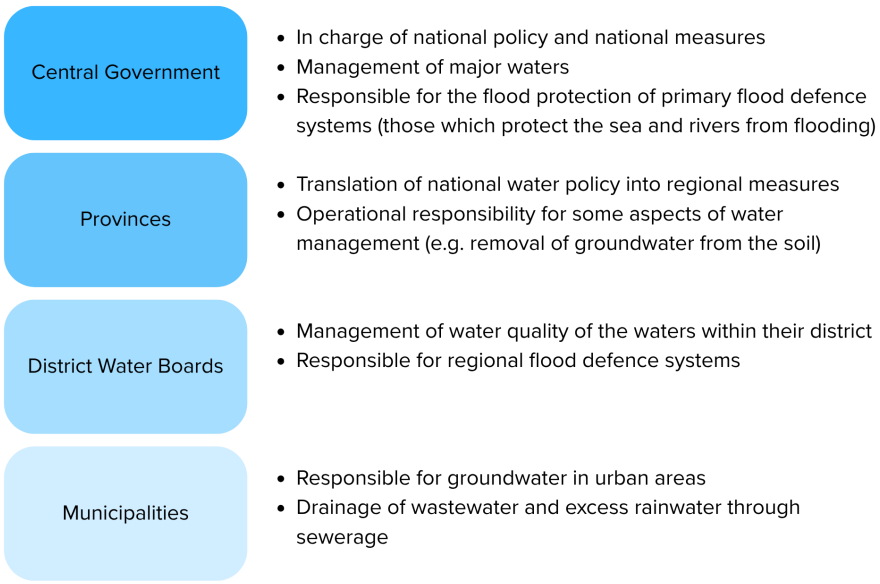

Figure 3: Multi-scalar distribution of water management responsibilities in The Netherlands. Source: (Krijnen, 2020)

Notwithstanding the international recognition for Dutch flood management, rapid urbanisation and climate change-induced extreme weather events have exposed the country's vulnerability to urban pluvial flooding (Boztas, 2020; Mees et al., 2019). As said, Dutch cities are responsible for rainwater management, and many of them see pluvial flooding as a new threat that they are inadequately ready to face (Mees et al., 2019; Sharma, 2023a). Data from the Royal Meteorological Institute (KNMI) shows that an increase in extreme precipitation is "very likely": both the number of days with considerable precipitation as well as the intensity of showers are expected to increase (Runhaar et al., 2012).

3.2.2 Amsterdam

In this context, the city of Amsterdam faces heightened pluvial flood risk. The Dutch capital is the second densest city in the country and one of the densest cities in Europe (OECD, 2017). At the same time, the city is sandwiched between increasing soil paving - and consequent reduced soil permeability - and growing likelihood of extreme weather events (Giezen et al., 2018).

Amsterdam has a long history of flood management. Sitting at the confluence of the Amstel River and the IJ bay, inundations have been a recurring presence since its founding. The construc-

Figure 4: Green roof in Amsterdam. Source: Weerproof.nl

tion of a wooden flood barrier across the Amstel was the foundation moment of the city, which then developed a complex system of man-made canals and dikes throughout the centuries. Just like The Netherlands as a whole, Amsterdam is renowned for the successful taming of floods. Flooding posed a constant threat until dike breaches were largely resolved in the 17th century with new flood barriers. The famous canal system that emerged during this period served multiple critical functions beyond the picturesque waterways we see today. The canals were used for draining and storing surplus water from the surrounding Amstelland region, collecting rainwater and household wastewater, and managing sewage. They also provided dredged material for raising land levels, functioned as traffic arteries for transportation and commerce, supplied water for firefighting. Despite solving immediate flooding and water supply issues, Amsterdam never adequately addressed water quality problems during its early development. The canals doubled as open sewers with poor drainage, creating heavily polluted waterways that drove wealthy residents to flee the city during summer months due to the stench and health risks.

The definitive solution to Amsterdam's water quality problems came with the advent of fossil fuel technology. The breakthrough arrived with the construction of the Zeeburg pumping station,

which used thousands of steam-powered mills to pump wastewater out of the city and flush it to the sea. Simultaneously, the Amsterdam Dune Water Company established pumps in the coastal dunes to supply clean drinking water directly to the city.

This technological revolution fundamentally changed Amsterdam's urban development patterns. As the city expanded during the 19th and early 20th centuries, new neighbourhoods were built without the extensive canal networks that characterize the historic centre. The areas outside the famous "canal ring" that surrounds the city centre relied instead on pump-based water management systems. This pump-based approach proved more efficient and cost-effective than replicating the complex waterway networks of the historic core. Consequently, modern Amsterdam lacks the density of canals and drainage systems found in the city centre.

However, ironically, the pumping system which relied so heavily on fossil fuel is facing new pressures due to climate change. The city's protection from sea level rise and excessive rainfall depends heavily on the IJ Muiden pump, located where the ocean meets the IJ river, 20km north of Amsterdam. This critical infrastructure piece "keeps out" seawater and manages regional water discharge. The IJ Muiden pump has a fixed capacity that experts warn may prove insufficient for future climate scenarios. The system's limitations are compounded by the fact that neighbouring municipalities, including Almere, also depend on this same pump to discharge excess water during heavy rainfall events. Recognizing these constraints, the Amsterdam Metropolitan Region—a collaborative body including the Municipality of Amsterdam and surrounding communities—has urged individual municipalities to enhance their capacity to slow rainwater discharge during storm events. This approach aims to prevent overwhelming the regional pumping system.

It is in this context that Amsterdam finds itself forced to deal with its water retention capabilities, beginning at the building level. Individual structures need to retain more rainwater before releasing it into the sewer system in order not to overcharge it. Preoccupation over the risk of pluvial flood risk induced by climate change is growing (Savini et al., 2016; Waternet, 2018). Many authors identify in the 2014 cloudburst the beginning of a mindset shift for Amsterdam. In the summer of 2014, over 10% of the annual average rainfall poured over the city in little more than one hour (Waternet, 2018). 90mm of rain in the span of 90 minutes caused severe damages to infrastructures, interruption of railways and electric lines, as well as roof leakages and house flooding. The sewage system, which has a capacity of 20mm of rain over 60 minutes (Sharma, 2023b), was overwhelmed. The event represented a wake-up call for the public that realised the risks posed to the city (Waternet, 2018). In its 2020 Climate Strategy, the city itself highlights the threats of pluvial flooding, "especially if

the water is not locally retained and can run off" (Gemeente Amsterdam, 2020, p. 23).

Despite being under the same sky, neighbourhoods across Amsterdam are far from equally vulnerable to flood risk. Both income and ethnic segregation have increased across the city since the 2000s (Van Gent & Musterd, 2016). When describing Amsterdam's class structure, Musterd and Gent speak of a transition from social classes to socio-spatial groups (Ibid.). This exacerbation of spatial segregation, when intersected with intensifying extreme weather events, sets the stage for unequal flood risk.

3.2.3 Amsterdam Weerproof

> As Amsterdammers, we are all responsible for our own house and garden. For example, it helps if you remove tiles from your garden and replace them with plants. Or choose a green (shed) roof that absorbs rainwater. Take action yourself. (Weerproof.nl, 2024)

In response to the growing threat of pluvial flooding, the municipality of Amsterdam and Waternet jointly launched the programme "Amsterdam Rainproof" in 2014 (recently renamed Amsterdam "Weerproof") [4], with the stated goal of preparing the city to cope with a rainfall of 60mm per hour without damages (Willems & Giezen, 2022). Waternet is the water company of the city of Amsterdam, responsible for the whole water cycle of the Dutch capital, including stormwater management. The scheme brings together Waternet, the Municipality, and a wide array of actors.

The programme does not mandate any large-scale flood control infrastructure. Rather, it prioritises engaging citizens to make the city "flood-proof" through hyperlocal interventions, such as green roofs and rainwater harvesting systems. As most of these interventions take place on private land, citizen engagement is at the core of the programme. To quote from Waternet's own magazine, the aim is to "to make people aware that they are the co-owners of both the problem and its solutions" (Waternet, 2018, p. 9).

The focus on citizen engagement stemmed from a very concrete fact: more than half of the land in the city of Amsterdam is privately owned (OECD, 2017). Intervening solely on public space would not be enough to make the city "rainproof", as runoff water from private terrain exceeds the capacity of the water system. Thus, Waternet acknowledged that in order to increase soil permeability in the city, it was necessary to involve private citizens and landowners. As a consequence, the way

[4] The renaming followed an expansion of the focus of the programme from flood risk alone to a broader set of climate impacts, with Weer meaning "weather" in Dutch.

Amsterdam provides for its constitutional "duty of care" towards its citizens is by "assisting residents in taking their own responsibility" (Dai et al., 2018, p. 7).

Amsterdam Weerproof is mainly funded through sewage levies. For the 2016-2021 period, the programme was allocated 1.75million. This sum excludes the costs of the actual implementations of the projects, but covers research, salaries and administration (Dai et al., 2018).

Multiple stakeholders

The team of Amsterdam Weerproof consists of hydrologists from Waternet, planners from the city of Amsterdam, as well as community managers and communication experts (Weerproof.nl, 2024). Besides these roles, the programme's various projects involve different figures: academics, designers, consultants, neighbourhood associations, real estate developers, homeowners, gardeners and, importantly, private residents (Dai et al., 2018). The team is independent from Waternet and the Municipality. For example, it uses its own logo and material without having to reference Waternet or the City (Willems & Giezen, 2022). I have mapped out the constellation of stakeholders involved in Figure 5.

The Network Approach

Amsterdam Weerproof defines its own strategy as a "network approach" (Krijnen, 2020). The focus is on providing the connections and the expertise to adopt flood-proof solutions to those in Amsterdam who may be looking for them, as opposed to directly providing help and support for climate adaptation projects.

The "network approach" within Amsterdam Weerproof is characterised by the frequent resort to public-private partnership and by the involvement of multiple stakeholders (Waternet, 2018). According to Dai et al. (2018), the role of the municipality of Amsterdam in flood management has thus shifted from "initiator" to "facilitator" (p. 660). In fact, Amsterdam Weerproof itself does not include binding regulations. Instead, residents and developers are encouraged to step up their efforts to flood-proof the city (Sharma, 2023a). "Together" is a word that stands out often in the programme's documentation.

Local Climate Adaptation Networks

Amsterdam Weerproof represents an ideal typical example of what Willems et al. (2022)refer to as

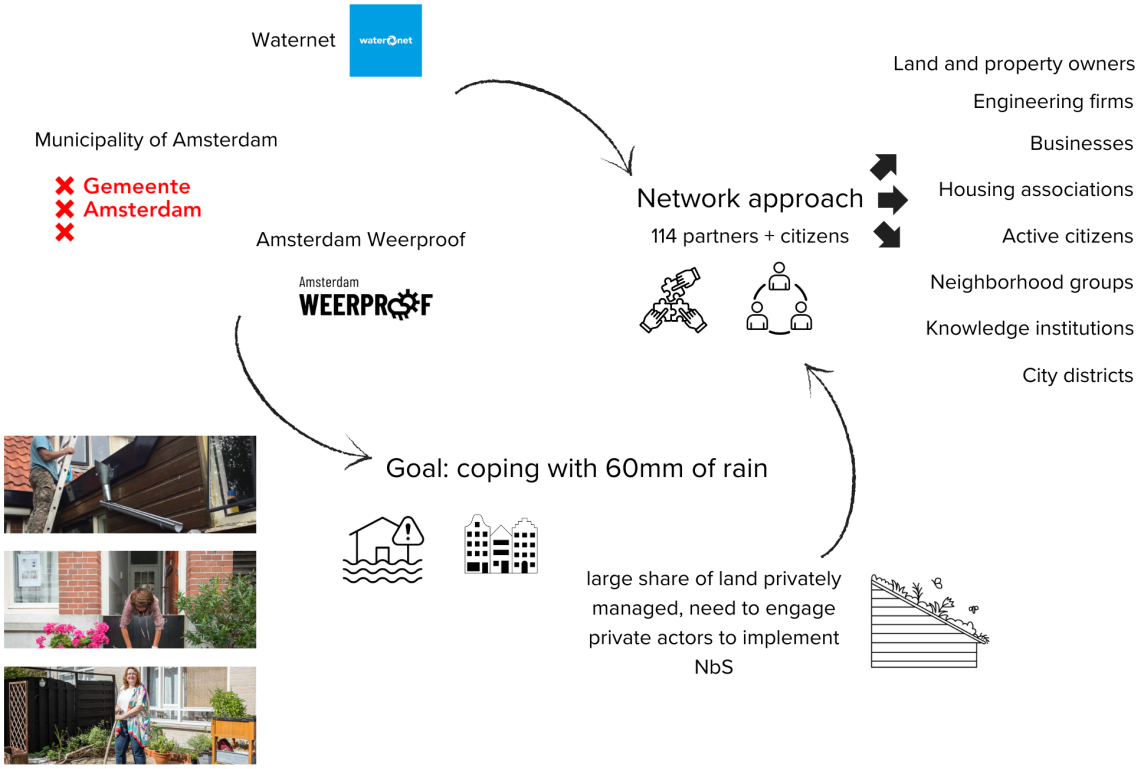

Figure 5: Author's own stakeholders map of Amsterdam Weerproof. Images sources: weerproof.nl

"Local Climate Adaptation Networks" (LCANs). LCANs are growing in popularity, both within the Netherlands - see the case of Water Sensitive Rotterdam - and outside. Examples include Brusseau (Brussels), and Climate Ready Boston. Their goal is to encourage uptake of climate adaptation measures through "public campaigns, knowledge dissemination, stakeholder mobilisation, and the establishment of pilots" (Willems & Giezen, 2022, p. 5). As such, networks mainly contribute to capacity building and to the generation of new "normative identities", such as the one that adaptation is a joint responsibility of all urban actors.

Positive brand identity

Amsterdam Weerproof has attempted to position itself with a positive attitude. With modern logos and web design, as well as public events, the programme has tried to generate appeal and trust around its initiatives. While this approach can help mainstream pluvial flood adaptation, it also downplays the urgency of climate adaptation. As an example, Waternet's CEO explained that

Figure 6: Author's own collage of screenshots exemplifying the responsibility shift in flood adaptation in Amsterdam. Sources: weerproof.nl, waternet.nl

they avoid using terms such as "climate change" or "climate adaptation", as these can feel too abstract or too threatening and hard to relate to for Amsterdammers (Sharma, 2023a). Instead, the language used by Amsterdam Weerproof frames pluvial flood adaptation as an opportunity rather than a threat. For example, there is great emphasis on the added benefits of environmental aesthetic quality yielded by nature-based solutions, as well as the possibility of harvesting rainwater (Weerproof.nl, 2024).

The initiatives

Amsterdam Weerproof is not concerned with large scale infrastructure, nor does it provide binding planning regulations. As a Local Climate Adaptation Network, its main activities are the following:

- Financial incentives: Offering subsidies for residents and businesses to implement green roofs, rain gardens, and other water-retention measures. Lack of financial resources is often cited as a barrier to adaptation in the scientific literature (Eisenack et al., 2014). In order to overcome

such a barrier, Amsterdam Weerproof provides a set of subsidies for citizens to flood-proof their premises. Examples include the “Green in Amsterdam” subsidy for the installation of green roofs, or the “Space for water” scheme for rainwater harvesting technologies. Moreover, a tile-collection service is provided for those citizens who unseal their gardens.

- Public awareness: Disseminating information about the risks of pluvial flooding and the benefits of water-sensitive urban design. The website of Amsterdam Weerproof includes different “tips” for private citizens and for businesses to implement nature-based solutions on their property. In parallel, public events and workshops are organised to spread awareness and information on flood risk and adaptation measures. To this end, the website also includes “success stories” of individual citizens who have installed water-retention features on their property.

- Pilot projects: Testing innovative water management solutions. Amsterdam Weerproof has sponsored pilot projects across the city to showcase disruptive solutions for rainwater retention. These include the construction of sustainable floating homes on IJburg (a recently reclaimed land on the IJ Sea) and Buiksloterham, a former harbour area reconverted into a self-build plot with rainwater harvesting facilities.

- Neighbourhood approach: flood adaptation in marginalised neighbourhoods. Since 2021, Amsterdam Weerproof has targeted three areas of Amsterdam which are generally regarded as lower income and more diverse: Nieuw-West, Noord and Zuid-Oost. In these districts, the programme has set up a “Neighbourhood approach”. A community manager was hired for each district to conduct focus groups, workshops and door-to-door visits to inform residents about flood risk and the different measures they could take.

The role of nature

Nature and greening play a key role within Amsterdam Weerproof. A cornerstone of Amsterdam Weerproof is the concept of the "sponge city," where urban spaces are designed to absorb and retain rainwater, reducing the burden on the drainage system in the case of extreme rainfall (Mees et al., 2019; Weerproof.nl, 2024). The focus on Nature-Based Solutions within the programme is partly a result of the alignment with city-wide policies pursuing the vision of a greener and more bio-diverse Amsterdam, as exemplified by Amsterdam’s Green Infrastructure Vision for 2050.

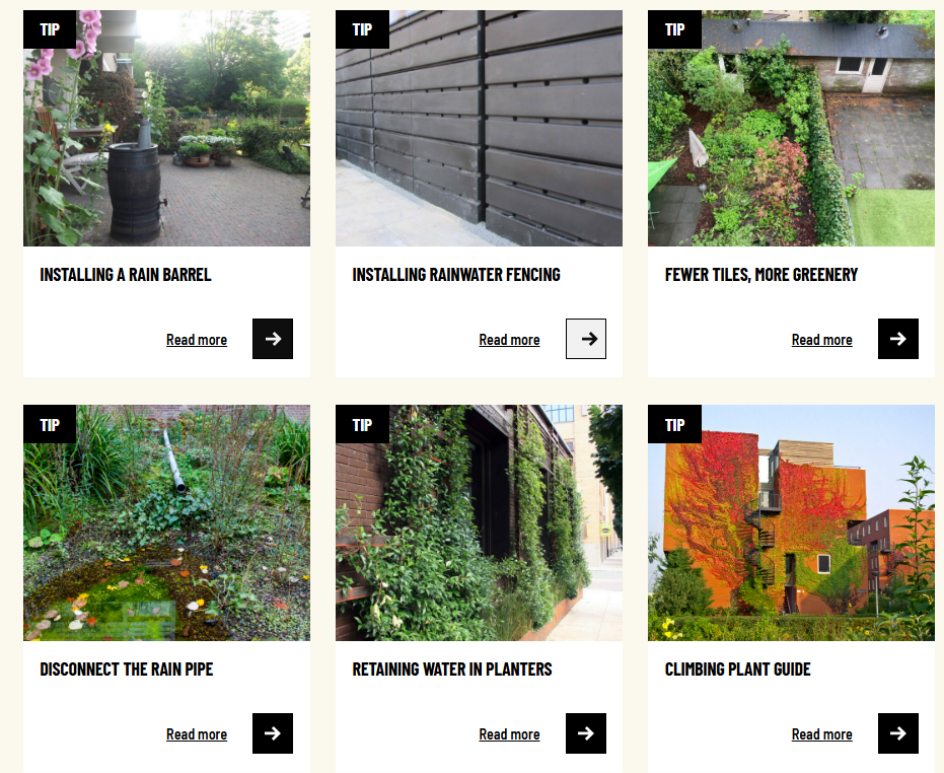

Figure 7: tips for flood-proofing measures for residents. Source: Weerproof.nl, 2024

In context

In parallel to Amsterdam Weerproof, the Municipality of Amsterdam developed its own Climate Adaptation Strategy (https://www.amsterdam.nl/en/policy/sustainability/policy-climate-adaptation/) in 2018 with the goal of mainstreaming adaptation concerns across its departments, from housing to infrastructure. While it does not invest directly into adapting the city, the Strategy serves as a guideline for the work of the Municipality to be aligned with its goal of protecting the city from climate impacts. As an example, street refurbishment, by which every street in Amsterdam undergoes maintenance once every 30 years, now prioritises areas that are at higher risk of flooding or urban heat island effect. In a way, the Municipal strategy can be seen as the "public space" equivalent of Amsterdam Weerproof: while the latter is concerned with interventions on private land, the former wants to promote adaptation within the work that the municipality does on public spaces.

3.3 Research Methods

Citizen's involvement in adaptation efforts has been studied through a wide array of methods. While some studies include quantitative surveys (Takagi et al., 2019; Ward et al., 2012), most adopt qual-

itative methods. This is justified by an interest in the individuals' perceptions, the meaning they attribute to their own actions, their challenges and motives.

Among the most popular methods is semi-structured interviews. Some authors only interview local officials, such as Wang and Palazzo (2021) and Hegger et al. (2017), while others include the perspective of citizens, such as Wamsler et al. (2020). Often coupled with interviews is document analysis.

Some studies concerned with values and subjectivities employ Q-Methodology (also known as Q factor analysis or simply "Q"), an approach introduced in medical research and more recently exported to the social sciences, where participants are requested to rank statements. Additional methods include transect walk (Khan et al., 2024) and participant observation (Mees et al., 2019; Wamsler et al., 2020).

For the purpose of this thesis, I employed a Q-Methodology study with professionals involved in the activities of Amsterdam Weerproof in different capacities. The following sections provide more background on Q-Methodology before I illustrate how I used it for this research.

3.3.1 Q-methodology

Q-Methodology is used to explore subjective values and perspectives. It does so by first asking respondents to rank statements based on their level of agreement, and then analysing the answers to uncover clusters of opinions, narratives, or value patterns. These are useful to a) identify the prevailing discourses that orientate opinions on a topic within a group of people, and b) to discern areas of consensus and dissensus (Sneegas et al., 2021; Uittenbroek et al., 2014).

Q-Methodology gets its name from the kind of factor analysis it performs. As opposed to R factor analysis - the one used, for instance, to verify correlation between variables - Q factor analysis looks for correlation between subjects in order to identify "distinct subjectivities" in the population (Albizua & Zografos, 2014). Q found its first applications in medical research in the 1930s. Since the 1990s, it has spread to other fields, including social sciences (Sneegas et al., 2021).

3.3.2 Q-Methodology in Adaptation Research

Q Methodology has been recently applied to the study of narratives around climate change adaptation (Sneegas et al., 2021). For instance, Q has been used by Albizua et al. (2014) in their analysis of discourses around climate adaptation in Spain. The authors interviewed 19 participants: 11 inhabi-

tants of the Ebro Delta and eight officials working in water management. Similarly, Utittenbroek et al. (2014) employed Q to study stakeholders' perspectives on adaptation in The Netherlands. They focused on Amsterdam, The Hague and Rotterdam, with the goal of uncovering the "organisational values" guiding local policymakers in climate adaptation. They were able to identify three value patterns, namely "start today", "not for us to lead", and "shared responsibility" that framed policy-making in the three municipalities. With a focus on the Brussels Capital Region, Fransolet et al. (2024) used Q to outline main narratives regarding social justice and sustainability. After interviewing 32 members of administrations and NGOs, they excavated three narratives: The "Smart City", the "Foundational City" and the "Exnovation City".

Since this thesis is concerned with identifying the guiding discourses on flood adaptation and citizen engagement among professionals involved in Amsterdam Weerproof, I chose to use Q-methodology, which is useful to explore different perspectives on controversial social issues (Nieuwenhuis et al., 2022). In contrast to a more conventional approach through interviews or surveys, a Q study allowed me to highlight not what specific individual thoughts, but which different perspectives were present among the sample. In a context like Amsterdam Weerproof, where different actors might have different priorities when it comes to climate justice, it was essential to uncover the guiding principles that drive their behaviour.

3.3.3 The Steps of the Q Study

This section explores the five phases of this Q study (Figure 8). These are based on an established research process in the Q-methodology literature: a) generating the set of statements for participants to rank (Q-Set); b) identifying the participants population (Q-sample); c) carrying out the q-study, asking participants to sort statements on a grid (Q-sorting); d) analysing the sorts; e) identifying "factors", meaning clusters of similar sorts, people who ranked the statements in a similar way(Barry & Proops, 1999; Sneegas et al., 2021).

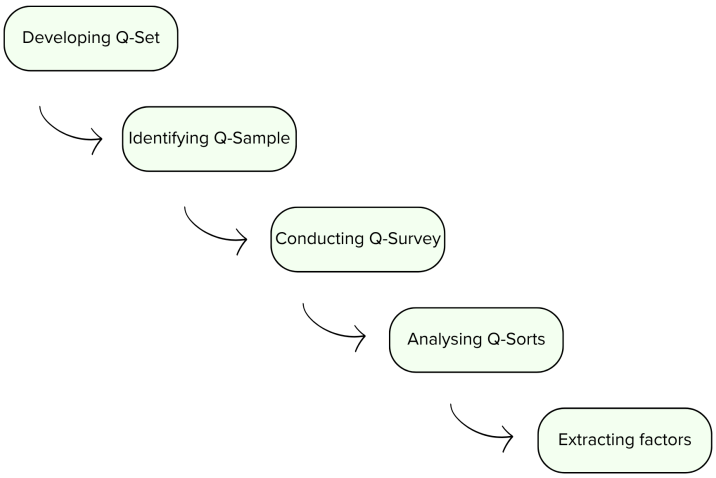

Figure 8: Steps of the Q-study

Q-set

The set of statements that participants are asked to sort is known as Q-set. In their review of studies using Q-Methodology in environmental studies, Sneegas et al. (2021) found that the average number of statements in Q-sets is 39.7; this reflects the assertion of Fransolet et al. (2024) that the number of statements in Q studies is usually around 40. Most scholars base the Q-set on desk research and existing literature (Barry & Proops, 1999). Some perform exploratory interviews at the beginning of the study to collect the necessary information for a comprehensive Q-set, such as Fransolet et al. (2024) and Uittenbroek et al. (2014). As for the sources of information for the set, Sneegas et al. (2021) found that document analysis is the most common approach, followed by interviews; one third of the studies in their review uses these two methods in combination.

In this research, the development of the Q-set followed a "structured" Q-set design. This means that I had a thematic framework around which to build the Q-set. The pillars of this framework were, on one side, climate justice, further divided into procedural, distributive and recognition justice following Schlosberg (Schlosberg, 2007), with the additional justice dimensions of epistemological and intergenerational justice. The second pillar was that of responsibility for climate adaptation, within which I identified residents, state and markets as potential actors responsible for adaptation efforts. Sources of information for the development of the statements were existing literature on co-production (see chapter 2), analysis of the policy landscape around climate adaptation in Amsterdam

(see chapter 3.2) and one exploratory conversation with an expert researcher at the University of Amsterdam.

As other Q-studies have done (Sneegas et al., 2021), I first developed an "unfiltered" list of statements. The list peaked at 72 statements when I reached a "saturation point" (Nóblega-Carriquiry et al., 2022, p. 7) where new statements would overlap too much with existing ones to be considered. This preliminary list was gradually thinned out to avoid repetition. Once I reached 49 statements, I conducted a pilot study with three participants, after which I reduced the number of statements to 35 and finally to 31 (see Table 2). The retention criteria were to prioritise different views and clarity.

The statements were then rephrased from general to Amsterdam-specific, making reference to Amsterdam Weerproof and specific actors in the city. The language was simplified in order to reduce misunderstandings, and finally the set was translated into Dutch with the help of native speakers at the University of Amsterdam. Participants would see the study both in English and in Dutch and were thus able to choose to use the language they were most comfortable with.

Table 2: The Q-set used for this study

#	Statement
S1	Individual residents are responsible for keeping themselves safe in the face of flood risk.
S2	Residents should help their neighbours in the case of flooding by offering time, tools, or shelter to those most vulnerable and affected.
S3	Residents should invest in Nature-Based Solutions to make the neighbourhood safer for everybody. For example, homeowners with large roof areas could install green roofs to reduce the amount of water that runs off in the sewage system.
S4	The long-term maintenance of Nature-Based Solutions for flood adaptation such as green roofs should be taken care of by residents.
S5	The best way to reduce flood risk is through many small-scale interventions on private land, such as Nature-Based Solutions.
S6	The Municipality of Amsterdam should be held responsible for protecting every resident from extreme events such as floods.
S7	By making most public spaces (streets, roads, squares, etc.) greener and more permeable, Amsterdam will be safer from climate risks, without the need for residents to take any action or to intervene on private land.
S8	Landlords and social housing associations should implement flood-proofing measures to their rented properties to protect tenants.
S9	Creating awareness among the public about the risk of flooding should be the main priority for the city of Amsterdam when it comes to flood adaptation.
S10	Flood adaptation interventions should prioritize protecting high-value economic areas of the city, such as the Zuidas business district.
S11	Flood adaptation measures should only be implemented if they provide a clear economic return over investment to the city and its residents.
S12	Amsterdam Weerproof should encourage private companies to develop and sell climate adaptation technologies such as rainwater harvesting systems to residents.
S13	While encouraging residents to install Nature-Based Solutions on their properties, the Municipality of Amsterdam should ensure that the housing market remains affordable for all residents.
S14	To reduce climate risks, the municipality of Amsterdam should promote high-quality climate-proof neighbourhoods, such as floating homes.
S15	The obligation to install rainwater harvesting systems should be extended to all buildings in the city, with a set deadline for compliance.
S16	Landlords who invest in climate adaptation measures in their properties should be able to increase the rent price.
S17	Amsterdam should focus flood adaptation measures in disadvantaged neighbourhoods such as Nieuw West, Noord and Zuid-Oost.
S18	Extra subsidies and one-to-one guidance should be provided to low-income residents to prepare for climate risks such as flooding.
S19	Amsterdam Weerproof should prioritise support for communities that have historically faced environmental injustices.
S20	Residents should have access to information on flood risks and adaptation plans in other languages besides Dutch.

Table 2 continued from previous page

S21	Emergency response plans should have specific protocols for children, elderly residents and those with disabilities during extreme flood events.
S22	The Municipality of Amsterdam should increase investments in large-scale infrastructure for flood defence (such as improvements to the sewer system, dikes, flood walls).
S23	Climate adaptation planning should rely only on the opinion of scientific and technical experts.
S24	If climate adaptation measures are not really urgent, they can be postponed to future years.
S25	Residents should be able to decide on which urban climate risks are more urgent to address.
S26	Public participation related to flood adaptation policies should include compensation for time and resources spent by participants.
S27	Residents should be able to provide feedback on public urban flood adaptation projects already in the design phase.
S28	Flood adaptation strategies should also consider ways to increase biodiversity and ecological connectivity, such as by creating wetlands or green corridors.
S29	Climate adaptation efforts should prioritise the needs of individuals with specific chronic health needs or other vulnerabilities.
S30	The municipality should facilitate partnerships between NGOs working on different issues (such as housing, healthcare, etc.) to create climate adaptation solutions together.
S31	Low income households with a migrant background may be at higher risk during extreme weather and may face more difficulties in recovery.

Q-sample

The Q-Sample refers to the population of subjects to be interviewed. The sample choice aims for diversity in views, rather than representativeness. In fact, many authors point out that sample size in Q studies is usually limited (Sneegas et al., 2021; Uittenbroek et al., 2014). Fransolet et al. (2024) indicate that a sample of 12 participants can provide "significant results" (p. 5). Some maintain that large samples can be "detracting" from the quality of the Q study (Sneegas et al., 2021). In their review of 277 studies using Q-Methodology, Sneegas et al. found that the mode of the sample size was 24. The most popular selection method within their sample was purposive sampling.

For the selection of the sample, my aim was to have a diverse set of respondents, involved in Amsterdam Weerproof in different capacities. These included officials working for Waternet and the Municipality of Amsterdam, representatives of NGOs and neighbourhood groups, as well as businesses that were part of one or more of the initiatives of the programme. Through purposive sampling, and in a few cases snowball sampling, a total of 24 participants participated in the study. The names and affiliations of individuals in the sample are undisclosed for confidentiality reasons.

Q-Survey

The 24 participants in the study were asked to sort the 31 statements on a quasi-normal distribution grid. Following established practice, I employed a fixed distribution, where respondents are forced to place a fixed number of statements for each section of the curve. This encourages them to think about the statements in relation to each other rather than as isolated ideas (Nóblega-Carriquiry et al., 2022). This study employed the quasi-normal grid portrayed in Figure 9, ranging from -5 (Not important at all/disagree) to +5 (Very important/fully agree). The statements were shown in a random order.

In order to conduct the exercise I used QMethod software, a software developed specifically to handle Q-sorts. 75% of the participants completed the sorting exercise autonomously following a link sent to their emails. The remaining ones completed the survey together with me, either online or in person. I was there to explain the functioning of the method and to ask follow-up questions after the sorting was completed, but I left them time to sort the statements autonomously.

At the beginning of the exercise, participants agreed to their data being used anonymously and only for the purpose of this research. Next, they were offered a short glossary of key terms included

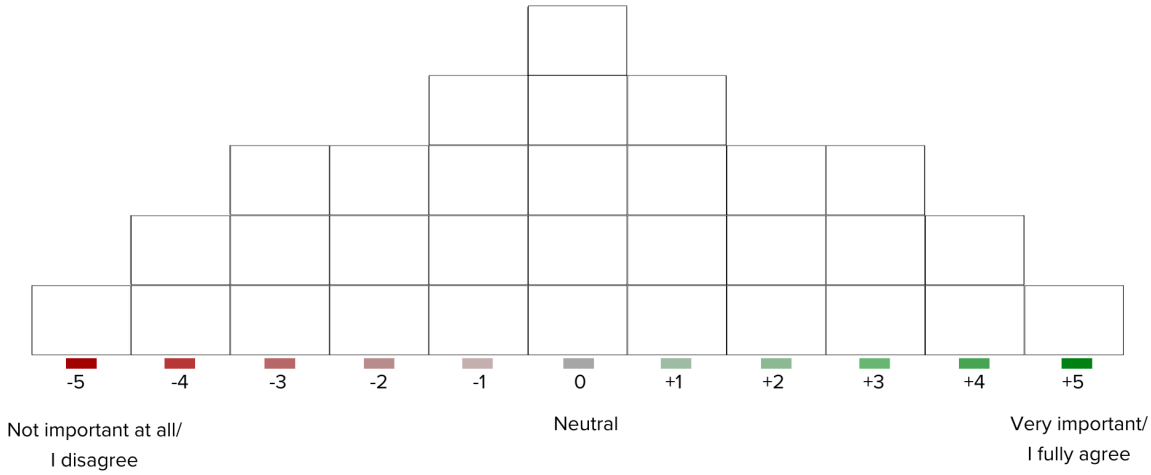

Figure 9: The Q-Survey grid used for the study. Participants were asked to place the 31 statements across the grid.

in the statements such as Flooding, Pluvial Flooding, Climate Adaptation and Nature-Based Solutions. After that, they started the pre-sorting phase, where they were able to pre-sort the statements into a "negative", "neutral" and "positive" pile before actually sorting the statements on the grid. The whole exercise took around 20 minutes on average. Data was collected between December 2024 and February 2025.

Analysis of Q-sorts and extraction of factors

The individual Q-sorts can be meaningful on their own if one is interested in how a specific individual thinks about climate justice in Amsterdam. However, to identify the broader discourses present across the sample, a statistical analysis of the Q-sorts was necessary. The 24 Q-sorts were exported to KenQ, a software that facilitates the extraction of factors—the statistical term for clusters of related viewpoints—in a systematic and rigorous manner.

To extract factors from the Q-sorts, I used Principal Component Analysis (PCA), which identifies clusters of similar sorts. These clusters are not mutually exclusive: they are simply different "ways" of grouping sorts to cluster together respondents who thought about the statements in a similar way. The PCA initially yielded eight factors. Appendix C shows the loading of each participant's

Q-sort on the 8 factors.

To refine these factors, I applied varimax rotation, a statistical technique that adjusts the factors to maximize the amount of variance explained. This approach is widely used in Q methodology studies (Sneegas et al., 2021).

However, not all of the eight factors were relevant or statistically significant. To determine the most relevant ones, authors employ various techniques. Sneegas et al. (2021) recommend not basing one's decision on a single criterion, but rather to triangulate between multiple criteria. The most used criteria, in descending order of popularity, are "the Kaiser-Guttman criterion, or eigenvalues greater than 1.0; the amount of variance explained by the factor solution; Humphrey's Rule; subjective interpretation" (Sneegas et al., 2021, p. 9).

I applied the first three criteria together, which gave statistically grounding to my final choice of factors:

- The Kaiser-Guttman criterion. This rule is, in simple terms, a requirement for a factor to explain enough variance. It is based on the eigenvalue, which is a measure of how much variance a factor accounts for. A factor must have an eigenvalue greater than one to be retained, ensuring that it captures a substantial portion of the variance in the data. It is basically asking, does this cluster of sorts make sense to explain a large-enough number of sorts? Table 3 shows eigenvalues for all 8 factors.

Table 3: Eigenvalues and variance explained for the 8 extracted factors.

	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6	Factor 7	Factor 8
Eigenvalues	7.096	5.1351	2.5553	1.622	1.2398	0.9759	0.8381	0.7555
% of variance explained	30	21	11	7	5	4	3	3

- Total amount of variance explained: A factor solution should explain a sufficient percentage of the total variance in the dataset. A three-factor solution accounted for 62% of the total variance, aligning with similar studies in the literature (Sneegas et al., 2021).

- Humphrey's Rule: this is a check to see if a factor is strong enough to be meaningful. It suggests that a factor is reliable if the cross-product of its two highest factor loadings (the correlations between individual Q-sorts and the factor) is greater than twice the standard error. Essentially, this rule helps ensure that a factor is not just a random pattern but represents

a meaningful grouping of viewpoints. The application of Humprey's rule highlighted the first three factors as significant.

The triangulation of these three criteria led me to the selection of three factors. These three factors were then interpreted by looking at which statements characterise them, allowing me to identify them as discourses. The interpretation of the discourses was further enriched with quotes by participants expressed during the follow up questions.

One third of the sample (8 participants) agreed to answer a few questions in a follow-up interview in English right after the Q-methodology exercise was concluded. This practice is common in other Q studies, and it is useful to contextualise the sorting of the statements within the climate policy ecosystem of Amsterdam. Studies such as Fransolet et al. (2024) or Uittenbroek at al. (2014) make use of follow-up questions in the analysis of the Q-sorts.

The interviews lasted around 20 minutes each and were recorded upon agreement with the participants. The structure of the interviews was loosely the same, starting with asking the participants to expand on the reasons for choosing their most extreme statements (those at +5 and -5). From that, the conversations moved on to the role of their own organisation within Amsterdam Weerproof, and the way they collaborate with the other partners. Finally, I asked about their main challenges when working towards flood adaptation in Amsterdam.

3.3.4 Reflections on the research process

The choice of the methodology for this thesis is a result of a long process where multiple options were explored. A process that evolved as I became more familiar with the city of Amsterdam and its policy landscape. At first, a policy analysis with expert interviews was considered to investigate the climate justice outcomes of flood adaptation policies in the city. However, as I got to know the case better, especially after I moved to Amsterdam, I became more interested in co-production as it is such a cornerstone of Amsterdam Weerproof and of Dutch public policy more in general. For example, during my time in Amsterdam I learnt about the "polder model", by which different issues in The Netherlands are addressed through consensus-making between different stakeholders. This resembles the democratic way of managing polders, the low-lying areas between the dikes that were reclaimed by coordinating the work of farmers, landowners, water board, and residents. Co-production is thus at the heart of flood management in The Netherlands, and land reclamation is a distinctive element in Dutch history and identity. My interest in the co-production aspect of flood

adaptation called for a method that would allow to systematically analyse the opinions of different stakeholders, and thus the choice of Q-Methodology.

Initially, I considered interviewing residents as part of my research, but language barriers prompted me to focus on officials, where English could serve as the primary language for communication. Additionally, given my limited time in Amsterdam, recruiting residents willing to participate in the study seemed particularly challenging. The issue of reaching out to officials was partially mitigated through connections at the University of Amsterdam, where my professors facilitated introductions to officials at Waternet and the Municipality. Despite these efforts, my status as a "foreigner" continued to influence the research process. It took time to familiarize myself with the intricacies of policy arrangements and the division of responsibilities across various levels of government—especially in water management, where water boards play a pivotal role, a type of entity I was unfamiliar with in contexts I had previously studied.

This ongoing learning process shaped the development of my Q-set, which expanded and became more refined as I gained deeper insights into flood adaptation in Amsterdam. One important element is that I became more and more aware of the collective memory about floods as I talked to people about their memories of the 2014 cloudburst.

4 Results

Apartment building and canal in Amsterdam Oost.

4.1 Sample description

The 24 participants in the Q-study are active within the scope of Amsterdam Weerproof in different capacities. Ten work for the public sector (four for the Municipality of Amsterdam; six for Waternet); six for NGOs/not-for-profit organisations; eight for the private sector. For a full list of affiliations, see Appendix A.

Table 4: Number of participants in the sample grouped by organisation type.

Organisation	#
Municipality of Amsterdam (Climate adaptation strategy, Land and Development office, Space and Sustainability Office).	4
Waternet (Amsterdam Weerproof team, Strategy and Development Department)	6
NGOs/not-for-profit (Partners of Amsterdam Weerproof: neighborhood groups, associations working towards greening, biodiversity).	6
Private sector (Partners of Amsterdam Weerproof: businesses providing green roofs and rainwater harvesting systems)	8
Total	24

Eight participants agreed to dedicate some time to answer follow up questions after the survey. The list of interviewees is available in Appendix B.

4.2 Identification of three distinct discourses

From the analysis of the Q-sort exercise, a diverse set of perspectives on flood adaptation in Amsterdam has been distilled into three distinct discourses. The first centres on private-led, market-driven adaptation. The second emphasises equity and meaningful participation. The third embraces co-production by placing responsibility on individual residents.

The three discourses explained a combined variance of 62%. Table 5 shows the eigenvalues for each of the three discourses and the amount of variance explained.

Table 5: Statistical characteristics of the three discourses.

	Discourse 1	**Discourse 2**	**Discourse 3**
Eigenvalues	7.096	5.1351	2.5553
Percent explained variance (cumulative)	30 (30)	21 (51)	11 (62)

The three discourses try to capture different clusters of opinions across the sample. Table 6 shows the correlation between the three discourses, highlighting their diversity.

Table 6: Pearson correlation matrix between the three extracted factors (discourses). None of the correlations is statistically significant at p<0.01.

	Discourse 1	**Discourse** 2	**Discourse** 3
Discourse 1	1	0.0673	0.2648
Discourse 2	0.0673	1	0.4165
Discourse 3	0.2648	0.4165	1

Before elaborating on each of the three discourses, Table 7 shows the full list of statements with factor scores. Each statement is accompanied by three numbers, which indicate the position in the q-sorting grid that the statement received for each of the three discourses. This is obtained as an average of the scores that participants whose sort loaded strongly on a certain discourse attributed to that statement. For example, factor scores for statement 1 are 0, -3, and 2 respectively, showing that Discourse 1 is neutral about this statement, Discourse 2 disagrees with it, and Discourse three moderately supports it. In the next section, I will expand on the three discourses by showing their defining and distinguishing statements. Defining statements are the ones ranked at the extreme of the Q-sort (+/-4, +/-5); distinguishing statements are those that are ranked significantly different as opposed to the other discourses. Afterwards, I highlight consensus and dissensus statements among the three discourses.

Table 7: Full list of statements with factor scores

#	Statement	D1	D2	D3
S1	Individual residents are responsible for keeping themselves safe in the face of flood risk.	0	-3	2
S2	Residents should help their neighbours in the case of flooding by offering time, tools, or shelter to those most vulnerable and affected.	0	3	3
S3	Residents should invest in Nature-Based Solutions to make the neighbourhood safer for everybody. For example, homeowners with large roof areas could install green roofs to reduce the amount of water that runs off in the sewage system.	3	4	4
S4	The long-term maintenance of Nature-Based Solutions for flood adaptation such as green roofs should be taken care of by residents.	-2	-1	0
S5	The best way to reduce flood risk is through many small-scale interventions on private land, such as Nature-Based Solutions.	2	0	4
S6	The Municipality of Amsterdam should be held responsible for protecting every resident from extreme events such as floods.	-1	-1	-4
S7	By making most public spaces (streets, roads, squares, etc.) greener and more permeable, Amsterdam will be safer from climate risks, without the need for residents to take any action or to intervene on private land.	-3	-1	-3
S8	Landlords and social housing associations should implement flood-proofing measures to their rented properties to protect tenants.	3	2	1
S9	Creating awareness among the public about the risk of flooding should be the main priority for the city of Amsterdam when it comes to flood adaptation.	2	1	2
S10	Flood adaptation interventions should prioritize protecting high-value economic areas of the city, such as the Zuidas business district.	1	-5	-2
S11	Flood adaptation measures should only be implemented if they provide a clear economic return over investment to the city and its residents.	1	-4	-3
S12	Amsterdam Weerproof should encourage private companies to develop and sell climate adaptation technologies such as rainwater harvesting systems to residents.	4	-3	3
S13	While encouraging residents to install Nature-Based Solutions on their properties, the Municipality of Amsterdam should ensure that the housing market remains affordable for all residents.	-1	1	-3
S14	To reduce climate risks, the municipality of Amsterdam should promote high-quality climate-proof neighbourhoods, such as floating homes.	3	-2	-1
S15	The obligation to install rainwater harvesting systems should be extended to all buildings in the city, with a set deadline for compliance.	1	0	-1
S16	Landlords who invest in climate adaptation measures in their properties should be able to increase the rent price.	4	-1	1
S17	Amsterdam should focus flood adaptation measures in disadvantaged neighbourhoods such as Nieuw West, Noord and Zuid-Oost.	-3	5	2

Table 7 continued from previous page

S18	Extra subsidies and one-to-one guidance should be provided to low-income residents to prepare for climate risks such as flooding.	0	3	0
S19	Amsterdam Weerproof should prioritise support for communities that have historically faced environmental injustices.	-2	2	-1
S20	Residents should have access to information on flood risks and adaptation plans in other languages besides Dutch.	-3	1	-2
S21	Emergency response plans should have specific protocols for children, elderly residents and those with disabilities during extreme flood events.	0	1	0
S22	The Municipality of Amsterdam should increase investments in large-scale infrastructure for flood defence (such as improvements to the sewer system, dikes, flood walls).	-1	0	-5
S23	Climate adaptation planning should rely only on the opinion of scientific and technical experts.	2	-2	-4
S24	If climate adaptation measures are not really urgent, they can be postponed to future years.	-2	-4	-2
S25	Residents should be able to decide on which urban climate risks are more urgent to address.	-4	-3	3
S26	Public participation related to flood adaptation policies should include compensation for time and resources spent by participants.	-5	-2	0
S27	Residents should be able to provide feedback on public urban flood adaptation projects already in the design phase.	-4	0	1
S28	Flood adaptation strategies should also consider ways to increase biodiversity and ecological connectivity, such as by creating wetlands or green corridors.	5	3	5
S29	Climate adaptation efforts should prioritise the needs of individuals with specific chronic health needs or other vulnerabilities.	0	0	0
S30	The municipality should facilitate partnerships between NGOs working on different issues (such as housing, healthcare, etc.) to create climate adaptation solutions together.	1	4	1
S31	Low income households with a migrant background may be at higher risk during extreme weather and may face more difficulties in recovery.	-1	2	-1

4.2.1 Discourse 1: Private-led, Market-driven Adaptation

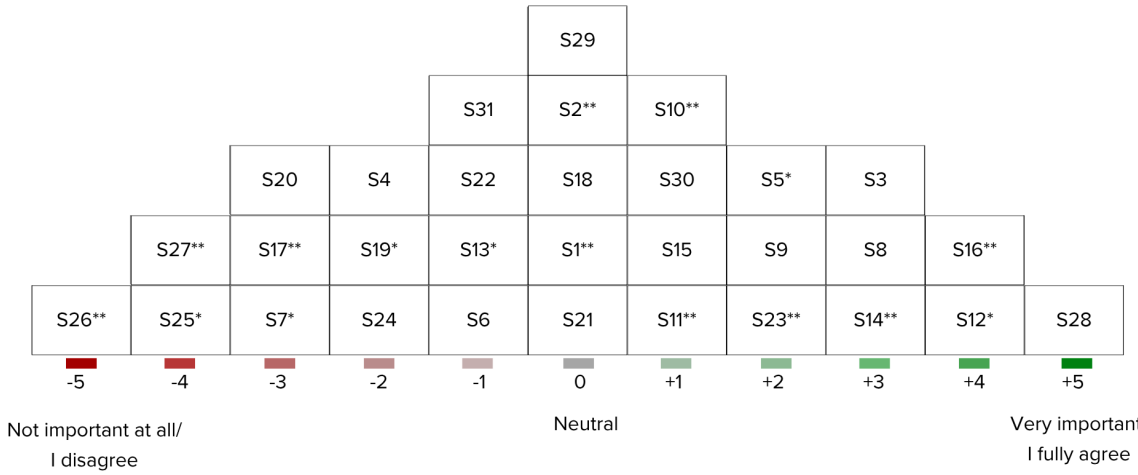

Figure 10: Idealised composite q-sort for Factor 1. Statements are placed based on the average score given by sorts loading on this factor. Statements statistically significant at p<0.05 are marked with *, at p<0.01 with **.

The first discourse understands flood adaptation as largely a private-led effort (S12: 4; S5: 2) [5]. It favours private investments in small-scale NbS and market-driven interventions (S8: 3), with the goal of protecting areas of high-economic value (S10: 1) and enhancing biodiversity (S28: 5) by implementing NbS on private land (S5: 2). Many participants represented by this discourse reason in economic terms of return over investment with regards to the location, timing and extent of flood adaptation measures (S11: 1). There is limited concern for marginalised groups (S17: -3; S31: -1) or large-scale public infrastructure (S22: -1). By looking at the defining statement in Table 8, meaning those that were ranked significantly differently from other discourses, and the whole composite Q-sort (Figure 10), the main characteristics of the discourse can be identified.

[5]The first digit corresponds to the number of the statement and the second one to the average score that the statement obtained for this discourse. A complete list of statements is available in Table 7

Table 8: Summary of distinguishing statements for factor 1. All these statements were statistically significant at p<0.05. Those marked with * were statistically significant at p<0.01. In other words, only statements that loaded significantly on this factor were included.

Discourse 1: distinguishing statements

+4	**S.16*** Landlords who invest in climate adaptation measures in their properties should be able to increase the rent price.
+4	**S.12** Amsterdam Weerproof should encourage private companies to sell climate adaptation technologies.
+3	**S.14*** The municipality should promote high-quality climate-proof neighbourhoods, such as floating homes.
+2	**S.5** The best way to reduce flood risk is through many small-scale interventions on private land, such as Nature-Based Solutions.
+1	**S.11*** Flood adaptation measures should only be implemented if they provide a clear economic return over investment to the city and its residents.
+1	**S.10*** Flood adaptation interventions should prioritize protecting high-value economic areas of the city, such as the Zuidas business district.
-1	**S.13** While encouraging residents to install NbS, the Municipality of Amsterdam should ensure that the housing market remains affordable for all residents.
-2	**S.19** Amsterdam Weerproof should prioritise support for communities that have historically faced environmental injustices.
-3	**S.7** By making most public spaces greener and more permeable, Amsterdam will be safer from climate risks, without the need for residents to intervene on private land.
-3	**S.17*** Amsterdam should focus flood adaptation measures in disadvantaged neighbourhoods such as Nieuw West, Noord and Zuid-Oost.
-4	**S.25** Residents should be able to decide on which urban climate risks are more urgent to address.
-5	**S.26*** Public participation related to flood adaptation policies should include compensation for time and resources spent by participants.

This discourse places private actors such as landlords and green-sector businesses as the main characters of flood adaptation in Amsterdam (S12: 4, S3: 3) and at the same time disregards public initiative (S22: -1; S9: 2). Proponents of this discourse agree that the primary role of the Municipality is that of "creating awareness" (S9: 2) and encouraging uptake of NbS, rather than "investing in large scale infrastructure" (S22: -1). This private-first approach to flood adaptation is reflected in the ownership focus of this discourse: priority is given to interventions on private land (S5: +2) as opposed to public spaces (S7: -3). As one interviewee from the Municipality put it, "We don't have much control over what is not ours, so you need the people who are inside the building" (Interviewee #2).

Great emphasis is placed on Nature-based Solutions. Statement 28 - *Flood adaptation strategies should also consider ways to increase biodiversity and ecological connectivity, such as by creating wetlands or green corridors* - is ranked as most important (S28: 5). In the same vein, the discourse also believes that floating homes (S14: 3) and NbS (S5: 2) should have priority. At the same time, these innovations are conceived as small-scale interventions, mostly on private land (S5: -2; S22: -1). As an example of the prioritisation of small-scale, private NbS, the discourse largely disagrees with Statement 7 (-3) - *By making most public spaces (streets, roads, squares, etc.) greener and more permeable, Amsterdam will be safer from climate risks, without the need for residents to take any action or to intervene on private land.*

The focus on private-led adaptation is accompanied by limited concerns for the social justice implications of co-produced adaptation. Proponents of the discourse accept that *Landlords who invest in climate adaptation measures in their properties should be able to increase the rent price* (S16: 4). The discourse also maintains a rational economic frame towards the implementation of flood adaptation: this should *prioritise high-value economic areas such as the Zuidas business district* (S10: 1) and be implemented only if it provides *a clear economic return over investment* (S11: 1). Participants who resonated with this discourse tend to disregard equity measures in flood adaptation, such as the prioritisation of vulnerable neighbourhoods (S17: -3), the provision of information in languages other than Dutch (S20: -3) or additional subsidies for low-income residents (S18: 0). Little importance is given to issues of environmental injustice (S19: -2) or the different vulnerabilities in the face of flood risk (S31: -1).

In terms of the role attributed to residents, proponents of this discourse see them mainly as "consumers" rather than included decision-makers. All statements related to the active participation of residents in the decision-making process regarding adaptation are given little importance (S27:

-4; S25: -4; S26: -5). This goes along with the already mentioned fact that this discourse does not consider expanding adaptation information to languages other than Dutch, thereby excluding a share of the population from the political process behind adaptation. The discourse also emphasises that *Climate adaptation planning should rely only on the opinion of scientific and technical experts* (S23: 2). At the same time, respondents in this cluster believe residents and landlords should install NbS on their premises (S3: 3; S8: 3), and buy climate adaptation technologies (S12: 4). This also derives from concerns over the financial resources available to the Municipality for adaptation, suggesting that individual action may make up for this deficiency. As an example, Interviewee #6, working for an NGO promoting biodiversity in Amsterdam, states that "the biggest problem with greening in Amsterdam is money, because we can buy trees and plant them but we cannot afford to maintain them".

Overall, this discourse, while framing adaptation as a collective responsibility, does not concern itself with the justice dimension of co-produced adaptation, emphasising instead market-driven adaptation strategies that follow supply-demand logics and see the municipality mainly as a promoter of the flood adaptation market and residents as consumers in this market.

4.2.2 Discourse 2: Community-led, Justice-driven Adaptation

Discourse 2 approaches flood adaptation in a more cautious and targeted way. It supports selective interventions towards disadvantaged neighbourhoods (S17: 5) and groups (S18: 3; S31: 2). It gives relevance to the issues of marginalisation (S19: 2) and excessive responsibilisation of individuals (S1: -3). Individuals are seen as an active part of the adaptation process, not just as consumers, with support for the role of NGOs (S30: 4) and mutual assistance between residents (S2: 3). This reduces the responsibility placed on the private sector (S12: -3), and it is accompanied by a rejection of cost-benefit analysis as the sole criteria (S11: -4). Table 9 shows distinguishing statements for the discourse.

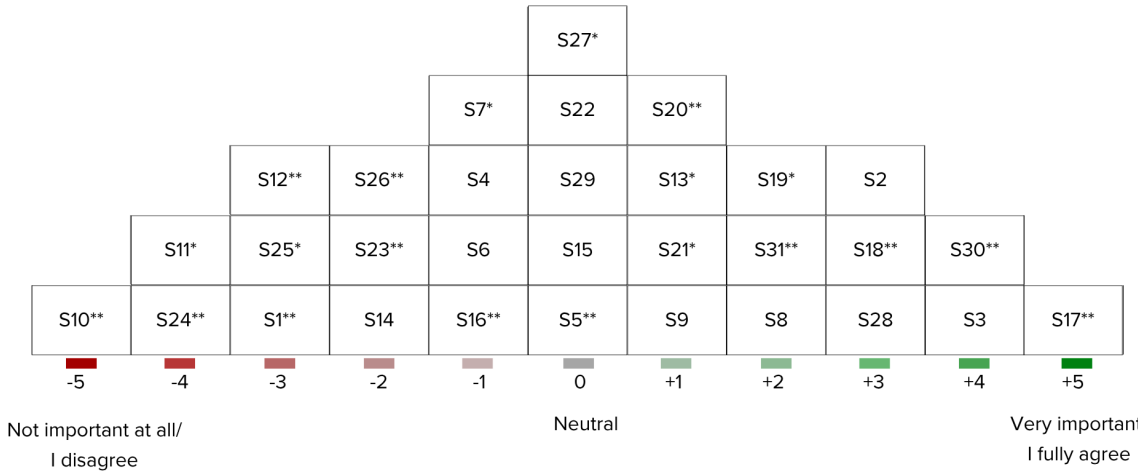

Figure 11: Idealised composite q-sort for factor 2. Statements statistically significant at $p<0.05$ are marked with *, at $p<0.01$ with **. The list of statements for reference is available in Appendix A.

One major concern for participants that belong to this cluster is that of climate justice. On one side, participants insist on the need to prioritise low-income areas of the city of Amsterdam, as shown by Statement 17 - *Amsterdam should focus flood adaptation measures in disadvantaged neighbourhoods such as Nieuw West, Noord and Zuid-Oost* - being placed at +5 (see figure 11). This attitude is reflected beyond the spatial distribution of adaptation efforts. There is a focus on vulnerable groups, as exemplified by statements 18 (additional subsidies for low-income groups) and 19 (support to balance environmental injustice) being both given importance (3 and 2 respectively). Notably, participants acknowledge the risks of climate gentrification by supporting the idea that the Municipality, while it encourages property-level climate resilient greening, also ensures housing affordability (S13: 1) and that landlords should not be allowed to use adaptation as a way to increase rent (S16: -1). An interview with a member of the Amsterdam Weerproof team (interviewee #4) showed clear awareness of climate justice implications:

> For example, [Amsterdam] Zuid is going well because people are well educated, they understand the message, they have money, ambition, means, time, awareness. Other areas are more difficult to reach. And we noticed it, and that's why we have the neighbourhood approach in areas that are more challenged.

Table 9: Summary of distinguishing statements for factor 2. All these statements were statistically significant at p<0.05. Those marked with * were statistically significant at p<0.01. In other words, only statements that loaded significantly on this factor were included.

Discourse 2: distinguishing statements

+5	**S.17*** Amsterdam should focus flood adaptation measures in disadvantaged neighbourhoods such as Nieuw West, Noord and Zuid-Oost.
+4	**S.30*** The municipality should facilitate partnerships between NGOs working on different issues to create climate adaptation solutions together.
+3	**S.18*** Extra subsidies and one-to-one guidance should be provided to low-income residents to prepare for climate risks such as flooding.
+2	**S.19** AW should prioritise support for communities that have historically faced environmental injustices.
+1	**S.20*** Residents should have access to information on flood risks and adaptation plans in other languages besides Dutch.
+1	**S.13** While encouraging residents to install Nature-Based Solutions on their properties, the Municipality of Amsterdam should ensure that the housing market remains affordable for all residents.
-1	**S.16*** Landlords who invest in climate adaptation measures in their properties should be able to increase the rent price.
-2	**S.23*** Climate adaptation planning should rely only on the opinion of scientific and technical experts.
-3	**S.1*** Individual residents are responsible for keeping themselves safe in the face of flood risk.
-4	**S.24*** If climate adaptation measures are not really urgent, they can be postponed to future years.
-4	**S.11** Flood adaptation measures should only be implemented if they provide a clear economic return over investment to the city and its residents.
-5	**S.10*** Flood adaptation interventions should prioritize protecting high-value economic areas of the city, such as the Zuidas business district.

Alongside justice concerns, discourse 2 understands citizen involvement beyond the "consumption" of flood adaptation measures. It values the expertise of residents, by rejecting the idea that adaptation *should only rely on the opinion of scientific and technical experts* (S23: -2), and supporting that flood adaptation information be provided in languages other than Dutch (S20: 1). The role of NGOs is seen as significant (S30: 4) and so is that of mutual help between neighbours (S2: 3).

Discourse 2 emphasises the urgency of addressing flood risk by rejecting the procrastination of adaptation (S24: -4). Together with this sense of urgency is the acknowledgement of the different vulnerabilities within the city. Participants agree that *Low income households with a migrant background may be at higher risk during extreme weather and may face more difficulties in recovery* (S31: 2) and are in favour of targeted support for vulnerable groups in the case of flooding (S1: 1). The following quote by interviewee #2 from the Municipality reflects concerns with distributive justice:

> Basically, we want to help the people who need help the most in everything that we do. So in richer areas people have mostly owned their own houses. They are probably more capable of taking measures themselves, but there are lots of people who are elderly or have low income or are otherwise less capable of helping themselves. We see that we need to step up as a municipality more here than in other richer areas.

Participants are less convinced about the privatisation of flood adaptation. First of all,in terms of ownership: Statement 5, which favours interventions on private land rather than public space, is given little importance (S5: 0). Secondly, in terms of the main actors carrying out adaptation. Private companies (S12: -3) and private residents (S1: -3) are given less responsibility. The prioritisation of the business district is given the lowest score (S10: -5).

In summary, this discourse advocates for adaptation measures that address both ecological and social vulnerabilities, prioritising vulnerable groups and areas and refusing the privatisation of flood risk and adaptation.

4.2.3 Discourse 3: Individual-led, Participation-driven Adaptation

The third discourse understands adaptation as a joint effort, where residents must play a major role both in terms of action and decision-making. It rejects top-down interventions, and has minor concerns for justice, overlooking the risks of climate gentrification.

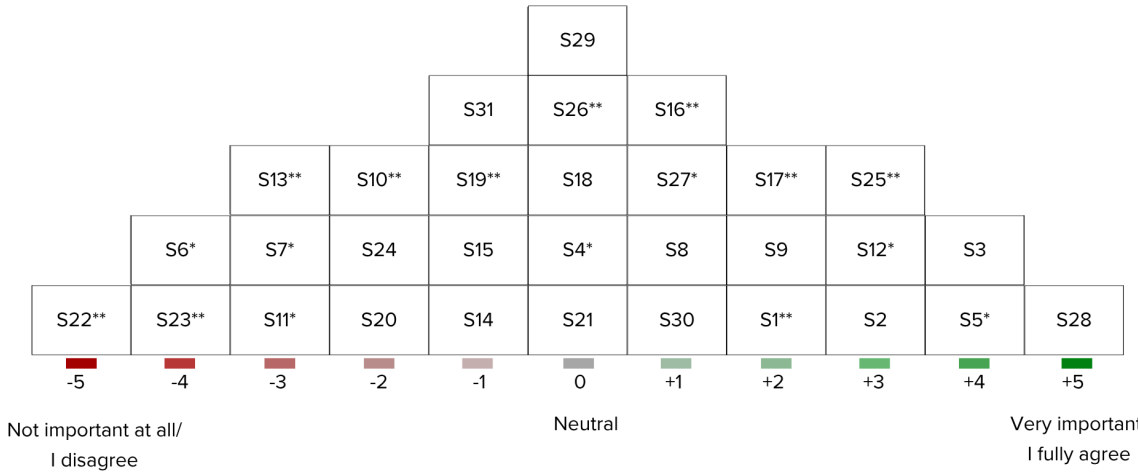

Figure 12: Idealised composite q-sort for factor 3. The list of statements for reference is available in Appendix A.

The discourse promotes individual responsibility by calling for strong citizen engagement in adaptation. Residents are seen as responsible for their own safety (S1: 2) and that of others (S2: 3). They are encouraged to invest in property-level NbS (S3: 4). According to this discourse, the *best way to reduce flood risk is through many small-scale interventions on private land* (S5: 4). This is in line with Amsterdam Weerproof approach of stimulating private initiatives. As interviewee #3 from Waternet stated, "the whole idea of what I'm doing is to involve private space, the private property and all the people who are concerning it".

At the same time, proponents of this discourse do not seem to be too concerned about the justice implication of such a strong focus on private responsibility. The connection between adaptation measures and rise in property price is not a priority (S13: -3). Statements regarding the different vulnerabilities and needs in the face of flood risk across social groups receive little consideration (S29: 0; S21: 0; S19: -1).

The discourse attaches great importance to the "green" side of adaptation. Statement 28, which champions biodiversity and ecological connectivity, is given the highest ranking (S28: 5). Both statements 5 and 3, which recommend Nature-Based Solutions, are given a score of 4 (S5: 4; S3: 4). Notably, discourse 3 supports high levels of residents' participation in the decision-making process regarding adaptation. It believes that *residents should be able to decide on which climate risks are*

Table 10: Summary of distinguishing statements for factor 3. All these statements were statistically significant at p<0.05. Those marked with * were statistically significant at p<0.01. In other words, only statements that loaded significantly on this factor were included.

Discourse 3: distinguishing statements

+4	**S.5** The best way to reduce flood risk is through many small-scale interventions on private land, such as Nature-Based Solutions.
+4	**S.3** Residents should invest in Nature-Based Solutions to make the neighbourhood safer for everybody.
+3	**S.12** AW should encourage private companies to develop and sell climate adaptation technologies such as rainwater harvesting systems to residents.
+3	**S.25*** Residents should be able to decide on which urban climate risks are more urgent to address.
+2	**S.1*** Individual residents are responsible for keeping themselves safe in the face of flood risk.
+1	**S.27** Residents should be able to provide feedback on public urban flood adaptation projects already in the design phase.
0	**S.26*** Public participation related to flood adaptation policies should include compensation for time and resources spent by participants.
-3	**S.13*** While encouraging residents to install Nature-Based Solutions on their properties, the Municipality of Amsterdam should ensure that the housing market remains affordable.
-3	**S.7** By making most public spaces greener and more permeable, Amsterdam will be safer from climate risks, without the need for residents to intervene on private land.
-4	**S.23*** Climate adaptation planning should rely only on the opinion of scientific and technical experts.
-4	**S.6*** The Municipality of Amsterdam should be held responsible for protecting every resident from extreme events such as floods.
-5	**S.22*** The City of Amsterdam should increase investments in large-scale infrastructure for flood defence (such as improvements to the sewer system, dikes, flood walls).

more urgent to address (S25: 3), and that they should have a say in the design phase of adaptation projects (S27: 1). In the same vein, it strongly rejects over-reliance on technical expertise (S23: -4).

The emphasis on individual action comes with the rejection of top-down adaptation measures. Participants in this discourse refuse additional investment in large-scale infrastructure from the Municipality (S22: -5), and obligations such as mandatory rainwater harvesting receive little support (S15: -1). Discussing the recent rainwater ordinance, interviewee #4 states:

> You can't just impose a policy—it won't be accepted. Before the ordinance, we had to work extensively with residents and architects to normalise the idea of rainwater harvesting. Only then could we introduce the ordinance.

Discourse 3 disagrees with the idea that the Municipality should be held responsible for protecting citizens from floods (S6: -4) and maintain that the main role for the Municipality should instead be to create awareness among the public (S9: 2). A hint to this is a quote from another interviewee (#8):

> You need awareness because you [municipality] cannot do everything yourself. If you do everything yourself it's more complicated and more costly. If we do it together it's cheaper, a collective effort will be cheaper.

The lack of support for mandatory top-down interventions is also rooted in concerns with the efficacy of the Municipality in dealing with flood adaptation. For example, when describing how the Municipality is trying to promote adaptation measures on social housing estates, interviewee #1 from the Municipality explains:

> At this point you can only nudge or incentivize and stuff like that, and lots of these housing corporations don't have a lot of money, so not a lot of means to do stuff, and as a government we want a lot of them and we want to make sure that they keep the house cheap for the citizens, we want them to get good insulation, good quality, and so they don't have a lot of means to make them climate adapted.

In many follow-up interviews, the issue of land ownership came up as a leading reason for incentivising citizen engagement. As interviewee #1 acknowledges: "As a Municipality we have impact on approximately 50% of the city because the other 50% is owned by other people and there it's more difficult to make policies because they have interests". Overall, proponents of discourse 3 place

great responsibility on the individual, downsizing the role of the municipality in the implementation of greening interventions for flood adaptation, while being mostly agnostic about the justice dimension of such an approach.

4.3 Consensus and dissensus

By measuring the difference between the ranking of each statement in the idealised q-sorts of the three discourses, it is possible to identify consensus and dissensus statements. Consensus statements are the ones with the lowest difference between discourses, dissensus statements are those with the highest difference. In short, participants placed consensus statements in a similar position on the Q-sort grid - for instance, there were statements that most people liked, or disliked; the opposite is true for dissensus statements, where opinions were less unanimous.

4.3.1 Consensus statements

Table 11 shows how all three discourses agree on the importance of greening interventions. Statement 28 - *Flood adaptation strategies should also consider ways to increase biodiversity and ecological connectivity, such as by creating wetlands or green corridors.* - receives the highest score in discourse one and three, and a score of three in the second discourse. As interviewee #8 states, "I believe that nature can solve a lot of problems, and we shouldn't try to outsmart nature." The three positions also converge on the notion that private residents should invest in NbS in an effort to mitigate flood risk not only for themselves but for their neighbourhood (S3: 3, 4, 4). All discourses moderately support the idea that the Municipality's main role should be that of creating awareness about flood adaptation among other stakeholders (S9: 2, 1, 2). This is reflected in the following quotes, which summarise the approach of Amsterdam Weerproof (Interviewee #5):

> What do they [businesses involved in flood adaptation] need to make a change happen? Do they need knowledge? Do they need money? Do they need each other or other professionals? So to listen to them, get to know them and try to help them by combining them, to let them do their job better [...] I cannot build a blue roof myself, I need to mainstream the idea of it so that others do it.

On the other hand, all three discourses refuse postponing adaptation efforts (S24), with scores of -2, -4 and -2 respectively, albeit discourse two is more pronounced on this point. As Interviewee

#8 notes, "There's always facts you can use to say [adaptation] is not urgent at this moment. But I think if you look at the bigger scale of things, it is."

There are statements that sit at the centre of the grid for all discourses, meaning that none of the three takes a strong stance on them. This is the case, for instance, with mandatory rainwater harvesting, which receives little support, but also little refuse (S15: 1, 0, 1).

Table 11: Consensus statements among the three discourses. Each statement is followed by the score that the three discourses attributed to it in the idealised q-sort of the discourse. The ranking value difference indicates how similarly (low score) or differently (high score) the three discourses ranked the same statement.

Consensus Statements	Factor 1	Factor 2	Factor 3	Ranking value difference
S9: Creating awareness among the public about the risk of flooding should be the main priority for the city of Amsterdam when it comes to flood adaptation.	2	1	2	0.02
S3: Residents should invest in Nature-Based Solutions to make the neighbourhood safer for everybody. For example, homeowners with large roof areas could install green roofs to reduce the amount of water that runs off in the sewage system.	3	4	4	0.029
S28: Flood adaptation strategies should also consider ways to increase biodiversity and ecological connectivity, such as by creating wetlands or green corridors.	5	3	5	0.053
S15: The obligation to install rainwater harvesting systems should be extended to all buildings in the city, with a set deadline for compliance.	1	0	-1	0.059
S24: If climate adaptation measures are not really urgent, they can be postponed to future years.	-2	-4	-2	0.173

4.3.2 Dissensus statements

The description of the three factors already highlighted some of the points of divergence between the three discourses around flood adaptation in Amsterdam. A closer look at Table 12 can illuminate what are the most controversial issues between the different positions.

There is clear divergence over the suggested distribution of adaptation efforts. Statement 17 - which advocates for giving priority to disadvantaged neighbourhoods - is the one with the most diverse scores across the sample: strongly supported by discourse 2 (S17: 5), opposed by discourse 1 (S17: -3) and only moderately favoured by discourse 3 (S17: 2). Similarly, the three discourses starkly diverge on the role of private companies in adaptation (S12: 4, -3, 3) and that of individual residents (S1: 0, -3, 2). Another area of disagreement is the expertise involved in flood adaptation. Both statements 23 - which prioritises technical and scientific expertise - and statement 25 - which supports amplifying citizens' voices in decision making - receive wildly different scores across the three discourses (S23: 2, -2, -4; S25: -4, -3, 3).

Table 12: Dissensus statements among the three factors. Each statement is followed by the score that the three factors attributed to it in the idealised q-sort of the discourse. The ranking value difference indicates how similarly (low score) or differently (high score) the three discourses ranked the same statement.

Dissensus Statements	Factor 1	Factor 2	Factor 3	Ranking value difference
S1: Individual residents are responsible for keeping themselves safe in the face of flood risk.	0	-3	2	0.543
S23: Climate adaptation planning should rely only on the opinion of scientific and technical experts.	2	-2	-4	1.018
S25: Residents should be able to decide on which urban climate risks are more urgent to address.	-4	-3	3	1.137
S12: Amsterdam Weerproof should encourage private companies to develop and sell climate adaptation technologies such as rainwater harvesting systems to residents.	4	-3	3	1.294
S17: Amsterdam should focus flood adaptation measures in disadvantaged neighbourhoods such as Nieuw West, Noord and Zuid-Oost.	-3	5	2	1.565

4.4 Overview

Table 13 summarises key characteristics for each of the identified factors.

Table 13: Overview of characteristics of the three identified discourses.

Discourse	Key elements
D1	→ Private-led, market-driven adaptation. Emphasis on landlords and businesses as main adaptation actors, while minimising the role of the Municipality. → Greening interventions on private land over public space, favouring small-scale NbS → Residents are seen as consumers and expected to invest in adaptation, with little concern for meaningful participation, public engagement, or equity.
D2	→ Community-led, justice-driven Adaptation. Priority is given to disadvantaged neighborhoods and groups while rejecting cost-benefit criteria for adaptation planning. Incorporates justice-oriented principles and acknowledges the risk of climate gentrification. → Opposition to business-led adaptation, private-sector responsibility, and prioritization of high-value economic areas, favoring public and collective efforts. → Residents play a key role in flood adaptation as active citizens, through mutual aid and participation. Rejection of purely technical expertise, openness to including residents in decision making
D3	→ Individual-led, Participation-driven Adaptation. Residents are encouraged to take action for their own safety and that of others through property-level NbS; individual responsibility is emphasised. → Residents are key decision-makers, with support for strong public participation, rejecting over-reliance on technical expertise and favoring local decision-making. → Opposition to top-down measures, including large-scale municipal interventions or mandatory policies, preferring awareness campaigns over government-led projects.

The next chapter will compare and contrast the different discourses, linking them to wider debates around justice in the co-production of flood adaptation.

5 Discussion

View of the Amstel River from Staalmeestersbrug.

This thesis sought to identify the main discourses around climate justice and responsibility across different stakeholders involved in Amsterdam Weerproof. The previous section described the three distinct discourses within the programme and identified potential conflicts and convergences with the consensus and dissensus statements.

This section contextualizes these findings with existing literature and the state of climate adaptation policy in Amsterdam. To do so, I start by framing the three discourses as competing future visions for flood adaptation in Amsterdam, using literature to highlight the justice implications of each of them. After that, I synthesise key tensions between the three discourses, to then move on to potential areas of agreement.

5.1 Three Visions of Flood Adaptation in Amsterdam

> A transition is thus underway in environmental governance. This shift involves environmental governance being reconceptualized from an overly structural or static view and toward a dynamic perspective that stresses the ability to navigate interconnected and multilevel social-ecological systems. (Plummer, 2013, p. 3)

As the literature on co-production approaches shows, urban climate adaptation policy is transforming into a political arena where more and more stakeholders are involved (Mees et al., 2019; Wamsler et al., 2020). Discourse 1 places businesses and homeowners at the centre stage. Its view on the role of residents falls under the second category of the typology developed by Hegger et al. (2017): residents as consumers on the market for adaptation goods (private property greening, rainwater harvesting systems, flood barriers, insurance schemes, etc.). Under this narrative, adaptation efforts are necessarily driven by market mechanisms because they depend on private capital. This is also reflected in some of the follow-up interviews where the issue of lack of public funding for adaptation interventions was often mentioned, such as in the case of green infrastructure maintenance. With its stakeholders platform, Amsterdam Weerproof brings in private businesses to make the city more flood proof, to activate private capital for the public good. This goes in line with the ample body of literature on neoliberal urbanisation, where municipal governments in times of austerity tend to rely on the market for the provision of urban services (Connelly et al., 2020; Harvey, 1989), For example studies like Geaves et al. (2015), where they show that between 2010 and 2015, flood risk management in the UK transitioned from a 98% of interventions being fully state funded, to 90% of them requiring “partnership funding” and being co-funded by the private sector.

In the case of urban adaptation, this can induce what Anguelovski et al. (2016) refer to as "Acts of Omission": if adaptation interventions are dependent on market-led investments, these may "omit" vulnerable groups and areas that provide a lower “return on investment”. Unsurprisingly, Discourse 1 disagrees with the prioritisation of lower income neighbourhoods such as Noord, Zuid-Oost and Nieuw-West and disregards support for disadvantaged communities.

Discourse 2 attributes a more prominent role to the municipal government in flood adaptation, not as much in delivering adaptation infrastructure, but mainly in determining where private property-level measures should be implemented. It thus clearly takes into account the concerns related to fully private-led adaptation exposed in climate justice literature. For example, by promoting the prioritisation of vulnerable neighbourhoods, this discourse aligns with research showing that property level measures are often "spatially-blind" - meaning they are not equally distributed across the city (Connelly et al., 2020). Its view on the role of residents is more aligned with what Hegger et al.(2017) refer to as “residents as civil society actors”, as it goes beyond seeing residents merely as consumers on the market for adaptation measures, but rather seeks to empower them as agents of change – see for example the great support in Discourse 2 for statements S2 (+3) and S30 (+4). Amsterdam Weerproof, while privileging the inclusion of the private sector in adaptation, also dedicates efforts to vulnerable groups. With the "neighbourhood approach", three low-income neighbourhoods are targeted with a community manager in charge of raising awareness about subsidies available for property-level adaptation measures. The follow-up interviews also show a clear awareness of climate justice within the Amsterdam Weerproof team, as highlighted by some of the quotes reported in the results section. In the same vein, the municipality of Amsterdam has developed a vulnerability assessment map, which identifies areas that are environmentally and socially vulnerable to climate risks, including flooding. Even though the map is only used to determine the priority for street upgrade (which happens every 35 years), it shows that the justice concerns represented in Discourse 2 are indeed present in the minds of public officials.

Lastly, the other crucial actor that is gaining relevance in flood adaptation are residents, in particular homeowners. As Wamsler et al. (2020) point out, this has a number of different causes, including the need to intervene on private land to implement climate NbS. Discourse 3 fits under this trend, with its strong emphasis on individual responsibility. As many interviewees remarked, the goal of Amsterdam Weerproof is to involve the private property in flood adaptation. It does not surprise then that a large part of the efforts of Amsterdam Weerproof are aimed at raising awareness among residents about climate risks and solutions. To support their awareness-raising efforts,

Amsterdam Weerproof makes available a series of subsidies for homeowners to install property-level measures. Research on these types of interventions shows that financial incentives can be convincing to nudge people to purchase property-level adaptation measures, but factors such as awareness of risk, social and cultural capital greatly interfere with the success of subsidies (Mees et al., 2018). Without attention to these barriers, such programs often end up serving those who are already privileged. Discourse 3 thus "naively" promotes a democratic approach to climate adaptation, without acknowledging the risks of 'Acts of commission" (Anguelovski et al., 2016), by which adaptation measures end up favouring elite enclaves and triggering climate gentrification.

When municipalities promote citizen involvement in climate adaptation without an explicit focus on climate justice, they risk treating participation as merely an efficiency tool rather than a pathway towards just adaptation. In this way, municipalities end up relying on citizens primarily for their money, time, and resources to reduce municipal costs, rather than genuinely empowering communities or addressing inequalities. This issue emerged in the follow-up interviews too, with some participants mentioning that a collective effort will be cheaper for the Municipality than to "do everything yourself" (Interviewee #8). In this context, co-production does not contribute to procedural justice, but rather shifts the responsibility for urban adaptation onto the individual.

The three discourses bring forward different approaches to (just) adaptation in Amsterdam, with three different main actors (the market, the state, the homeowners). These three divergent visions are all present within the ecosystem of Amsterdam Weerproof. For the successful implementation of the programme, especially in its goal to bring together all these different stakeholders, it is necessary to unpack the tensions between the three discourses and find potential areas of convergence.

5.2 Key Tensions Between Discourses

Two key tensions emerge between the three discourses identified in the Q-study: the role of the state (in this case, the municipality) in delivering or steering flood adaptation efforts; and the justice implications of citizen involvement.

5.2.1 The responsibility of the Municipality

> Climate change is a challenge which cannot be addressed solely by a single organization or governance institution (Archer et al., 2014, p. 346)

All three discourses agree that the Municipality of Amsterdam should raise residents' awareness about climate action (S9: 2, 1, 2). This function is crucial in a context where "water awareness in Dutch society is very low," as noted by Interviewee #4.

However, the discourses diverge significantly regarding the Municipality's responsibilities. Discourse 3 strongly rejects direct public intervention (S22: -5), while Discourse 1 only favours state involvement in developing new climate-proof neighbourhoods such as floating homes (S14: 3). In this discourse, the Municipality acts as a promotor of high-end climate-proof housing - with the risk that new climate-proof developments are often geared toward the wealthy, as previous research shows (Anguelovski et al., 2022; Hughes, 2013). In contrast, Discourse 2 assigns the Municipality broader responsibilities than merely raising awareness. It endorses what Mees et al. (2018) describe as the state's "facilitating" role, where the Municipality actively coordinates partnerships with NGOs and the private sector to promote adaptation (S30: 4). Although Amsterdam Weerproof partially meets this role by creating a network among various actors, its influence on setting priorities in terms of areas or specific risks to be addressed remains limited.

This "supportive" stance - where the Municipality does not steer or set priorities but instead limits itself to backing private initiatives - is reflected in the general approach of Amsterdam Weerproof that emerges from the post-sorting interviews shown in the previous chapter, with participants #4 and #5 both highlighting that the role of the Municipality is that of providing knowledge or network to facilitate private-led adaptation efforts. For example, in order to reduce pressure on the sewage system in case of heavy rainfall, Amsterdam Weerproof aims to incentivise the adoption of green roofs on private homes. To do so, it promotes the services of private companies such as GroenDak-Specialist ("Green roof specialist") or De Dakdokters ("Roof doctors") on its website, presenting their projects under the category of "success stories". To encourage the uptake of green roofs, rainwater harvesting system and other property-level measure, the Municipality tries to leverage what Bisaro and Hinkel (2016) refer to as "two-way interdependence" between the providers and beneficiaries of adaptation. While a "one-way" interdependence would see a certain group providing adaptation and another benefitting from it (as it is the case with large scale infrastructure measures developed by public authorities), a two-way interdependence sees providers and beneficiaries of adaptation being the same group. That is the case, and this is "advertised" very clearly in the documentation and website of Amsterdam Weerproof, of homeowners adopting property level measures. They are the providers of flood adaptation, as their capacity to retain rainwater and discharge it more slowly in the sewage system benefits the wider community; but they are also the beneficiaries, as they too

enjoy reduced flood risk, together with the aesthetic and thermal comfort provided by, for example, green roofs.

This same approach is present beyond Amsterdam Weerproof. For example, the Municipality of Amsterdam has its own Climate Adaptation Strategy, launched in 2018 with the goal of integrating adaptation measures across its own departments. It does not directly invest in adaptation infrastructure, but rather plans to create favourable policies so that other actors can contribute to adaptation efforts. A clear example is the work done in social housing estates. The Strategy limits itself to offering non-binding guidelines for social housing corporations (*Woningcorporaties*) to install NbS. This is due to the fact that social housing corporations - which are strictly regulated and not-for-profit but still have to manage their own budget - lack resources (both financial and human) to install NbS. As a consequence, the Municipality of Amsterdam finds itself in a situation common to other cities, where greening interventions on social housing estates rely on the private initiative of the housing providers or external funding (Sejdullahu et al., 2024). For instance, the recently launched EU-funded project RESILIO aims to install 10.000 m2 of green-blue roofs over social housing buildings in Amsterdam. RESILIO is funded through the Urban Innovative Action of the EU and thus bypasses the issues of limited funding available to social housing corporations for nature-based building interventions.

The Municipality faces significant challenges in promoting adaptation in social housing due to fragmented land and real estate ownership. This limitation, well-documented in urban climate governance literature, restricts its ability to implement adaptation measures (McCarney et al., 2011). Post-sorting interviews highlighted this issue repeatedly. The Municipality of Amsterdam has direct influence over only a fraction of the city's land—approximately 50% according to some interviewees. This limited control makes it difficult for local government to impose flood adaptation measures on private landowners, who operate according to their own interests and priorities rather than municipal climate objectives.

In both Amsterdam Weerproof and the City Climate Adaptation Strategy, the "state" in Amsterdam does not intervene directly in adaptation but instead fosters private initiatives and networking between private actors. Whether this is enough to address future flood risk scenarios was the object of recent research by Sharma (Sharma, 2023a, 2023b), who concluded that Amsterdam Weerproof's goal - to manage 60mm of rainfall per hour without damage to people, buildings and vital infrastructure - may be unattainable without large-scale infrastructural investments. For example, the current sewage system of Amsterdam is built to handle only 20mm, and without major upgrades, relying

solely on NbS on private land might prove insufficient (Sharma, 2023a). This conclusion however requires a further level of detail: scattered private NbS might sufficiently protect one part of the city. If the state limits itself to promoting private initiatives, and does not set guidelines when it comes to who should be prioritised in flood protection, the risk of climate injustices is looming ahead, and that is what the next section tries to unpack.

5.2.2 Justice in flood adaptation

> The politics and practice of urban climate change responses are shaped by everyday contestations over the meaning of justice. (Bulkeley et al., 2014, p. 39)

A second main point of tension between the three discourses is how justice is considered in flood adaptation, especially in relation to citizen involvement in Amsterdam Weerproof. There is strong disagreement on the statements related to justice, such as Statement 17 on the prioritisation of vulnerable neighbourhoods (-3, 5, 2) or Statement 16 on the possibility for landlords to raise rent prices after investing in property-level adaptation measures (4, -1, 1). The rankings of statements of the three discourses highlight that not all actors in the network share the same justice concerns or are aware of the equity implications of Amsterdam Weerproof.

This may stem from a limited understanding of differing vulnerabilities, overlooking the fact that natural disasters represent an "uneven apocalypse" (Swyngedouw & Kaika, 2014, p. 472). The phenomenon is known in the literature as the "Bordiga fallacy", from the name of the founder of the Italian communist party who stated that climate change would impact everyone equally - rich or poor (Swyngedouw, 2015). Empirical research has demonstrated that the highest share of loss and damage, including death toll, from climate disasters occurs in low-income groups (Hughes, 2013). For instance, in the aftermath of Superstorm Sandy, Faber (Faber, 2015) demonstrates that the poverty rate in flooded neighbourhoods in New York City was 20% higher than not impacted areas.

In addition, it is also widely recognized that the dynamics of urban climate injustice are not well understood by the general public (Hügel & Davies, 2020; Juhola et al., 2022). For instance, discourses 1 and 3 show little concern for the risks of climate gentrification linked to offering subsidies to homeowners for installing climate NbS. Research has highlighted the justice implications of such fragmented interventions if applied without coordination or prioritisation of low-income groups (Connelly et al., 2020), which can potentially lead to homeowners using public subsidies for

adaptation to raise the value of their rented property (Dai et al., 2018; Planas-Carbonell et al., 2023).

Discourse two does emphasise distributive justice, with high scores for statements such as 17 and 18. Distributive justice concerns were clearly expressed in some of the post-sorting interviews, with quotes bringing forward issues such as home ownership, income and awareness in determining the uptake of flood adaptation initiatives. In contrast, proponents of discourse 3 emphasise citizen engagement in decision-making (S25: 3) - an aspect of procedural justice. This is not a priority in discourse 2 and is opposed by discourse 1, which favours technical expertise over residents' knowledge (S1: 2). While discourse 2 raises concerns about the inclusivity of engagement - such as barriers to participation for groups like tenants and low-income households (S19: 2) - discourses 1 and 3 do not share these concerns. This links to what Turnhout et al. (2020) call "power blindness" regarding citizen engagement, which is typically depoliticized and seen as a neutral tool to legitimise decisions. It is in this direction that Amsterdam Weerproof goes, explicitly framing adaptation as "you can do it yourself".

5.2.3 Bridging justice and responsibility

The two tensions outlined above are deeply interconnected. The justice implications of co-production are closely tied to the state's role in actively steering citizen involvement and setting priorities. Currently, in almost the totality of its actions, Amsterdam Weerproof operates under a "facilitative" model (Dai et al., 2018), where it limits itself to facilitating private initiatives without defining specific justice targets or directions for adaptation. This is evident, for instance, in the subsidies for property-level greening: they are not linked to income or geographic vulnerability, and their relevant documentation is only available in Dutch, which can lead to both Acts of Commission and Omission, as outlined above.

The only exception is Amsterdam Weerproof's neighbourhood approach initiative, which shows a parallel commitment to reaching marginalised communities - though with minimal resources and limited success. This internal contradiction reflects the tensions within the program's competing discourses. Amsterdam Weerproof appears caught between two conflicting objectives. On one hand, relying on private capital and individual initiative due to public funding constraints and limited authority over private land. For example, all three discourses agree that citizen involvement in co-implementing flood adaptation interventions is crucial.

On the other hand, there is the need and ambition to pursue climate justice and make sure

that adaptation efforts in Amsterdam target vulnerable groups and leave no one behind. Municipal intervention becomes necessary to strategically address social inequalities, and this is clearly acknowledged in some of the interviews. These contradictory goals create a precarious balancing act within the programme.

This contradiction can be interpreted through Bulkeley et al.'s (2014) pyramid framework, which brings into conversation the traditional three dimensions of justice with the concepts of "rights" and "responsibilities". The framework helps explain how Amsterdam Weerproof's approach to co-production is simultaneously redefining responsibilities for flood adaptation while inadvertently reshaping rights to protection from climate risks. As the municipality shifts responsibility for adaptation onto residents and private actors, it implicitly creates a system where the right to flood protection becomes dependent on one's own capacity to participate in adaptation initiatives.

The role of Amsterdam Weerproof repositions the municipality's responsibility from direct adaptation provision to network coordination. This redistribution of responsibilities, however, occurs without explicit consideration of recognition, the base of Bulkeley's pyramid, which would require acknowledging the different capacities, resources, and vulnerabilities of various stakeholders. This redistribution of responsibilities without adequate recognition has direct implications for distributive justice. When flood adaptation becomes framed as something 'you can do yourself,' as in Amsterdam Weerproof's approach, the distribution of adaptation benefits inevitably reinforces existing inequalities.

The procedural dimension of climate justice is also related to this tension. While Amsterdam Weerproof emphasizes citizen involvement (reflected particularly in Discourse 3), the nature of citizens' actions are primarily instrumental, focused on implementation rather than inclusion in decision-making. This limits residents' capacity to influence how responsibilities are distributed in the first place. As Bulkeley et al. (2014) note, determining who has responsibility for fulfilling adaptation is "highly contested" (p. 32), yet this contestation is largely absent from Amsterdam Weerproof's approach.

The contradiction within Amsterdam Weerproof, between its reliance on private initiative and its aspirations for climate justice, exemplifies what Anguelovski et al. (2022) identify as a common tension in urban climate governance: municipalities increasingly recognize the justice dimensions of climate adaptation while simultaneously adopting governance approaches that limit their capacity to address inequalities. This tension is particularly acute in contexts like Amsterdam, where fragmented land ownership constraints direct municipal intervention.

A more comprehensive application of Bulkeley's pyramid would suggest that Amsterdam Weerproof needs to explicitly address recognition as the foundation for redistributing responsibilities. This would mean acknowledging differential capacities among stakeholders before assigning them co-production roles in adaptation, and explicitly considering how rights to protection from flood risks are being reshaped through this redistribution of responsibilities. Without this attention to recognition, co-production risks becoming what Turnhout et al. (2020) describe as a mechanism that legitimizes the withdrawal of state responsibility while maintaining an appearance of inclusive governance.

Bulkeley et al.'s pyramid thus helps bridging justice and responsibility in the case of co-production of flood adaptation actions in Amsterdam. It suggests that while co-production may be necessary given public funding constraints and private land ownership, it requires explicit attention to how responsibilities are distributed in relation to the recognition of each stakeholder's vulnerability and capacity.

5.3 Navigating Conflicts: Insights from the Consensus Statements

The tensions outlined above present significant governance challenges for Amsterdam Weerproof. However, the Q-methodology study reveals important areas of consensus across the three competing discourses that offer potential pathways for reconciling these tensions. In particular, three points of consensus emerge:

First of all, urgency. All three discourses agree on the urgency of climate action (S24: -2, -4, -2). This shared recognition of the need to act now can serve as a unifying factor. Research has shown that a stronger sense of urgency can prompt firmer climate action, and that in scenarios where climate impacts are perceived as closer, stakeholders may be prone to set aside their concerns and collaborate for the common good (Orlove et al., 2020). That the three discourses converge over urgency can be a starting point to promote joint adaptation efforts.

Second, nature-based adaptation. The discourses align on the importance of green infrastructure (S28: 5, 3, 5). As interviewee #5 observes, "People like greening more than climate adaptation because of the environmental quality." This is in line with literature suggesting that greening can be a catalyst for climate action due to its widely accepted qualities (Dai et al., 2018; Runhaar et

al., 2012). This convergence means that different actors can be brought together over support for greening interventions. For example, green roofs may represent both a rain buffer and a way to make social housing estates more aesthetically pleasing. Emerging concepts such as multispecies justice (Chao et al., 2022) can also be important to generate consensus around climate adaptation interventions that benefit biodiversity and ecological connectivity.

Lastly, voluntary action over mandates. The three discourses favour voluntary involvement. Statements supporting mandatory measures received little endorsement. This is also reflected in interviewee #6's remark: "Residents should also be part of the action. And that's fine, but only when they want to". While Amsterdam recently adopted a mandatory rainwater harvesting ordinance, it applies only to new developments above a certain size. Literature on co-production shows that it is easier for local governments to kickstart climate adaptation by relying on the voluntary actions of "active citizens" (Buijs et al., 2019; Mees et al., 2016). Starting from this premise, it may be more conducive to leverage on existing initiatives rather than forcing residents or businesses to take action.

These three areas of consensus suggest that Amsterdam Weerproof could effectively bridge its internal contradictions, not by abandoning its facilitative approach between private actors entirely, but by strategically leveraging common priorities to create a more justice-oriented facilitation model - one that maintains the benefits of citizen involvement while introducing stronger municipal intervention toward just adaptation. One way to build on these three areas of consensus would be for Amsterdam Weerproof to insist on climate literacy. Raising awareness on the urgency of climate action and the benefits of green infrastructure could lead to more widespread and committed voluntary engagement on behalf of residents, businesses, and neighbourhood groups.

5.4 The three discourses as subjectivities

The three discourses identified in this research provide insights into the study of "deep leverage points" that shape adaptation. As Meadows (1999) argues, paradigms and narratives represent the most profound intervention points in a system, containing the "unstated assumptions" that guide our actions. The divergent perspectives on responsibility and justice revealed through this Q-methodology study demonstrate how these underlying discourses influence adaptation approaches, responding directly to the research gap identified by Wamsler et al. (2020) regarding the role of "subjectivities" in climate adaptation.

Each discourse represents a distinct narrative about how flood adaptation should unfold in Amsterdam. These competing narratives do not simply reflect different policy preferences: they embed fundamentally different perspectives about the relationship between citizens, the state, and climate risk. Particularly noteworthy is how present the "Bordiga fallacy" - the idea that climate change will impact every social group equally (Swyngedouw, 2015) - appears within Discourses 1 and 3, indicating a limited understanding of differential vulnerability to climate impacts. This perspective is not merely a knowledge gap but represents a paradigmatic belief — an unstated assumption that adaptation is primarily about technical solutions rather than addressing social inequalities. The persistence of such narratives within the network helps explain why Amsterdam Weerproof's approach to justice remains inconsistent despite explicit equity goals in some of its actions (such as the neighbourhood approach).

The tension between actors' responsibilities, particularly the Municipality, and co-production highlighted earlier can also be understood as competing discourses about who bears the main responsibility for adaptation. Discourse 3's strong rejection of state intervention (S22: -5) reflects a paradigmatic belief in individual agency that shapes how stakeholders approach their roles within the network. Similarly, Discourse 2's emphasis on state coordination (S30: 4) stems from a fundamentally different narrative about collective responsibility. These narratives are precisely what Wamsler et al. (2020) refer to when arguing that "subjectivities are as important as power structures when managing climate adaptation" (p. 248).

5.5 Strengths, limitations and further research directions

The Q-Methodology study allowed for uncovering and defining these discourses. What made it an ideal technique for this research is that it broadened the analysis from the opinion of the individuals to the discourses shared by subsets of the sample. Choosing Q-Methodology as the main method for data collection and analysis helped answering both research questions. The method is gaining popularity and certainly holds great potential, especially in bringing to the fore the underlying narratives about controversial issues, such as justice and responsibility in climate adaptation.

This method, however, came with limitations. First of all, the development of the set of statements, while grounded in existing literature, review of policy documents and one exploratory interview, is inevitably influenced by the author's personal biases and expectations, which would have been less evident if more traditional methods such as interviews or surveys were chosen instead.

Second, while the Q-method was provided in Dutch and English, language barriers might have reduced the willingness of participants to the Q exercise to take part in follow-up interviews, which were conducted in English. Third, the methodological choice allowed to target official stakeholders, while leaving out other relevant actors such as homeowners or representatives of social housing associations.

Further research is needed in three main directions. First, it is necessary to focus closer on residents' perceptions about co-production in climate adaptation. Citizen involvement programmes such as Amsterdam Weerproof leverage strongly on residents' action. Residents are asked to and supported in installing property-level measures, and the way they understand their own role in adaptation definitely deserves scrutiny. This was considered in the first stages of this research, but it could not be further pursued due to language and access barriers. Second, research should provide empirical evidence on the distribution of adaptation interventions within co-production programs, to detect patterns of inequality in, for example, the different presence of property-level measures across neighbourhoods. Finally, a comparative approach, where climate adaptation networks in different cities are compared, would be conducive to unveil not only general trends but also best practices in the promotion of justice in co-production.

6 Conclusion

Rope left on a boat at Marineterrein.

This thesis explores the justice implications of co-production in flood adaptation. In particular, it focuses on the role that discourses play in the justice outcomes of an ambitious programme such as Amsterdam Weerproof. The three discourses that emerge through the Q-Methodology study provide insights into the first research question, *What are the main narratives around climate justice and responsibility among different actors involved in Amsterdam Weerproof?* Three divergent visions of what adaptation should look like in Amsterdam emerged: 1) private-led, market-driven; 2) community-led, justice-driven; and 3) individual-led, participation-driven.

Looking at how the three discourses diverge and converge helps finding an answer to the second research question, *What are the main tensions and possible areas of consensus among the different discourses?* The analysis of dissensus and consensus statements, together with the contextual elements offered by the follow-up interviews, help answer this second question. Within the co-production framework, the main nodes of tension are a) the role of the Municipality of Amsterdam and b) considerations of climate justice. Alongside these tensions, the consensus statements reveal possible areas of convergence, namely a shared sense of urgency, a shared appreciation for nature-based climate interventions and a focus on voluntary actions rather than mandatory regulation schemes.

An increasing number of cities are adopting co-production approaches similar to Amsterdam Weerproof (some of them directly inspired by its predecessor, Amsterdam Rainproof, such as the "Rainproof New York" programme). The findings from this research bring valuable insights for those cities trying to juggle citizen involvement and just adaptation. First, different stakeholders involved in co-production may come to the programme with their own set of beliefs, and, as shown, these translate into them supporting contrasting policies. For a climate adaptation network to maintain a coherent line of work, clear priorities need to be spelled out and agreed upon. If, for example, the prioritisation of vulnerable groups is left to the discretion of the single projects, the overall efforts of the programme will look more like a patchwork and less like a cohesive plan to address climate risks. One concrete way to address this challenge, for the case of Amsterdam Weerproof, would be to adopt a map of vulnerability to flooding, which would include socio-economic and environmental indicators, and explicitly direct subsidies only to those areas that need it the most. Second, despite mounting scientific evidence on both the uneven exposure to climate impacts and risks of climate gentrification, justice is yet to be mainstreamed into climate policy documents and the minds of the actors involved in co-production. This is relevant for those municipalities trying to promote climate justice - such as, to a certain extent, the Municipality of Amsterdam - that might face backlash or communication barriers when involving other stakeholders in promoting (just) co-

production. Finally, the identification of tensions and areas of consensus is relevant beyond the case of Amsterdam as other cities trying to kickstart climate adaptation networks (such as Boston or Brussels) may face the same roadblocks: tensions on the role of the state and considerations of justice. The focus on urgency, green infrastructure and voluntary actions could serve as entry points to navigate conflicts.

In addition to these policy implications, this work contributes to field of urban political ecology and climate adaptation by applying a climate justice lens to co-production. It brings together two strands of literature, one on citizen involvement, and the other on climate justice, and shows in a concrete case study how novel forms of adaptation governance need a critical lens to understand whose voices and whose interests are being prioritised in co-production. With co-production of climate adaptation growing more and more widespread, a political ecology approach that dissects citizen involvement in its potential for inclusion and efficacy and its risks of exclusion and injustice becomes essential. This thesis shows how adaptation governance and climate justice research should go hand in hand. Moreover, this study addresses the methodological gap identified in the literature review by moving beyond policy analysis to examine how stakeholders themselves understand justice and responsibility in climate adaptation. While studies have developed useful typologies of co-production, they have typically focused on institutional arrangements rather than the subjective dimensions that animate these structures. This research moved beyond studying the outcomes of co-production programmes to the underlying discourses that shape them. Because only by understanding these discourses can cities realise the potential of co-production to deliver just and transformative adaptation.

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Appendix

A Sample Description

#	Organisation	Type
1	Municipality of Amsterdam - Climate adaptation strategy	Public
2	Municipality of Amsterdam - Climate adaptation strategy	
3	Municipality of Amsterdam - Land and Development Office	
4	Municipality of Amsterdam - Space and Sustainability Office	
5	Waternet - Amsterdam Weerproof team	
6	Waternet - Amsterdam Weerproof team	
7	Waternet - Amsterdam Weerproof team	
8	Waternet - Amsterdam Weerproof team	
9	Waternet - Amsterdam Weerproof team	
10	Waternet - Strategy and Development Department	
11	Natuurhub (greening and biodiversity)	NGOs/Neighborhood groups
12	De Gezonde Stad (greening and biodiversity)	
13	De Gezonde Stad (greening and biodiversity)	
14	Buurtgroen 020 (community engagement, greening)	
15	Natuur & Milieuteam (community engagement, greening)	
16	Jungle Amsterdam (Community gardens, greening)	
17	Justnimbus (Rainwater harvesting)	Private sector
18	Upperbloom (Design of green spaces)	
19	Green business club (Network of organisation, sustainability)	
20	Het Natuur Talent (Biodiversity, design of green spaces)	
21	The knowledge mile (Network of organisation, sustainability)	
22	Groen dak specialist (Green roofs)	
23	Dakdokters (Green roofs)	
24	De groene grachten (Greening, canals cleanups)	

B Interviewees Affiliations

	Organisation
Interviewee #1	Municipality of Amsterdam - Climate Adaptation Strategy
Interviewee #2	Municipality of Amsterdam - Climate Adaptation Strategy
Interviewee #3	Waternet - Strategy and Development Department
Interviewee #4	Waternet - Amsterdam Weerproof Team
Interviewee #5	Waternet - Amsterdam Weerproof Team
Interviewee #6	Natuurhub
Interviewee #7	De Gezonde Stad
Interviewee #8	Groen dak specialist

C Unrotated Factor Matrix

Participant #	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6	Factor 7	Factor 8
1	0.2634	0.2217	0.2288	0.5958	0.2629	0.2595	0.3356	0.3634
2	0.6072	0.231	0.2158	0.3078	-0.1967	-0.3504	0.3708	-0.2365
3	-0.274	-0.5433	0.4309	0.0414	-0.3483	0.1236	0.3612	0.0805
4	0.5127	0.3895	0.24	0.5067	0.012	-0.153	-0.2201	0.2746
5	0.0745	0.6375	0.1368	-0.4218	0.307	-0.247	0.2128	0.021
6	0.6711	0.2405	-0.3636	-0.3649	-0.1622	0.1154	0.2462	0.1113
7	0.7088	-0.5142	-0.2669	-0.1624	-0.1326	0.1338	0.0495	0.1249
8	0.762	0.1687	-0.4066	0.1005	-0.2263	0.1124	0.0533	0.1252
9	0.4215	0.6217	-0.0166	-0.262	-0.3843	0.2523	-0.0865	0.1738
10	0.1485	0.7934	0.1022	-0.1099	-0.3458	0.1259	-0.0719	-0.066
11	0.7126	-0.4355	0.1878	-0.0385	-0.0432	-0.2185	-0.0189	-0.2138
12	0.7018	-0.3684	0.01	0.2382	-0.0868	0.1735	-0.121	-0.2935
13	0.8048	-0.0878	0.2274	0.1696	-0.1917	-0.1498	-0.2709	0.08
14	0.0231	0.3574	0.7626	-0.3225	0.0296	-0.0291	-0.0458	0.1165
15	0.3338	0.1818	-0.7292	0.2185	0.318	-0.1652	-0.0344	-0.0352
16	0.427	-0.5414	-0.3783	-0.2675	0.2793	-0.0302	0.0192	0.2879
17	0.8277	-0.2114	0.0378	-0.0556	-0.0857	-0.1655	-0.2229	0.0407
18	0.5861	0.3809	0.2584	-0.0344	0.3869	0.2129	0.0963	-0.2244
19	0.5273	0.0282	0.485	-0.2092	0.3486	0.2194	-0.2578	0.0076
20	0.3436	-0.7838	0.305	0.0673	0.0456	0.0493	0.1005	0.0054
21	0.5629	-0.4604	0.2482	-0.2324	0.1025	-0.2753	0.0949	0.2081
22	0.5369	-0.3892	-0.0026	-0.0572	0.148	0.4397	0.0754	-0.2322
23	0.3477	0.8294	-0.0598	0.1809	0.1211	0.1029	0.0009	-0.0707
24	0.6988	0.4117	-0.0988	-0.1807	-0.0004	-0.1746	0.2071	-0.1292