Considerations of vulnerable groups in the context of green infrastructures

Exploring the position of vulnerable groups in green plans from Dutch municipalities.

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Master's Thesis for the Environment and Society Studies programme

Nijmegen School of Management

Radboud University

July 2021

Colophon

This document is a Master Thesis for the completion of the Master Environment and Society Studies at Radboud University, Nijmegen, The Netherlands.

Title:	**Considerations of vulnerable groups in the context of green infrastructures**
Version:	Final version
Date:	30-07-2021
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Executive summary

Climate change is of high concern for human rights, public health and socio-economic justice because of its disparate impacts and the disproportionate effects on vulnerable and socially marginalized populations. It is more difficult for vulnerable group to anticipate, cope with, resist and recover from the impacts of extreme weather events. Green infrastructures have the ability to have positive effects on climate change and the liveability of a neighbourhoods. The most important point is that the people who benefit most from green infrastructure often live in the neighbourhoods with the least green space, in terms of distribution. It is in these neighbourhoods that green infrastructure can make a difference.

This research explores two case studies in the municipality of Rotterdam and Groningen to investigate the implementation of green infrastructures. The municipalities are working with green plans to guide this process. To research to what extent the vulnerable groups are taken into account in these decision-making processes the following research questions is formulated to guide this research:

> **How can the decision-making process of implementing green infrastructure in the city be improved to develop more equitable outcomes to increase the public health and climate adaptation including the vulnerable groups in the Dutch municipalities of Rotterdam and Groningen?**

To be able to answer the research question, 3 in-depth interviews with two municipalities and document analysis of green plan from Dutch municipalities were conducted. This research shows that on the basis of the theory of environmental justice, it appears that it is not enough to look only at the distributive justice. It is necessary to look at recognitional and procedural justice as well. The interviews were used as an analysis to see to what extent these three dimensions are taking place in the municipalities' processes of implementing green infrastructure. Distributional justice requires that the distribution be fair among different groups, across space and in both the short and long term. Recognitional justice refers to the recognition of existing governance arrangements and the different rights, worldviews, knowledge systems, cultures and needs of different groups when making decisions. The last dimension, procedural justice, refers to the quality of the governance processes through the degree of participation and inclusiveness of decision-making.

For distributional justice, it appears that the distribution of certain functions such as green space is important. The municipality of Groningen has already carried out several studies of distribution that form the basis for the green plan and the implementation of green infrastructure. The Municipality of Rotterdam has started this process and is still in the early stages. Recognitional justice for both municipalities does not go much further than stating that the young and the elderly are the target group, because they are more sensitive to climate changes such as heat stress. Procedural justice, on the other hand, is a process that is increasingly becoming self-evident. In the Netherlands, participation is seen as important, as is the case for both municipalities that play an active role here. Although in Groningen it mainly plays a role in the initial process of the green plan, the municipality of Rotterdam also provides guidance in participation projects at a later stage.

It turns out that the extent to which these three dimensions are achieved differs from municipality to municipality, this has several underlying reasons. An important point here is that how the initial process of decision-making is set up has a great effect on the outcomes. For the municipalities, it is therefore important to look at these decision-making processes in order to improve them and work towards more equitable outcomes. This research formulates a number of recommendations to be able to achieve this.

The recommendation consists of involving the vulnerable groups more. It is necessary to further elaborate on these groups and to look at them per neighbourhood or district. This information must then also be used in the choice of locations to start implementing green infrastructures. In addition, the various studies can be expanded so that all knowledge about the city can be linked together. For this, it is also important to cooperate with different policy areas, here the social domain is an important policy area to include, because all policy areas have different knowledge about the city and its residents. To be able to achieve this, the term green infrastructures should be further developed, at the moment this term does not appear in the green plans but green infrastructures can work as a system and tool that encompasses all these recommendations, because green infrastructures include different themes such as climate, health and biodiversity and has many positive effects on the vulnerable groups. Hereby this research adds to the theory of environmental justice and shows that it is useful to include more dimensions than only the distributional justice. To be able the give a broader picture of environmental justice in the Netherlands it is necessary to further research municipalities that are not included in this study.

Preface

This master thesis is the final assignment for the Master's Programme Environment and Society Studies at Radboud University. Looking back, the Master has been an incredibly valuable addition to my Bachelor's Degree.

During my studies, I developed an interest in improving the living environment, a process in which many aspects must be taken into account, such as the residents and the consequences of climate change. I aim to give as much attention as possible to all groups in society by looking at the different outcomes of climate adaptive measures between different groups. I especially consider the importance of green as a measure for climate resilience, improving the health of residents and increasing biodiversity. I decided to dedicate my graduation research to this subject. Over the past five months, I have studied the extent to which vulnerable groups are included in the decision-making process of green infrastructure in Dutch municipalities and how this can be improved.

Firstly, I would like to thank my thesis supervisor Friederike Landau for her guidance and support in the process of writing this thesis.

Additionally, I want to thanks my family and friends for their support throughout the last months.

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Chapter 1 Introduction Green Infrastructure

Europe is a relatively densely populated continent where the land is in active use. As a result, natural areas are under pressure and are at risk of becoming fragmented. This affects the working of ecosystems (European Union, 2010). According to the European Union habitat fragmentation can happen as a result of changes in land use, including urbanization, transport infrastructures and intensification of agriculture or forestry. Recent statistics from the European Environment Agency show that these trends are significant. In the 1990s, about 8,000 km2 were concreted over, this is a 5% increase of artificial areas in 10 years. Between 1990 and 2003, 15,000 km of highways were built in the European Union (European Union, 2010). Consequently, half of the world's population currently lives in cities (Brzoska & Spaáe, 2020).

Cities have several types of green infrastructure at their disposal, such as parks and gardens. These green infrastructures can contribute to the conservation of ecosystem services, have a great impact on human well-being and are central to tackling climate change and providing protection from flooding and other negative impacts of changing weather patterns (European Union, 2010). The European Union uses the follow description of green infrastructure: "Green infrastructure is a strategically planned network of natural and semi-natural areas with other environmental features designed and managed to deliver a wide range of ecosystem services such as water purification, air quality, space for recreation and climate mitigation and adaptation" (European Commission, 2013, p.2). In Europe, the concept green infrastructures have been linked to multifunctionality, climate change and green growth, especially in the last decades, which has led to a research and policy agenda (Chatzimentor et al., 2020). Green infrastructures can thus be seen as part of the transformation towards sustainable cities.

The rising of the world's population is an important element of the urbanization and densification of cities. The Netherlands is also expected to densify further. According to prognoses the national government foresees a need for 700.000 new dwellings by the year 2025 (Ministry of Internal Affairs, 2018). It is also decided that these new dwellings should be realized within the existing urban context. Urbanisation and densification results in less space for greenspace in urban areas, this especially takes place in deprived neighbourhoods (De Vries et al., 2020). According to the Dutch National Institute for Public Health and the Environment (RIVM) (2019) the benefits of green infrastructure are the greatest in neighbourhoods where there is little green space and where many people live. In addition to urbanization and densification, there is also an increase and frequency of extreme weather events. Climate change in this sense is a threat and challenge to the public health and well-being (American Public Health Association, n.d.).

Social and environmental injustice are related in today's discussion of natural disasters and ecological challenges. Injustice relates to the unequal distribution of costs and benefits between different groups and to the fact that the group that has to bear the problems is often not the group that has caused the ecological problems (de Keyzer & Soens, 2012). Social injustice takes place when communities exposed to poor environmental quality and social inequities experience more negative effects than other groups. Exposure of vulnerable groups to extreme weather events shows the relationship between social injustice and environmental injustice. Today, COVID-19 exposes even more how social injustice disproportionately affects the health and well-being of citizens (Aschner et al. 2021). There are several examples of groups and communities that are disproportionately affected by the impacts of climate change (United Nations Framework Convention on Climate Change (UNFCCC), 2018). Older and younger people and people in poor health tend to be more sensitive to the climate impacts like floods and heatwaves (Climate Just, 2017).

The specific groups that are vulnerable differ from country to country, for most countries it is likely that they are aware of the vulnerable groups in that country through existing data and policies. Countries could therefore consider such known vulnerable groups and integrate considerations in the decision-making process (UNFCCC, 2018).

This study will examine whether green infrastructure is being implemented in the right places in the city to achieve the most benefits for climate adaptation and public health and well-being, with a focus on the vulnerable groups in society, i.e. neighbourhoods with low socio-economic status, children, elderly and groups most affected by the changing weather patterns (European Institute for Gender Equality, 2021). To investigate this, two case studies were chosen in Dutch municipalities, Rotterdam and Groningen, both cases are aimed at adding green space in the neighbourhoods of cities, with an emphasis on climate adaptation and health. The case studies will shed light on the decision-making process and the extent to which vulnerable groups are included in this process.

1.2 Research aim and research question

The aim of this study is to assess the state of policy and practice for developing socially just adaptation responses to climate change in urban areas by looking at the decision-making processes for green infrastructures of two Dutch municipalities, Rotterdam and Groningen. This results into the following research question and sub questions:

"How can the decision-making process of implementing green infrastructure in the city be improved to develop more equitable outcomes to increase the public health and climate adaptation including the vulnerable groups in the Dutch municipalities of Rotterdam and Groningen?"

1. How can green infrastructures contribute to improving climate adaptation and public health and well-being focused on the vulnerable groups in urban areas?
2. To what extent are vulnerable groups taken into account in the decision-making process of implementing green infrastructures based on procedural, recognition and distributional dimensions in the Dutch municipalities of Rotterdam and Groningen?
3. How can the use of green infrastructure be improved to achieve more equitable outcomes?

1.3 Scientific and societal relevance

1.3.1 Scientific relevance

In this research the focus will be on environmental justice regarding urban green infrastructures due to several factors. Firstly, because of the urbanisation and densification of cities, which is also happening in the Netherlands, it is expected that this will continue to happen in the Netherlands. At the same time, attention is paid to sustainable cities with safe, inclusive and accessible green spaces in the UN Sustainable Development Goals (SDGs), which state that efforts must be made to 'make cities and human settlements inclusive, safe, resilient and sustainable' (goal 11.7) (United Nations, 2015). This goal coincides with the increasing evidence that green spaces can have a positive effect on people's health and well-being. According to De Vries et al. (2020), this effect is even stronger for people with a low socio-economic status and/or who live in disadvantaged neighbourhoods.

A transformation is needed to work towards sustainable cities, but it needs to be a just one. Social justice has barely been part of the theory of transformations, this has been mainly confined to the transition literature (Bennett et al., 2019). In the transformation literature, little emphasis has been placed on the

social impacts of the changes or on the degree of involvement of stakeholders in the decision-making process (Van den Bergh et al., 2011). As Bennett et al. (2019) also emphasise, it is known that social transformations are shaped by the distribution of wealth, opportunity and privilege. Recently, more attention has been paid to justice in the transformation towards sustainability (Patterson et al., 2018; Temper et al., 2018; Ellis & Tschakert, 2018). There is a need for greater attention to and understanding of social justice in the transformation taking place in urban areas. Social justice is seen as a perspective that can create a number of potential risks in the transformation. such as a lack of recognition of pre-existing rights, needs and livelihoods of stakeholders or the exclusionary decision-making process that fails to include local people. What can help in this guidance is the literature of environmental justice (Bennett et al. 2019). This literature is lacking of exploration of industrialized nations other than the United States (Coenen & Halfacre, 1999). By analysing municipalities in the Netherlands, the research can deepen the scope of the literature and can provide additional information about problems and solutions relating environmental justice. At the first the literature was mainly focused on critiques of the inequitable distribution of the effects of climate change but now also has been used to guide sustainability and the climate adaptation decisions in urban areas. This resulted in a growing number of studies on reflecting social vulnerabilities to climate change. An example of this is the study by Wilson et al. (2010) using geographic information system (GIS) analysis, which found that areas in the US are likely to be disproportionately vulnerable to climate change due to the concentration of disadvantaged populations and environmental risks. Another example is reported by Harlan et al. (2006) where neighbourhoods in Phoenix with the highest temperatures were the most socioeconomically disadvantaged. Inequalities in heat exposure have direct consequences on human health and well-being (Grineski et al., 2012).

In the study by De Vries et al. (2020) they showed that in The Netherlands, neighbourhoods with a lower socioeconomic status tend to have a lower presence and quality of green space than those with a higher socioeconomic status. Studies about environmental justice are mostly not focused on the Netherlands but an unfair distribution of the effects of climate change is also visible in the Netherlands, which shows that it is useful to research this further. This research wants to fill this gap by making the connection between environmental justice and climate change for the Netherlands with the focus on green infrastructures. Green infrastructures are used by municipalities in their plans to work towards a sustainable future. Green infrastructure can be seen as a broad term encompassing several aspects and types. According to Nieuwenhuijsen (2020) this can explained by a lack of studies and by the different types of green infrastructure. The definition is given by the European Commission, among others, but the term is hardly used in plans and policy documents of the government and municipalities in the Netherlands. The definition is not consistent and may have conflicting principles (Institute for Nature and Forest Research, n.d.). This research wants to fill this gap to give more structure to the definition of green infrastructures and the decision-making process for the greening plans. Green adds most value in places with little to no green space and where many people live (RIVM, 2019).

This research wants to fill both gaps, the first gap about how environmental justice takes place in the Netherlands and the second gap on how green infrastructures play a role in this, in order to contribute to the theorisation of environmental justice.

1.3.2 Social relevance

In studies of environment-society relationships, it has been illustrated that it is possible to look beyond one's own discipline, which can lead not only to solutions for real problems but also to progress in the discipline itself (Freudenburg, 2006). Whereby green infrastructure belongs to different disciplines such

as climate change, public health and well-being and social justice. In addition, green infrastructures can ensure that different disciplines can be seen together and can provide better and integrated solutions. Green infrastructure has an ecological, social and economic value, through the use of multifunctional natural capital. According to Science for Environmental Policy (2012) the multifunctionality of green infrastructures can be a very valuable policy tool and contribute to the fulfilment of policy objectives of various stakeholder groups. Green infrastructures can be created in different places, both natural and semi-natural, in urban, rural and marine areas (Chatzimenter et al., 2020).

Biodiversity is the focal point of green infrastructures but the tool is much broader than just the preservation of biodiversity (Science for Environmental Policy, 2012). Green infrastructures are a useful opportunity for study, especially if they also take into account the inequalities that exist in cities. There are several studies of the impact of green infrastructure on climate and health from the United Kingdom and the United States, but studies focused on the Netherlands is still lagging. The current situation in the Netherlands is that the term green infrastructure is not used that often in the projects and plans by the municipalities. Even though the projects still could consist of different types of green infrastructure. This research can be a valuable way to see what the current situation is of green infrastructure in the Netherlands and to what related issues it is linked. Green infrastructures are an important part of public open spaces and can promote public-health for all members of society. It needs to be ensured that the green infrastructures are easily accessible for all population groups and distributed equitable in the urban area (World Health Organization, 2017). The problem of urbanization and density increase in cities is mostly visible in the urban areas and is therefore an important area too research.

By researching this topic, it becomes clearer in what way injustice is taking place in the Netherlands in the decision-making processes from Dutch municipalities. Only through understanding what happens in these processes will it be possible to work towards a more just society. The more equitable way of working not only contributes to justice, but also ensures that more positive effects can be derived from the green infrastructure, which contributes more to a better health and well-being of the residents and to climate adaptation.

Chapter 2 Theoretical Framework

2.1 The European Green Infrastructure Strategy

The European Parliament decided in 2013 that there was an urgent need to integrate green infrastructure into European sectoral policies. The European Commission launched the strategy: Green Infrastructure (GI) - Enhancing Europe's Natural Capital (European Commission, 2013). The European Commission considers green infrastructure as a strategy to connect rural and urban areas by creating a network of natural and semi-natural areas that provide a wide range of ecosystem services (Schneiders et al., 2016). The European Commission uses green infrastructures in their communication and strategies, but the definition of green infrastructures is very broad and includes many different examples. Consequently, the European Commission explains further the aspects of green infrastructures and shows what is crucial to understand green infrastructure. These aspects are that green infrastructure can generate ecosystem services, it is a toolbox for natural elements to work on important issues in society, various scales should consist of ecological networks, it is a well-thought-out design requiring planning and it is based on collaboration between (European Commission, 2013).

2.1.1 Green policy plans of municipalities

Municipalities in the Netherlands work with sectoral policy plans, which lay the foundations for management and maintenance for a longer period. In the case of green plans, investments in green and blue networks are worked out in detail for the municipality. The importance of green space is great because it contributes to various policy areas and can provide an answer to urgent societal issues (Atlas Natural Capital, n.d.). The Atlas of Natural Capital (ANK) platform, which is under the responsibility of the Ministry of Infrastructure and Water Management in The Netherlands, provides information on natural capital and ecosystem services. The platform puts forward three important fields of work that together can contribute to a stronger green policy by recognizing the importance of green. The first field is climate adaptation. This concerns the water and heat management in the city, which means that cities must adapt to and take more action against heavy rainfall, heat waves and dry periods. Green roofs and walls can contribute to a better living environment (Atlas Natural Capital, n.d.). The second field of work is health and well-being; living in a green environment contributes to the health and well-being of the residents. The third field of work is urban development; in project developments, green space is always a component, but no context is given to the qualitative aspects of green space. In sustainable development, green space and water are put forward as important for climate adaptation and for public health and well-being (Atlas Natural Capital, n.d.). This shows that these three fields of work are all related to green planning and that these fields of work are thus intertwined.

2.2 Green infrastructures in the urban areas

2.2.1 Value of green infrastructures to climate adaptation

Green infrastructure reacts to weather patterns as well as other components of climate change. According to the Environmental Protection Agency (2020) green infrastructure can contribute to climate resilience in the areas of managing floods, preparing for drought, reducing urban heat island, lower building energy demands, spending less energy and managing water. This is possible because green infrastructure can improve water quality and quantity, air quality, climate resilience, habitat and wildlife and communities. For the communities it can contribute to more green jobs, health benefits and recreation space (Environmental Protection Agency (EPA), 2016). Types of green infrastructure can be green roofs or green walls which has mostly effect on urban flooding, indoor temperatures and heat

islands. Larger green infrastructure, such as parks, community gardens or other natural landscapes has more effect on reducing temperatures, air pollution and social effects on crimes and violence. Urban trees can also be seen as part of a green infrastructure and can reduce air pollution, heat exposure and improve mental health and reduce stress (Nieuwenhuijsen, 2020).

2.2.2 Value of green infrastructures to health and well-being

In recent years, there have been more studies on the positive impact of green space on public health and well-being. A number of studies have begun to examine what the health effects are of green infrastructures. Hewitt et al. (2019) sees an opportunity for the positive effects of green infrastructure on public health, although it differs per context what the effects are. The study by Bojorquez & Ojeda-Revah (2018) is focused on public parks and concludes that the parks improved mental health. Wood et al. (2017) found that not only nature parks but also parks with recreational and sporting function results in a positive mental health. This is also supported by Min et al. (2017) who found that people living in regions with the lowest number of parks and green areas are 16-27% more likely to suffer from depression and suicidal indicators. Contact with green spaces, for instance, by having a view of greenery, can actually have positive effects in people with high stress levels (Ulricht et al. 1991).

The connection between spatial planning and health has existed for a long time. From around 1900, efforts have been made to develop healthy neighbourhoods and cities, always focusing on society's current needs. In addition, in recent years, attention has been paid to health promotion, which is about how the living environment can encourage people to adopt healthy behaviour. This changed the focus from quantity to quality, which is about local tailor-made work from a certain setting such as a neighbourhood and an integrated approach together with different policy areas (Kruize et al., 2015). The study by Tol and Yohe (2007) shows that different potential inputs of climate-related health risks such as cultural, economic and educational have effects on the outcome in varying degrees, which implies the need to use adaptation strategies that can be tailored to the target. Another shift involved is from a top-down approach to a bottom-up approach, which increasingly involves citizens and stakeholders (Kruize et al., 2015). The importance of public health is also mentioned by Boeckmann & Zeeb (2014) stating that human health is only one of the concerns in decision-making on climate-related aspects. From a public health perspective, the environment has a strong influence on health and it is strange that environmental protection could take place at all without establishing a connection with health.

2.3 Inequalities in the urban area

2.3.1 European strategy for vulnerable groups

Climate change poses several risks, although everyone will be affected by the health effects of climate change, the impact will be disproportionate. Certain groups can be less climate-resilient, such as children, elderly, communities of colour and low-income communities (APHA, n.d.). According to Cardona et al. (2012), this is the result of a complex set of driving forces, based on historical, cultural, social, environmental and political concepts. In urban policies, equitable distribution of green space and recognition of the vulnerable group are important objectives.

The Paris Agreement calls for acknowledgement in article 7.5:

> Parties acknowledge that adaptation action should follow a country-driven, gender-responsive, participatory and fully transparent approach, taking into consideration vulnerable groups, communities and ecosystems, and should be based on and guided by the best available science and, as appropriate, traditional knowledge, knowledge of indigenous peoples and local

> knowledge systems, with a view to integrating adaptation into relevant socioeconomic and environmental policies and actions, where appropriate (UNFCCC, 2018, p.7).

The 17 Sustainable Development Gaols (SDGs) wants to achieve economic, social and environmental development with attention for equity (Bogle et al., 2016). The targets of the SDGs respond to the needs of the vulnerable groups, one of the goals is 'Make cities and human settlements inclusive, safe, resilient and sustainable' (Goal 11) where they give priority to urban greening in urban planning policies (Liotta et al., 2020). As target 11.7 states that cities have to "provide universal access to safe, inclusive and accessible, green and public spaces, particularly for women and children, older persons and persons with disabilities by 2030" (UNFCCC, 2018, p.8). There is a growing recognition for the positive effect urban green can offer people. Cities develop policies to increase access to green space and design urban green infrastructures from which citizens derive ecosystem services, including health and well-being benefits (World Health Organization, 2017). The environmental justice literature initially observed that ethnic minorities were more exposed to industrial pollutions, later, this scope was further extended to the distribution and division of green spaces (Liotta et al., 2020).

The European Green Deal (European Commission, 2019) is an example of recognizing that environmental justice is key for a successful transition towards sustainable cities as The Green Deal "aims to protect, conserve and enhance the EU's natural capital, and protect the health and well-being of citizens from environmental-related risks and impacts, at the same time, this transition must be just and inclusive" (The European Commission, 2019, p.2). It indicates that attention is being paid to the vulnerable groups in society at an international level, the targets and goals from the convention and the green deal are part of the shift towards more sustainable pathways. However, this transformation still needs to be more equitable, which needs to consider the social impacts on groups in society and the exclusion of people from the decision-making process.

2.3.2 Inequalities of climate adaptation

Climate change is of high concern for human rights, public health and socio-economic justice because of its disparate impacts and the disproportionate effects on vulnerable and socially marginalized populations (Shonkoff et al. 2011). The climate gap addresses the gap between the intense attention paid to climate change on the global level and the day-to-day concerns of vulnerable communities (Gaillard, 2012). Vulnerability to climate change is determined by the ability of a community to anticipate, cope with, resist and recover from the direct and indirect impacts of extreme weather events, including the sea level rise, heat waves and air pollution (Shonkoff et al., 2011). The frequency and intensity of these extreme weather conditions are expected to increase in the forthcoming period (Solomon et al. 2007). This increases the risk for populations that are unable to adapt to or protect themselves against such events. Climate change has direct and indirect consequences on the global to local scale (Shonkoff et al., 2011). Although it has been argued that the effects of climate change are less seen as a problem at the local level, Gaillard (2012) argues that the long-term focus on climate change distracts from the priorities of the local community. Increased focus on the importance of the local level does not diminish the importance of climate change for development. It is about better embedding policies and practical measures in the day-to-day problems that matter most to local communities. This will ultimately result in greater gains in tackling climate change through increased adaptive capacity (Gaillard, 2012).

2.3.3 Inequalities of health and well-being

Global climate change is an urgent issue affecting the environment and public health. The Intergovernmental Panel on Climate Change (IPCC) (2007) predicts that the environmental effects of climate change will have an impact on the health and well-being of people all over the world, with vulnerable populations, such as those living in poverty, being the most negatively affected (English et al., 2009). The disparities of the deprived population not only relate to wealth and income, but also to health and well-being. People in urban neighbourhoods with lower income and higher age were proportionally healthier if their neighbourhood had accessible public green space of good quality (Dennis et al., 2010). The inequalities and disparities of distribution in different neighbourhoods have effects on the health of the people and the climate resilience quality of these neighbourhoods. Studies show that disadvantaged people benefit most from improved access to green spaces (Allen & Balfour, 2014). However, it is seen that in neighbourhoods where green infrastructure is needed and can contribute the most, it is often the least available (Davoudi & Brooks, 2014). More research has been done in recent years, mainly in the United Kingdom, United States and Mexico (Kenis & Barratt 2021; Trainor et al. 2007; Grineski et al. 2013). The vulnerable groups are in smaller numbers in the Netherlands compared to these studies from the UK or the US, although there are still vulnerable groups in the Netherlands that deserve attention, to elaborate on this, the theory of environmental justice will be discussed.

2.4 Environmental justice

When it comes to the definition of justice, egalitarian, libertarian and utilitarian theories can be distinguished, which respectively use the following meanings to describe fairness: equality (everyone should get the same amount regardless of their input or need), equity (what people get from society should be based on their need) and well-being (what people get should be based on their need) (Davoudi & Brooks, 2014). John Rawls' (1971) 'Difference Principle' describes those inequalities are justified if they are "to the greatest benefit of the least advantaged members of society" (p. 293). Cohen (2009) implies that priorities should be given to the needs of disadvantaged people in society. Justice can also be viewed from an ecological point of view, focusing on the effects of natural disasters on society. The start of the ecological justice movement took place in North America in 1978; two ecological disasters raised awareness of injustice caused by the disasters (Schlosberg & Collins, 2014). This has led to an emphasis on the issues of environmental justice.

Environmental justice is defined by Bullard (1996) as the principle that "all people and communities are entitled to equal protection of environmental and public health laws and regulations" (p. 495). The study by Davoudi & Brooks (2014) shows that the distribution of green space is often unfair. While it is precisely in these areas that green space can contribute most to climate adaptation and the health and well-being of people. Contributing to the theory of environmental justice is the study by Grineski et al. (2012) which investigated a pattern of environmental justice related to climate change hazards. Neighbourhoods from lower social classes tended to be more at risk. The authors use an environmental justice approach to assess the inequitable implications of climate change across neighbourhoods within an urban area. By using an environmental justice approach, it is possible to provide knowledge to better plan and prepare for extreme weather by the tailoring of interventions for neighbourhoods most at-risk, in other words, reducing the climate gap (Grineski et al., 2012).

In the last decade, the theory of environmental justice has broadened and the definition has diversified. Walker (2009) explains this further by the example of flooding, which is a threat to the wellbeing of people. Flooding became part of the environmental justice debate after Hurricane Katrina happened in

the USA in 2005 (Sze 2006; Pastor et al. 2006). Floods are one form of environmental risk where the concept of vulnerability has been explored more deeply and which clearly demonstrates the need to think beyond socio-spatial patterns to understand inequality (Walker, 2009). This is equally important for the environmental justice dimensions of green space, it is clear that green space also extends beyond the socio-spatial patterns (Walker, 2009). Only looking at the spatial distribution is not enough in the case of green spaces, it is not only about the availability of the green space but also on the quality of the space, the functions and services and the accessibility for everyone. Distributional justice can also be about the responsibility for the realization and the outcomes. The responsibility then lies, on the one hand, with the situation where the inequalities in distribution are the result of actions or choices made by the same people who are affected. On the other hand, the situation in which there is a dislocation between those who benefit and those who suffer from the distribution patterns (Walker, 2009It is also important to take into account the local scale. Climate change campaigns and policies are given a national identity with overall reduction targets and estimates of national per capita totals (Walker 2009). At first glance, this may seem an equitable way of working, but by looking at different scales, this will ultimately provide a risk distribution that is local and specific to a particular place rather than national in scope. Næss (2006) supports this by stating that the local level is important because vulnerability is place-specific and because many decisions affect vulnerable groups.

Walker (2009) follows the work of Young (1990) and Fraser (1997) who both argue for an extension of the concept of justice to include the processes by which injustices are created. Schlosberg (2004) also draws on both theorists and argues that the issue of distribution must be integrated with that of participation and recognition in order to arrive at a more complete understanding. Schlosberg emphasises that these notions do not compete with each other, nor are they contradictory; an unfair distribution with a lack of participation and recognition together lead to injustice. Often, the more affluent group is the one responsible as Davoudi & Brooks (2014) give an example about Newcastle where the group that experiences the most air pollution from NO2 emissions is precisely the group that owns the least cars overall. Responsibility also overlaps with participation, in terms of the ability of the vulnerable groups to respond to and influence new plans (Davoudi & Brooks, 2014). According to Nussbaum (2003) the focus should be on the outcome and not on the resources, since the focus should be on what the resources mean to people and what they can do with them. Davoudi and Brooks (2014) give the example that if people want to take the means to improve their health by going outdoors, the outcome can still cause problems because of air pollution due to the limited availability of green spaces. The discussed authors show in their work that multiple factors can overlap and function not only to show unequal distributions but also to show other claims of injustice, which are recognitional injustice and procedural injustice.

Bennett et al. (2019) follows the previous discussed authors (Young, 1990; Fraser, 1997; Schlosberg, 2004; Walker, 2009;) and suggest the following definitions for the three dimensions:

- Distributional justice can be defined as fairness in the distribution of benefits and harms of decisions and actions to different groups across space and time;
- Recognitional justice refers to the acknowledgement of and respect for pre-existing governance arrangements as well as the distinct rights, worldviews, knowledge, needs, livelihoods, histories and cultures of different groups in decisions, and,
- Procedural justice refers to the level of participation and inclusiveness of decision making and the quality of governance processes. (Bennett al. 2019, p. 4-5).

The authors suggest that all three elements of environmental justice should be integrated into decision-making processes on sustainability. Bennett et al. (2019) developed a framework to show how this can

be implemented in practice. For distributional justice, this means understanding how different groups will be affected by change, considering the potential economic costs and benefits of the sustainable initiatives. This should be expanded to include an analysis of how economic costs and benefits are distributed between and within groups, across space and over time.

According to Bennett et al. (2019), recognitional justice first requires the identification of all interest groups that are present at the site and who could participate. In addition, historical and current events at the site must be considered. Recognition of traditional practices, knowledge systems, cultures and worldviews require that in the process these considerations are better understood and are better integrated into the plans. Methods that can be used for this are stakeholder analysis and participatory action research methods. Documenting local knowledge and mapping cultural values can enable the integration of this information into sustainability initiatives.

Procedural justice requires a way of working that ensures more qualities of good governance, such as transparency, responsiveness and accountability. Transparency can be achieved through the open communication of information and the sharing of the rationale for the decisions that are being made (Bennett et al. 2019). Sustainable initiatives must be able to respond to different social contexts and the needs of residents. It is important to share knowledge with local populations so that skills can be developed and the population can effectively participate in participatory projects and take part in the decision-making process (Wyborn, 2015).

2.5 Dimensions of justice in the city

Distributional, recognitional and procedural justice makes it possible to properly look at the situation that is happening with the addition of green infrastructure in the city. The first dimension, the distribution justice in the city concerns the distribution of and access to green space in the surrounding area. Here the quality, function and accessibility of green space are important to consider. The corona crisis also demonstrates the importance of access to green space in the surrounding area. The consequences of the corona crisis are causing greater changes in society, the view of nature has changed, the corona crisis has made all groups more in contact with nature. Students saw nature as calming and stress relieving, for the elderly, who came into closer contact with nature during the corona crisis, it ensured better health (van de Wiel et al., 2021).

Recognitional justices means that in the city different groups are taken into account, this can be the elderly or the younger children but also the population with lower income. In addition, for each group, its knowledge systems, different households and cultures must be taken into account. This is especially important to do in the decision-making process.

Procedural justice takes this further, with the level of participation being important in the choices that are made in the city. It is important to give all groups of society the opportunity to have their say in these processes. This also means taking into account the different ways in which the groups have the opportunity to contribute to the participation. In the Netherlands, participation in society is relatively high, yet part of the population is socially excluded. The disposable income of a household plays an important role here, with almost 1 in 10 of the lowest income group being socially excluded. Being socially excluded is associated with poorer health. Statistics on the Netherlands show that social cohesion is relatively strong, although this only looks at the average, but for the vulnerable groups it is especially important that they receive more attention and do not get snowed under by the use of average data (Coumans & Schmeets, 2020).

2.6 Conceptual model

By focusing on environmental justice in the decision-making process about green infrastructure projects it is possible to work towards more equitable outcomes. The equitable outcomes also add to more positive benefits for climate adaptation and the well-being and health. By taking the vulnerable groups into account and reach for even more positive benefits from green infrastructures it is possible to work towards a just transition towards sustainability.

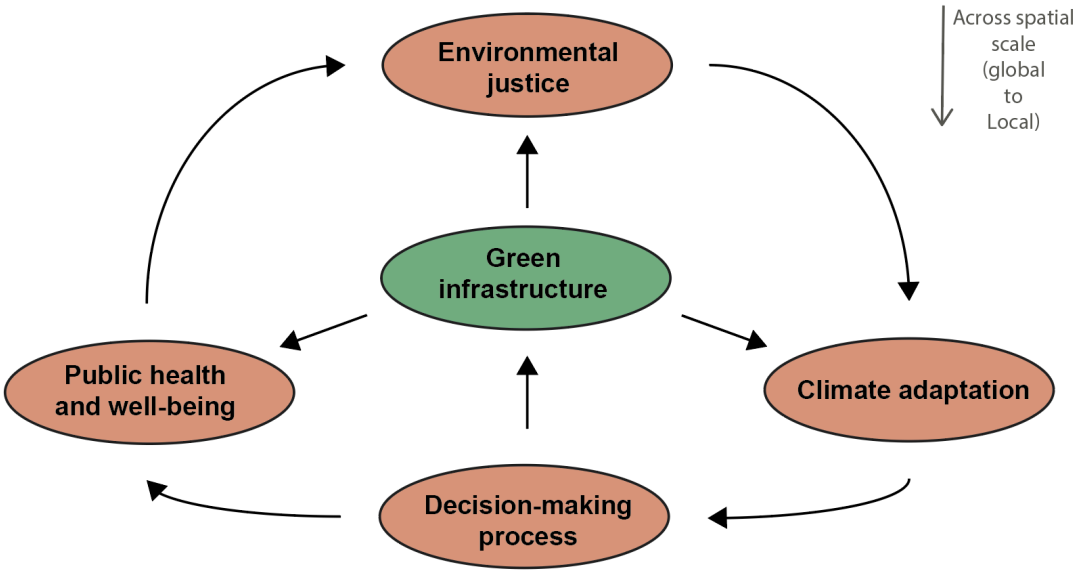


Figure 1: Conceptual model

The conceptual framework works from a global to a local scale, as this is an important representation in this study. Environmental justice is a broad concept on a global scale, and from that theory the local scale is considered where the decision-making process takes place and green infrastructures have an impact on the health of residents and adaptation to climate change. By adapting and improving the processes at the local scale, it again contributes to the theory of environmental justice and this theory can be developed further.

The outer circle has a process that contains inequalities, even though the green infrastructures have positive benefits on environmental justice, climate adaptation, public health and well-being and the decision-making process, as long as the process around green infrastructures is inequitable it is not possible to get the best benefits from green infrastructures. This study focuses on the process around green infrastructure and how they are influencing each other and what needs to be improved to get the equitable outcomes, because by reaching justice the public health and climate adaptation will also be increased.

It is necessary here to clarify what exactly is meant by the concept of the decision-making process and environmental justice. The decision-making process is the process that the municipality in the Netherlands take towards implementing new green infrastructures in the cities. The decision-making process is the moment to include the vulnerable groups to take into account environmental justice. This

research uses three dimension to define environmental justice and as a use for analysing the municipalities. For the equitable outcomes, the fairness of the choices made in the process of implementation are considered. This involves looking not only at the project but at the municipality as a whole to see if more benefits could be gained in other places. This study also indicates that when there are more equitable outcomes, this also ensures that there are more positive benefits to be gained from the green infrastructures. All of this is part of the transition towards sustainability and is needed to make this transition just.

Chapter 3 Methodology

3.1 research strategy

This research has a qualitative approach and the strategy forms a guideline for this research (Bryman, 2012). The research strategy will be focused on the suitability, feasibility and ethics by choosing a method that produces the right kind of data, makes sure all can be produced in the time frame and discussing if the method will allow to be ethical with participants (Denscombe, 2012).

A research paradigm is the choice of informing and guiding inquiry. A paradigm can be seen as a set of basic beliefs based on ontological, epistemological and methodological assumptions (Guba & Lincoln, 1994). Ontology is defined by Crotty (2003, p.10) as "the study of being". According to Guba and Lincoln (1989, p.83) ontological assumptions responds to the question 'what is there that can be known?' or 'what is the nature of reality?' Ontology is a theory of being, it expresses a view of the world (Marsh & Furlong, 2002). Epistemology is the theory of knowledge, focusing on the process of acquiring and validating the knowledge (Grix, 2002). Epistemology according to Crotty (2003, p. 3) is 'a way of understanding and explaining how we know what we know'. The research paradigm for this thesis will be the qualitative paradigm of critical theory.

The ontology of critical theory lies in 'historical realism' (Guba & Lincoln, 1994, p. 110). This means that reality exists and can be understood. The reality was formed over time by social, cultural, economic, ethnic, gender and political factors. Critical theory's epistemology means that knowledge is created as the investigator and interest objects are considered to be interactively linked, because the investigator's values influence the inquiry and mediate findings. Critical theory is a paradigm that tends to look at society as a whole and at the interaction between its actors and structures. Thus, theories that look at traditional structures fit into the paradigm of critical theory (Guba & Lincoln, 1994). Environmental justice is an example of a theory that looks at the social structures in society and the shifts around these structures.

This study uses the case study methodology and therefore generally uses a bottom-up approach where specific cases are used to support a probable conclusion. This emphasises the inductive reasoning for critical theory and shows that the conclusion is rarely interpreted as a universal truth (Jupiter, 2020). Inductive reasoning moves from specific observation to more general ones whereby observations of specific circumstances are applied to the wider situation (Page, 2014).

3.1.1 Case study

By using the methodology of a case study, it is possible to in-depth investigate about a small number of cases (Guba & Lincoln, 1994). The case study approach allows to use a variety of sources and types of data, in this research a combination of interviews and document analysis will be used. The case study is an approach about the exploration of a phenomenon through a variety of data sources. According to Baxter and Jack (2010) this ensures that the phenomenon is understood through a variety of lenses. The case study will be helpful to study things more in detail, the details unravel the complexity of the situation (Denscombe, 2010).

It is important to understand how the different parts are connected, since in society relationships and processes are interrelated. This makes a case study approach more useful than for example a survey as a case study can study a case as a whole and thus have a chance to discover how the different parts influence each other, in this respect according to Denscombe (2010) case studies have a more holistic view. For this research the case study will also provide insight on explaining how certain outcomes

might happen besides only finding out what the outcomes are (Denscombe, 2010). As Yin (2009) points out, the case study is already occurring prior to the research and it continues to exist after the research. The case study approach allows to use a variety of sources and types of data, in this research a combination of interviews and document analysis will be used.

This method lends itself to studying the processes and relationships within municipalities. Climate change and environmental justice are complex situations and show themselves differently in the green plans of the municipality. According to Denscombe (2010) it is important to define the case with clear boundaries. The two cases are about the municipality of Rotterdam and the municipality of Groningen. The choice for this is based on a number of considerations. Firstly, in this research the guideline is green infrastructures, this is a specific term with different definitions. Therefore, not only the term but also the descriptions are considered. The focus is mainly on the connection of green space as a network through the city, whereby the terms green network, green structure or green-blue network are also used and are connected to green infrastructures. Secondly, the condition is that the municipality have a green plan or project in which greening the city is the main focus. This made it possible to look at how the processes ran and what the underlying thoughts were for carrying out the plan or project. The projects also linked specific locations to be able to look at the differences in the city per neighbourhood. For Rotterdam, this means the plan for seven urban projects and the associated plan to add 20 hectares of green space. In the municipality of Groningen, a green plan has been developed focusing on Health, Green, Happy Groningen. Even though, in this research the link is made with environmental justice, it is not directly a condition that this must be included in the green plans, the case study is used to see whether or not the link of the vulnerable groups and green infrastructures is already made and to what extent. This is considered from the point of view of green infrastructures. Therefore, this is not a direct condition for the selection of the case studies. Although environmental justice will be further examined through the use interviews which will be discussed in the methods section, and thus does not need to be a direct part of the green plans of municipalities.

3.1.2 Case study selection

The case study selection started with looking at how green infrastructure is used in Dutch municipalities. This term is less used in the Netherlands, but there are many other terms that have the same coverage as mentioned earlier. The term ‘green network’ for example gives way more results as a search term on the search engine such as Google Scholar in the Netherlands than the term ‘green infrastructure’. Therefore, in addition to green infrastructure, other terms such as ‘green network’, ‘green-blue network’ and ‘greening’ also was searched for. Green plans often focus on the city and in combination with climate and health aspects. Once a number of municipalities with such a green plan had been selected, contact was sought, this led to two municipalities that were willing to be interviewed, the other municipalities with a green plan were therefore only used for the document analysis. By conducting interviews, the study examines the choices and strategies of the municipalities for adding green infrastructure and the extent to which vulnerable groups are included, which locations are chosen by the municipalities for the addition of green infrastructure and how a link is made with health and the vulnerable groups.

3.2 Methods

The ontology and epistemology determine the methodology for the research. As discussed in the previous section it is identified that the use of case study is most suitable to answer the research questions. This section describes the methods of data collection and data analysis which are used in this research, which is a combination of semi-structured interviews and documentary analysis.

3.2.1 Interviews

For the method of interviews the choice was made for semi-structured interviews. Semi-structured interviews provide the opportunity for an informal tone and an open response by the interviewee (Bryman, 2012). Therefore, this method is useful in gaining insight into the motives by the municipality for implementing green infrastructures. Nevertheless, interviews as a method may also have weaknesses that the researcher was aware of. The first one is bias factors, which may include interviewer bias in the selection of interviewees and the drafting of the questions. Awareness of the researcher's own values is ensured. Before the interview, the interviewees were informed about the content of the research, so the respondents know the purpose of the research and what happens to the data and that it will be processed anonymously. Secondly, as Yin (2009) states, the interviewee may also give socially accepted answers. The semi-structured interviews were used as a method to explore this complex phenomenon. An interview guide was used for the semi-structured interviews with a list of issues that needed to be addressed but in the interview guide, flexibility was also taken into account and the interviewees were able to give open answers and explain their own reasoning (Appendix A) (Denscombe, 2010).

Semi-structured interviews were conducted with two Dutch municipalities who are working on greening the city and/or have published a green plan, the consideration for this choice has previously been explained. In order to get in touch with the right employees of the municipality, contact was made through a contact form and was forwarded internally to the right department. Two separate interviews were conducted with the municipality of Rotterdam; the first interview was with an advisor Environment and Health at the Municipal Health Service as part of the municipal department, this interview was focused on the seven city projects from the municipality. The second interview was with a Programme manager for the addition of 20 hectares of green space in Rotterdam. At the municipality of Groningen one interview was conducted with a Policy advisor at the programme Quality of Living and an advisor health for a healthy living environment. Preferably, interviews were also conducted with several other municipalities in the Netherlands to get a broader picture. In total 6 municipalities were contacted and the municipality of Rotterdam and Groningen responded for an interview. This makes it more difficult to give a picture of the whole of the Netherlands in the field of green infrastructures and environmental justice, although there is now more room to delve deeper into the two municipalities. For the municipality of Rotterdam this means that two interviews were conducted, for this municipality it is the case that the green plan consists of two parts, for the municipality of Groningen this could be done in one interview. Because of Covid-19, the constraint was to work from home, which resulted in interviews being conducted through the use of Microsoft Teams. The interviews were recorded, with the consent of the interviewee, and then transcribed.

3.2.2 Documentary analysis

An analysis of the green plans of the two municipalities was carried out to obtain more information in addition to the interviews. Furthermore, to obtain a broader picture of the term green infrastructure and the involvement of vulnerable groups, available green plans from other municipalities in the Netherlands were also analysed with the focus on which term they used in their greening plans. The documents that were analysed were chosen based of their accessibility and the focus on green space in

the city. The validity was checked based on authenticity, representativeness, meaning and credibility as Platt (1981) and Scott (1990) have argued. The documents were written with the purpose to show what their plans are for the city and were produced by the corresponding municipality. All the documents used have been written for a certain period that has already started and will continue in the coming years (Descombe, 2012).

The first document is 'The 7 city projects' by the Municipality of Rotterdam (2020a), the document about the adding of 20 hectares of green 'Making Green Meters, Rotterdam goes green (Municipality of Rotterdam, 2020b). For the municipality of Groningen, the document 'Green Plan Groningen, Vitamin G' (Municipality of Groningen, 2020) is used. These documents were analysed in depth. In addition, the following green plans have been used to analyse the term and definition of green infrastructures: the Eindhoven Green Policy Plan, 2016-2026 (Municipality of Eindhoven, 2016), the Green Plan Hengelo (Municipality of Hengelo, 2015), the Green Plan Purmerend, 2019-2022 (Municipality of Purmerend, 2019) and the Green Plan Apeldoorn (Municipality of Apeldoorn, 2018), as showed in the map below.

Map 1: Overview of the analysed green plans

3.4 Data analysis

By the use of the two methods, semi-structured interviews and documentary analysis, triangulation is enabled and provides more comprehensiveness and accuracy of findings as data from both methods can complement each other (Descombe, 2012). The semi-structured interviews and document analysis are used to collect data to answer the research questions and both methods are complementing each other in the process of answering the questions.

3.4.1 Grounded theory analysis

For the data analysis, a grounded theory approach is used, which involves referring back to the relevant literature during the analysis. This is used to further shape the data collection in which new perspectives can be used. By using grounded theory in the data collection phase, unforeseen characteristics in the answers can be identified and further refined. It is important to note here that this grounded theory approach ensures that the data analysis is strongly influenced by the researcher, as this can lead to a certain bias (Heydarian, 2016). This is taken into consideration in this study by carefully taking into account the perspectives of the interviewee and reviewing the data several times using a codebook. A provisional codebook is first developed with certain constructs and their corresponding definitions, and is refined throughout the research. The code books with the codes and their definition were created in response to the three research questions (Appendix B, C and D). In this study, the codebooks were developed by using the relevant literature.

To be able to answer the research questions the grounded theory approach is used. For the first research question (RQ1) this means analysing the data from the literature with the outcomes from the interviews about the contribution from green infrastructures to the urban area from the perspective of the municipality and the related theory. In order to be able to compare the results and draw a conclusion from the case study, the line of reasoning of Young (1990), Fraser (1997), Schlosberg (2004) and Walker (2009), among others, is followed with an emphasis on not only distributional justice but also recognitional and procedural justice to be able to answer RQ2. This is also taken into account in the interview questionnaire and in the process of coding the transcription from the interviews. This allows a connection to be made in analysing green infrastructures and to what extent vulnerable groups are taken into account, and in this way contributing to environmental justice theory. By using the three dimensions of environmental justice, the codes for analysing the interviews and documents are focused on them, this resulted in different codes. For RQ3, the approach and decision-making process of the municipalities will be analysed, the focus is more on the approach and process from the municipalities. Therefore, a third part has been added to the codebook, focusing on the motives of the municipalities and the approach of different processes. Here a connection is made with the literature of environmental justice as the basis. From the theory the decision-making process is analysed to see what needs to be improved.

When answering the questions, it is important to note that own interpretations are used for the codes and sub-codes, which can lead to a bias of the results; this has been kept in mind in this study. The analysis consisted of going through the interview transcripts, greening plans, reports and municipality websites to identify how green infrastructures are positively benefit to climate adaptation and the public health and to what extent vulnerable groups are been taking into account in the decision-making process.

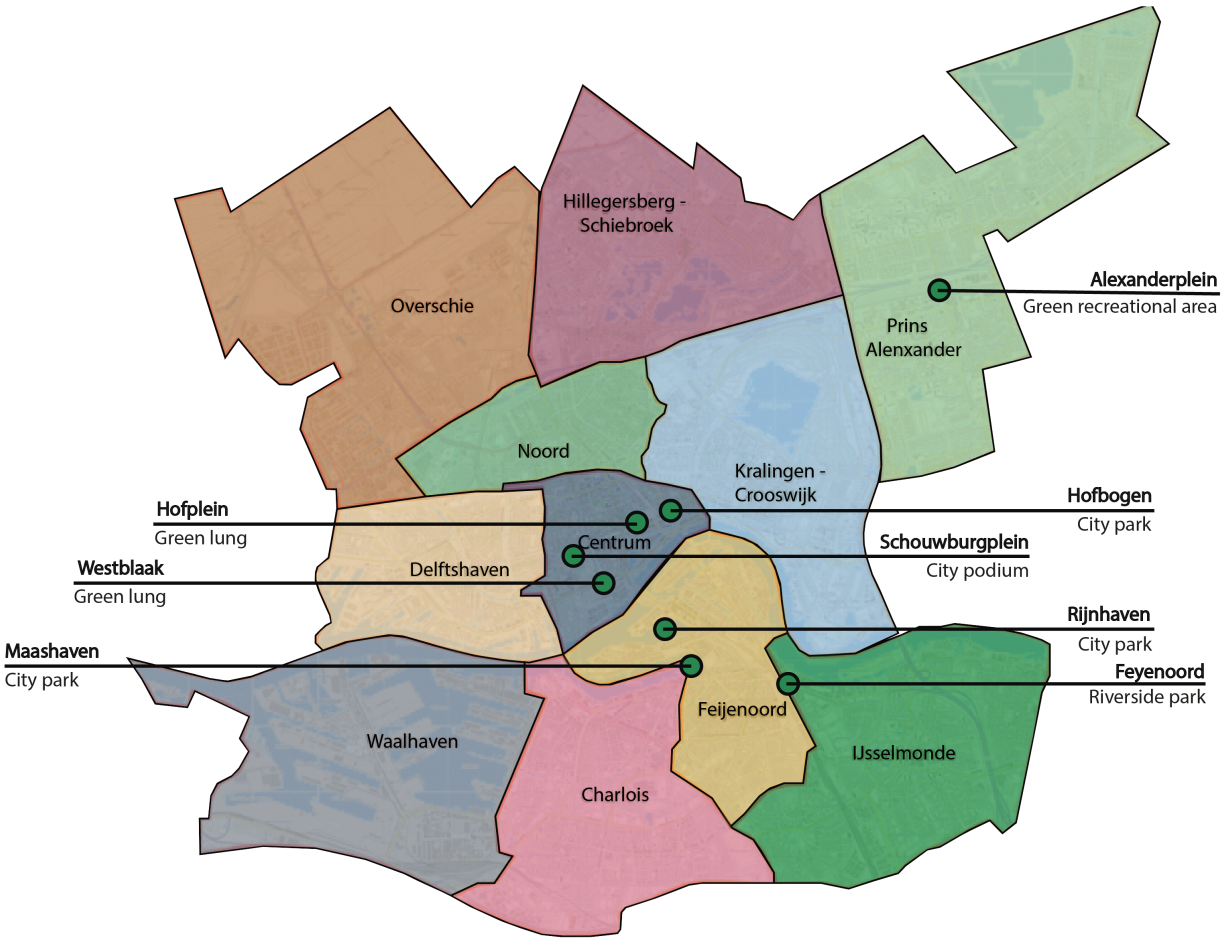
Chapter 4 Results

This chapter describes the findings and the results of the research. The first and second section dives further into the two Dutch municipalities Rotterdam and Groningen and will describe to what extent the three dimensions of environmental justice are considered in the green plans with specific attention to the vulnerable groups. The results for both municipalities will start with general information obtained from interviews and document analysis showing the process and background information. Further the three dimensions, distributional justice, recognitional justice and procedural justice will be addressed in this order for each municipality. The third part elaborates on the results relating to the concept of green infrastructure by indicating how the municipality uses this concept and what definition is used for it.

4.1 Green plan of the municipality of Rotterdam

The Municipality of Rotterdam aims to provide Rotterdam with more green city lungs by implementing seven city projects. In addition to creating attractive public spaces where residents and visitors can meet, exercise and recreate, the urban projects also provide solutions to important challenges facing the city. Rotterdam is looking to the future by reducing heat stress, improving the retention of heavy rainfall and building new houses. In addition, creating space in the city is a very important element for Rotterdam. Developing the seven city projects and making the city greener can help reduce heat stress by up to 7°C in some places. Rotterdam is doing this through a number of additions in the city, especially by adding greenery, such as more than 700 trees, approximately 100,000 m2 of greenery, 4,400 m3 of water storage and 10,000 m2 of green roofs, this will ensure that approximately 17,000 new households will live within 200 metres of greenery.

The municipality sees the addition of greenery as important due to the benefits for climate adaptation but also for the health of the residents. According to the municipality of Rotterdam, greenery less than 1 km from home can lead to less obesity, depression and anxiety disorders. For the development of these seven city projects, perspectives from the strategy on spatial planning and environment from the municipality are used as a compass. The perspectives are: Compact City, Healthy City, Circular City, Inclusive City and Productive City. The seven city projects are: Hofplein, Westblaak, Alexanderplein, Hofbogen Maashaven, Schouwburgplein, Rijnhaven and Feyenoord. All projects add green to the city in a different way and fit the definition of green infrastructures mainly because the focus is on the connections between green spaces and green spaces in connection with the residents.



Map 2: Project locations of the seven city projects in the municipality of Rotterdam

The new municipal council in 2018 set the goal of adding 20 hectares of green space to Rotterdam in four years, up to and including 2022. In addition to green spaces in public areas, there will also be green spaces closer to the homes of residents. The municipality sees it as its ambition to work together with residents, businesses, investors and housing corporations. This is necessary because the municipality owns only 40 per cent of the ground of public spaces in the city. The seven city projects discussed above also contribute to the 20 hectares of green space. After two years in 2020, 12.8 hectares of green space have already been added in Rotterdam (Municipality of Rotterdam, 2020c). The municipality has four focal points in adding greenery, which are green roofs, green in public spaces, green in business parks and green close to home.

4.1.1 Distributional justice

In the municipality of Rotterdam, the most frequent choice is for a location is where space can be made available, with a link to climate adaptation and public health. The municipality was already working on a number of projects, such as Coolsingel, and was also looking at surrounding squares and places that could be linked to it. Eventually, this was combined under an umbrella project called the Seven City Projects. The following choices were made for the seven city projects.

The Westblaak location will be transformed in to a green lung, for this location it was an option to reduce the number of traffic lanes for cars to open up more space for cyclists, pedestrians and visitors.

The creation of this space will improve health by reducing noise pollution, and the greenery will allow more people to stay on roof terraces and balconies situated along the green lung. In addition, this green lung can contribute to the climate by providing more shade and cooler spots. The document about the seven city projects states about the green lung on Westblaak:

> Initial calculations show a reduction of 7°C if a quarter of the space is greened and 25% more trees are added (Municipality of Rotterdam, 2020, p. 10).

The green lung in Westblaak is part of the green lung on Hofplein. Hofplein has a historical context that has been changed by the reconstruction with lots of space for cars. The square is now described by the municipality as:

> The square currently consists of little more than the iconic fountain and some residual space at its edge, split sharply by almost uncrossable wide zones of car and tram traffic (Municipality of Rotterdam, 2020, p. 8).

The Hofplein will be a residential area where the iconic fountain will have a prominent place. The new green recreational area will also provide a connection between other parts of the inner city and with Rotterdam North.

The third location is the Hofbogenpark, where a two-kilometre-long city park is being realized. With this park, the municipality of Rotterdam is providing an integral answer to various pressing issues. The city park will provide a green link between the inner city and the surrounding area, it will have an ecological value and a circular water system that will provide more water for climate adaptation. In addition, the green park also invites people to stay and move around, which the municipality indicates is important for the residents of Rotterdam North due to the large number of paved surfaces.

The Alexanderplein is an important urban intersection, but it lacks a connection to water and green structures because 64% of the space is for cars. By making space available and adding new functions, such as living and accommodation, the municipality of Rotterdam wants to turn this into a centre area. The municipality wants to restore the focus on pedestrians and cyclists, which will result in a green residential square. The new layout also provides a better connection to the surrounding neighbourhoods, which contributes to the ambitions of the municipal councils.

Covering an area of 7 hectares, the Maas Harbour Park in Rotterdam South is an addition to the park structure. The new development and the addition of a lot of greenery will make it a place to stay. The accompanying square and underground station will also become an attractive residential area where the pedestrian is central with a connection to the surrounding urban districts.

Schouwburgplein is a square that residents and neighbours regard as empty. For a number of practical reasons, this square can be improved, such as a leak in the parking garage below the square and necessary replacement of ventilation towers. Together with several stakeholders to goal is to make the square a cultural square for all residents of Rotterdam.

Rijnhaven Park will be a city park that partly floats on the water, with a permanent urban beach. The city park is easily accessible and will have functions for accommodation, recreation and various housing possibilities. The plans for the Rijnhaven arise from earlier developments in the district Kop van Zuid. The square is sheltered by the surrounding buildings and waterfronts, and new high-rise dwellings and other facilities will also be built. The connection with surrounding districts will also be made, as pointed out by the interviewee:

> This part of the city centre, with its new buildings and the city park with beach, offers a new destination for the city and for residents of the surrounding neighbourhoods in particular (Interviewee advisor environment and health, 2021).

The last location of the seven city projects is a tidal park in the district Feyenoord. A lot of greening will take place here. The ecological and recreational qualities of the river banks will be improved. The municipality explains this further:

> A tidal park is about making the river more natural, more experienceable and more attractive in relation to the urban environment. Seen from the river's perspective, a tidal park strengthens the relationship between water and land and between nature and the city (Municipality of Rotterdam, 2020, p. 30).

In various studies, the municipality of Rotterdam has reviewed the distribution in the city, one of which is the supply of education. This study showed that in certain neighbourhoods, there is less choice and the schools with higher education are less easily accessible. With this new insight, the municipality is now working on this situation by creating a better distribution of the schools. A study like that shows the current situation and makes it possible to zoom in on the effects for each neighbourhood.

The greening of the seven locations will provide better outdoor spaces where local residents can recreate and stay, contributing to better health, but as the interviewee states:

> Because actually, if you want to add greenery to the city, especially to reduce health inequalities, then you simply have to create neighbourhood and community greenery (Interviewee advisor environment and health, 2021).

This neighbourhood and community green space are less discussed in these seven city projects, although the municipality does have a related part of the green plan to add 20 hectares of green space. One of the ways to add green space is to connect it to maintenance projects that are already on the schedule, although the interviewee indicated that these are not often the neighbourhoods that need the green space the most. The city council has also raised questions about this matter, with the result that neighbourhoods with a lot of petrification, high density and little green space now also qualify for the maintenance projects. In Rotterdam South, in addition to the maintenance programme, own projects will be implemented to be able to add more greenery.

4.1.1.1 Conclusion of distributional justice

The choice for the locations is mainly based on the possibility of making space available and on iconic places in Rotterdam. These locations are therefore not so much chosen for reaching vulnerable groups but where opportunities arise such as reducing the number of lanes and from that point the vulnerable groups, climate change and health aspects are considered. Although all projects focus on the connection between all the projects and connected several places in the city, such as the city centre and the surrounding neighbourhoods. The municipality did start with analysing the distribution of schools in the city and worked further from that analysing in creating a better distribution.

4.1.2 Recognitional justice

The municipality of Rotterdam has set various challenges as the basis for the green plan; greening the city is seen as contributing to the health of the residents and to climate adaptation. Each of the seven city projects has its own project leader, and through various sessions with all the project leaders, attention is paid to inclusiveness and health. The interviewee's role is to supervise this on behalf of the social domain; for example, the interviewee states that after all the sessions, the projects will continue:

> Then every project has its own dynamics and now all the programmes of requirements come to us one by one and they ask us to look at them again and what we can possibly add to the programme of requirements in terms of inclusiveness or health (Interviewee advisor environment and health, 2021).

In this way, different policy areas are involved and can assist each other towards better outcomes, which in this case focuses on inclusiveness and the health of residents.

The target groups identified by the municipality of Rotterdam are the elderly, the young and the disabled. The projects are therefore further adapted to these target groups by, for example, making it more accessible for everyone. The Hofbogen park, for example, takes accessibility into account since the park will be on a higher located old railway track:

> For example, explicit attention was paid to people who have difficulty walking, who need wheels, with a walker or a wheelchair, that they can also get there and that they themselves can also get on top of the old railway line (Interviewee advisor environment and health, 2021).

In the Hofbogenpark, attention is paid to this target group because according to the interviewee it is known that the surrounding neighbourhood has a poorer health, the municipality uses this information by programming activities to make it accessible for this target group to go to these places.

In addition, the municipality of Rotterdam also pays attention to the youth, as mentioned in the interview:

> And something that is also very often forgotten is youth, people often think about how do we prevent young people from hanging around here, that it becomes their place or that things get destroyed, but that instead it is used in a positive way by young people (Interviewee advisor environment and health, 2021).

For the youth, this also includes a standard for a certain size of space per neighbourhood that belongs to the neighbourhood; this can be an outdoor play area but also a rose bed for the elderly. This is also included in the seven city projects by looking at what the projects do with this standard and whether there is any space left that the neighbourhood can fill.

The five perspectives are used by the municipality as a guiding principle in the projects, with the healthy city, inclusive city and circular city being newly added. These topics are now more recognized and receive attention. For the perspective of a healthy city, it is considered that in order to reduce health inequalities the focus needs to be on neighbourhood and community green space. Various studies also show that the sight of greenery can already reduce stress.

The municipality also takes the needs of various neighbourhoods into account. This approach stems from an active climate adaptive approach that considers maps of flooding and heat stress, where a link is made to the fact that green spaces are good for residents, but also for water retention and heat stress. It is emphasized by the interviewee on adding 20 hectares of greenery that the effect of green space on public health is considered to be very important.

> And I always want to emphasize that effect because you just see that people exercise more and feel more at ease in greenery (Interviewee programme manager 20 hectares of green space, 2021).

In addition, biodiversity is also related to this so that the greenery is actually designed to have positive effects on humans, animals, birds and bees.

The interviewee on 20 hectares of greenery also states that the corona crisis also draws extra attention to how important greenery is and that a lot of attention should be paid to this. During the crisis it also became clear how important public green spaces are, as many parks became overcrowded.

4.1.2.1 Conclusion of recognitional justice

The target groups that are recognized by the municipality in the seven city projects are the youth, elderly and disabled. The municipality uses sessions to make sure that the project is considered from different policy areas, in this case, it is the social domain that looks at inclusiveness and health. In addition, the five perspectives are used as a guideline for all projects; the extent to which the perspectives are improved differs per location. When the focus is on the neighbourhood and community green space, attention is also paid to certain needs of the neighbourhood, such as water retention or heat stress. This is not directly the case for the locations of the seven urban projects.

4.1.3 Procedural justice

It is possible for residents to apply for a subsidy for green projects they would like to realize in their street through the sub-municipal council or neighbourhood associations. The municipality will continue to carry out the maintenance, but residents have to come up with their own plans. The municipality ensures that projects that can be designed by residents or schools receive proper guidance. Schools can submit plans for a 'green and blue' schoolyard and the best plan will receive a subsidy to implement the plan. It has become clear to the municipality how important it is to supervise participatory projects, especially to ensure that the schoolyard is actually created and properly maintained, as the interviewee stated:

> And then, every year, the five schools that have submitted the best plan can receive a subsidy, and we provide them with extensive guidance, because we've also seen that the moment you don't provide guidance to a school, they think, 'ha, we'll lay a kind of green carpet, and then no one will maintain it, and in no time, they'll be back on our doorstep because maintenance is required (Interviewee programme manager 20 hectares of green space, 2021).

This guidance was also chosen by the municipality because resident projects in neighbourhoods with little green space are not always obvious, but they can achieve good results here:

> We also see this a bit with resident projects in neighbourhoods like that, where you often see that people do not often start thinking about greening the street first, so extra support and encouragement is very much needed there (Interviewee programme manager 20 hectares of green space, 2021).

With new projects, residents are involved and invited to see the plans, and they can also respond to these plans and think along. Due to the corona crisis, last year's resident meetings were organised digitally, sometimes with more residents present than at the previous meetings, according to the interviewee. The way in which these residents' meetings are organised varies from one neighbourhood to another. An example was given in the interview of a mixed population in Rotterdam Zuid, where the meeting was organised in the neighbourhood itself and children were also involved to help think about the design.

The Dutch Environmental Planning Act has already had an impact on the municipality's processes, even before it officially came into force. The Environment Planning Act has led to the development of an environmental vision for the municipality, which states that the development of the city will take place on the basis of the predetermined five perspectives of the municipality. This is shown in the seven city

projects, with each project indicating how it contributes to the five perspectives. Between the social domain and the seven city projects, mutual consultation takes place on what is still missing and what can be added based on the five perspectives in the projects through the plan of requirements. Within the municipality of Rotterdam, attention is mainly paid to the seven city projects because these are striking projects where a lot of green space is added, which means that less attention is paid to neighbourhood green space, according to the interviewee about the 20 hectares of green space.

The linking of the seven city projects under one name is a way of framing that has been used by the municipality of Rotterdam, it can be found on the internet and a city agreement is developed in which stakeholders are involved. The City Agreement is signed by external parties and in doing so they contribute to the city projects, this can differ per party, but by linking the city projects, they become the property of several parties in the city and not just the municipality. Each project has a different way and amount of involving residents. In Hofbogenpark, for example, the residents are much involved, because it takes place near the houses and gardens of residents. In each project, some form of participation takes place, but in some projects, this is easier than in others; in Rijhaven, houses are being added so that means that currently few residents live in the neighbourhood. Since all the projects are for the entire city, the municipality does realize that it is important to maximise participation. Participation also falls under the new Environment Planning Act:

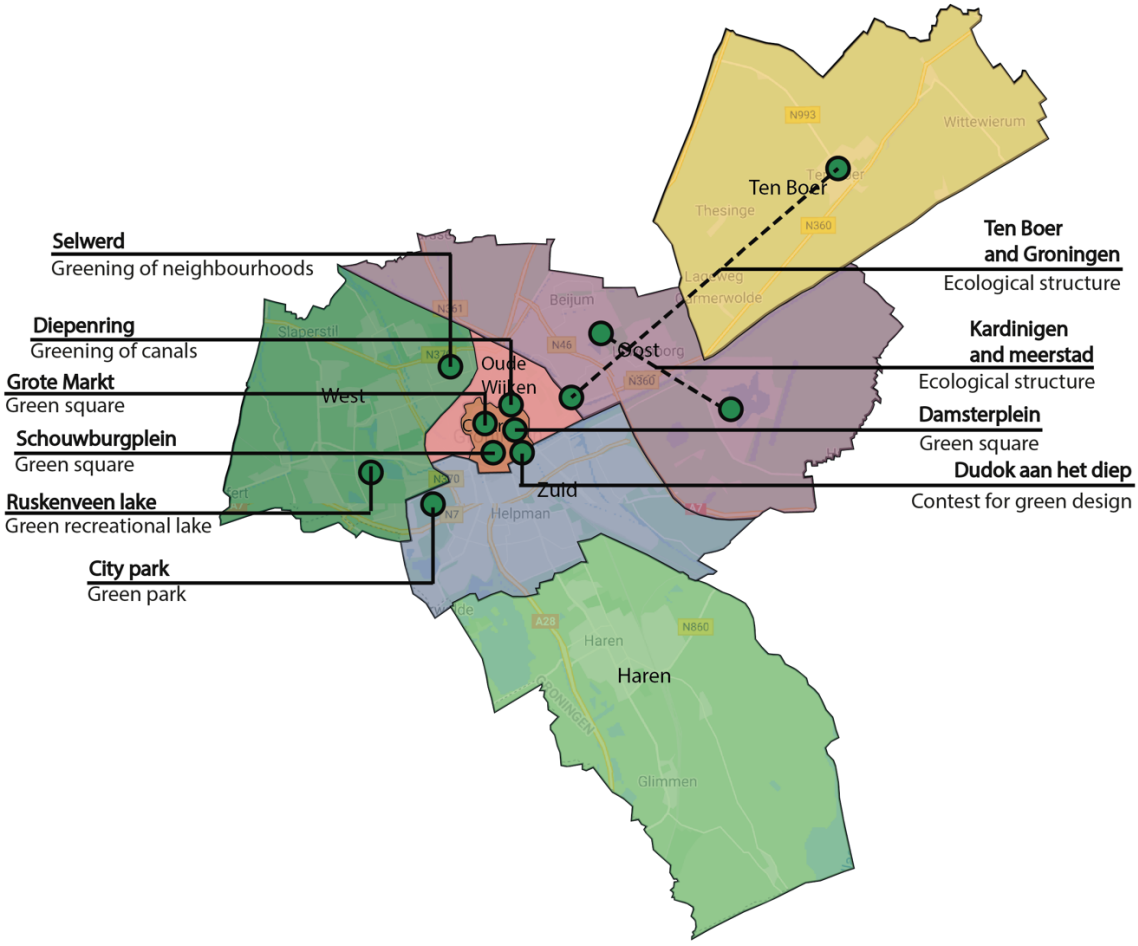
> Participation is also under the duty of the Environment Planning Act but also just by the spirit of the current times it is an important one, and people are also just more likely to speak up, but not always the vulnerable people (Interviewee advisor environment and health, 2021).

4.1.3.1 Conclusion of procedural justice

The municipality involves their residents in the projects, this differs in every project and neighbourhood. The municipality has chosen to do this because each project and each neighbourhood requires different requirements. The municipality recognizes that some neighbourhoods that are less likely to participate can still achieve a lot with the help of the municipality through guidance. By giving the project a name and making it public, the municipality ensures that there is more transparency towards the residents and it is easier to have a say for them. As a result, the project belongs to the entire city.

4.2 Green plan of the municipality of Groningen

In 2018, the environmental vision 'The Next City' was adopted for the municipality of Groningen, this vision is about the future development and focuses on the physical living environment. The vision has 2030 as the time horizon and included five important tasks: facilitating the growth in the city, the employment grows along with the city, the growing city remains liveable and attractive for all residents, the energy transition is accelerated and everyone participates and helps in a growing city (Municipality of Groningen, 2020). In 2020 the green plan 'Vitamin G' has been adopted by the municipal council of Groningen. The plan has been linked to the implementation programme of the municipal which indicates the objectives and how this will be achieved over the next five years, with numerous projects. With a new coalition agreement in 2019 a new slogan for Groningen was formed: 'Health, Green, Happy Groningen' which outlines what the municipality does in terms of greening. The municipality's ambition is to become the healthiest municipality in the Netherlands. Public space has an important role to play here, after all, this has the chance to contribute to health and quality of life, because this is the place where people meet, exercise and have fun. The ambition from the municipality is to create a good living environment and considers the health of the residents as very important (Municipality of Groningen, 2020). The green plan of the municipality of Groningen looks broadly at all the fronts on which greenery has an impact. It wants to emphasize the value of green for Co2 capture and biodiversity but also specifically zoom in in on health and climate adaptation. The green plan is a framework where at the project level further detailing and application of the data on the social challenges at hand can be explored.



Map 3: Project location of green infrastructures in the municipality of Groningen

4.2.1 Distributional justice

The document that is published by the municipality of Groningen (2020) discusses various locations that are involved in the implementation of a green infrastructure. The first locations are two squares, the Schouwburgplein and the Damsterplein, within the context of climate adaptation, through greening the squares and laying out green borders. An ecological connection between Kardinge and Meerstad will be realized to restore existing landscape elements and create new ones. The Grote Markt is also scheduled for a redevelopment where more trees will be planted. After a contest, the winning design for 'Dudok aan het diep' will be worked out further. Several canals in the Diepenring will be made more attractive in order to bring back the missing green links in the 17th century Diepenring. In a number of neighbourhoods in Selwerd, they are going to start greening together with the ideas of the residents. There are concrete plans to improve the attractiveness of the citypark and the Ruskenveen lake. The municipality also focus on biodiversity by making the stadsweg (city road) between Ten Boer and Groningen greener, they have a municipal ecological structure that regulates for nature-inclusive building. More development is taking place on the western flank of the city, the municipality is creating a vision where a green, robust network connects the rural area with the city.

The municipality has started these projects and more are to follow. There are many challenges to be met for green space, ecology and biodiversity, climate adaptation and public space. The Green Plan therefore elaborates on these tasks (Municipality of Groningen, 2020).

To answer the question of how certain locations are chosen, the interviewee states that it is a difficult task because the green plan sets the bar high to create the right or good effects with limited resources. On the one hand, the municipality uses the different target groups, such as children and the elderly, and uses this in the choice for the locations. On the other hand, the municipality also uses a project list in which each project is given a score on a number of themes, resulting in certain projects being given a higher priority.

Green is seen as something important that contributes a lot to the target groups who need it. For example, if an area has 10% more greenery, the residents are less prone to depression. This is seen as important by the municipality:

> To us, these are all instruments which mean that we have to invest in green spaces in certain areas, because the level or quantity of green spaces in these areas is low compared to other areas (Interviewee Policy Advisor Programme Quality of Life, 2021)

Analyses have shown that in the southern districts of cities people on average live 7 years longer than in the northern districts, greenery is part of the reason for this. In the northern districts, there is green space, but it is not programmed, so the quality of the green space is low and no link is made with the needs of the target group in this district.

4.2.1.1 Conclusion distributional justice

The municipality uses for new projects a scoring system that shows the location with more priority based on several themes. The municipality has also realised the need for programming green, through which a link can be made with the target groups to achieve better results in neighbourhoods.

4.2.2 Recognitional justice

The municipality recognizes the value of green space and is aware of its contribution to a good living environment for both people and animals. In addition to better health, air quality and a climate-adaptive environment, the municipality also recognizes that green infrastructures can contribute to more: "Green provides a place to meet and exercise and contributes to a good living and working environment and a healthy lifestyle" (Municipality of Groningen, 2020, p. 14). The municipality keeps green values in mind in all plans and projects.

In formulating the green plan and the ambitions from the coalition agreement, the Municipality of Groningen states that people are central. The aim is to promote a healthy population with an eye for the vulnerable groups. In the green plan, different target groups are defined, the interviewee says about this:

> We are talking about children up to the age of eight or ten, really the children who go to primary school, who are very sensitive to heat stress for example, and the same applies to the elderly, people who are 65 years of age or older (Interviewee Interviewee Policy Advisor Programme Quality of Life, 2021).

The municipality has made various analyses in order to find out where, percentage-wise, most elderly people live. This information is used to choose priorities for certain areas. In addition, a number of neighbourhoods have been designated for neighbourhood renewal, whereby a certain target group is also taken into account:

> The municipality of Groningen has designated four or five neighbourhoods with many social problems and we have also said that we want to invest in those neighbourhoods, not only by adapting the housing stock, but by making better housing, but also by investing in the outdoor space, and greening is an important part of that (Interviewee Policy Advisor Programme Quality of Life, 2021).

The municipality also made a project list with 90 projects on it, and a good selection had to be made as to which projects could best be implemented first. Each project was given a score on five or six themes and the higher the score, the higher the project will be prioritized. The interviewee stated:

> So, we actually tried to find a mix of projects that we want to carry out quickly and projects that can wait a while, but also looked at whether it corresponds to those specific target groups we had already identified (Interviewee Policy Advisor Programme Quality of Life, 2021).

4.2.2.1 Conclusion of recognitional justice

The municipality gives priority to vulnerable groups, because they see the value of green space to provide a healthy and liveable environment. They specify the elderly and younger children as their target group, and several studies have already been carried out to find out how these groups are distributed in the city and in which neighbourhoods' problems occur.

4.2.3 Procedural justice

The green plan starts from five important tasks for the municipality of Groningen that show that as the city grows, it must be taken into account that it remains liveable for all its residents and that everyone can participate and help the growing city. The green plan of the municipality is the actualization of the municipality's green structure plan from 2010. Since 2010, various policies have been established for the municipalities of Groningen, Haren and Ten Boer, which now form together the municipality of

Groningen. The new green plan does not replace these policies, which will still be in force, but they have been used as a basis to reflect the current state of play and to work further on from here.

After the adoption of the green plan, there was a public consultation period during which anyone who wished to do so could submit their comments and/or ideas on the draft version of the green plan. Since the participation period fell in the middle of the coronal crisis, the municipality used a different approach to obtain more participation in the green plan. The municipality used various methods to inform a large group of people about the green plan and to ask them to react, such as municipal communication tools and by bringing the green plan to the attention of residents' organisations and neighbourhood newspapers. The municipality received many responses and ideas, which were incorporated into the final version including more background information or explanatory notes on a number of themes. According to the municipality (Municipality of Groningen, 2020), the importance of a green and attractive living environment is not yet equally recognised by all districts and villages, therefore, they want to put extra effort into communication and participation by informing these residents of the positive effects of green.

According to the interviewee there is a certain approach for participation for the municipality of Groningen. For the green plan, however, this participation was kept limited because in previous years various studies had already been carried out with regard to greening, including using a city panel and digital surveys. The municipality believes that much information has already been obtained from this and it will be used in the green plan. For the draft version of the green plan, there was a public consultation period as mentioned earlier, where residents could respond to the policy part of the green plan. As soon as a neighbourhood or a street undergoes redevelopment, a participatory process begins in which greenery and health are an important part of the conversation.

The municipality works together with the residents on the projects of the green plan by greening their gardens, planting trees and cooperating with schools to green their playgrounds. The residents of the municipality have proposed several green initiatives, and the municipality has indicated that in any part of the city where there is a spatial challenge, one of these initiatives will be implemented. The municipality has already started to implement several projects and more will follow, whereby the greening projects include the initiatives of residents and organisations.

4.2.3.1 Conclusion procedural justice

There are various ways for the residents to participate, which was already possible in the draft version of the green plan by giving their reactions and by proposing various green initiatives. Later in the process, there is less room for participation. The Municipality points out that several studies have been carried out in which the input of the residents was included, which created a good picture for the municipality for the implementation of the projects.

4.3 Green infrastructures in the green plans from municipalities

This section will include the results from the document analysis of green plans from municipalities in the Netherlands, green plans from Purmerend, Apeldoorn, Hengelo and Eindhoven will be discussed with the focus on how these municipalities use the term green infrastructure. The green plans from Rotterdam and Groningen are also included.

4.3.1 Use of the term green infrastructure

The municipality of Rotterdam usually uses the term green-blue network. Here, green is seen as important for climate adaptation and the public health and well-being. In its green plan, the municipality of Groningen refers to the creation of a green network that connects the city to the rural area. The interviewee indicates that the term green infrastructure is not used, but rather a slightly different term is used. The municipality of Apeldoorn wants to strengthen the green-blue network in and around the city. The municipality of Purmerend focuses on green maintenance on structure but does not use any other terms to indicate green infrastructures in their green plan. Eindhoven uses the term robust green structure to indicate that this structure can act as a buffer for rainfall and drought. This requires sufficient diversity in urban green space to be able to cope with the consequences of climate change. The municipality of Eindhoven also refers to an interlacing network of green and blue which forms a recreational connection between residential areas, parks and the countryside. This interlacing network can give structure to the city. Besides providing recognition and identity of a place it also provides an ecological connection and climate adaptive purposes. Examples of this green network are trees, gardens and greening vacant lots, or in other words the more finely-meshed greenery between the large green structures. Hengelo states that a coherent green structure is the basis for healthy green for the preservation of plant and animal species and recreational opportunities for people. The municipality of Hengelo emphasises that the city should be a pleasant green place to live and should have a healthy connection with the surrounding area.

The green plans published by the municipality uses different terms, but the same goals are set and similar definitions are given. The structure and connection of green space is the most frequently used concepts in the green plans.

4.3.2 Value of green infrastructures

The value of green space is seen by municipalities as the basis for their green plans. After all, urban green space can be seen as a multidisciplinary amenity that is of value in different ways and to different users at the same time, according to the municipality of Eindhoven. In the municipality of Purmerend, green space is important to residents; it provides an important experience of the public space. The municipality of Hengelo emphasises that green space is healthy and important for people's feelings of comfort and safety. Here, too, the residents attach great value to greenery around their homes; this shows an increasing need for green recreational facilities close to home. The municipality of Groningen has found that people who live in green areas are healthier and less stressed. Besides being good for one's health, greenery also contributes to climate adaptation; the municipality of Hengelo, for example, claims that it is 10 to 15 degrees Celsius cooler on a hot day under a tree. The municipality of Apeldoorn also emphasises the contribution of green space to improvements for the current and future generation, as research has shown that a green living environment can play a major role in contributing to solutions for various current problems in society.

The green plans of several municipalities in the Netherlands show that green space contributes to climate adaptation, improves ecosystem services and contributes to the health and well-being of residents.

Chapter 5 Conclusion and discussion

This chapter discusses the conclusion and discussion of this research, this includes recommendations and discusses the differences between the two case studies. The limitations and reflection of the research and future research are also discussed.

5.1 Conclusion

This section contains the conclusions of the research where the focus will be on answering the research question and sub questions. Within this section the theoretical conclusions of this research will also be discussed with appropriate recommendations.

1. **How can green infrastructures contribute to improving climate adaptation and public health focused on the vulnerable groups in urban areas?**

Green infrastructures are good for people's health and contribute to climate adaptation; this is also recognised by the municipalities and can be seen from the green plans that are made public. This shows that the value of green space is seen as important by the municipalities. In the green plans this is emphasised by presenting various data on the extent to which green space can contribute to various themes. This is used as a guideline by all the municipalities that are analysed in this study. The municipalities of Purmerend, Apeldoorn, Hengelo and Eindhoven all state, in addition to the municipalities of Rotterdam and Groningen, that green can contribute to climate adaptation, health and biodiversity in the city. Because the municipalities have this knowledge and have researched this matter, green plans have been developed that make green infrastructure a new part of policy implementation.

With regard to the health of residents, the young and the elderly are often mentioned as a target group that would benefit more from an improvement in health through green infrastructure. This often lacks a specific focus on the vulnerable groups; this group includes more than just the young and the elderly and may differ per neighbourhood or district. Although, green infrastructures can contribute to the connection of green spaces throughout the city, which means that if a project is not directly aimed at vulnerable groups, the green infrastructure can still make a positive contribution by drawing people to green spaces. By adding different types of greenery, green infrastructure can make the living environment more attractive; for instance, greenery can reduce air pollution and make it more attractive to spend time outdoors. Greenery also ensures that when there is a lot of rainfall, the water leads to less flooding. In addition, the view of a green space means that residents suffer less from stress and their personal well-being is better than that of residents who do not have a view of a green space.

The addition of greenery at neighbourhood and community level contributes most to climate adaptation and the public health and well-being of residents. This green space will be closest to the residents. The green plans of the municipalities in the Netherlands also show that there is a demand from the residents for more green recreational areas close to home. On the local scale, climate change can cause a lot of problems such as water flooding in the streets and houses, in which case it is important to add green space especially in those areas. The same applies to improving health: green spaces close to home can be used as a meeting place or a place to exercise. It is precisely the groups that suffer most from climate change or whose health is worse that fall within the vulnerable groups. It is therefore important that the focus is on these groups and as close to their homes as possible.

2. **To what extent are vulnerable groups taken into account in the decision-making process of implementing green infrastructures based on procedural, recognition and distributional dimensions in the Dutch municipalities of Rotterdam and Groningen?**

The choice made regarding where to add green space has consequences for its distribution in the city. Rotterdam aims to add 20 hectares of green space within four years. These are challenging tasks, but they may also lead to less thought being given to the process and distribution of the green space throughout the city. There is little or no specific attention for vulnerable groups and often decisions are made based on locations where space is available or can be made available. By identifying target groups, the municipality recognises that young people and the elderly are more vulnerable to the effects of climate change. The needs of these groups are therefore taken into account. However, the municipality does not elaborate on these groups and does not recognise the different degree of knowledge, world views and history of these groups. The municipality of Groningen pays more attention to the vulnerable groups when choosing locations. By setting up a prioritisation system, it can ensure that the green infrastructure is implemented more rapidly in places where the vulnerable groups will benefit greatly.

The municipalities use target groups to indicate who gets more priority in the green plans and which groups are recognised. For both Rotterdam and Groningen the younger children and the elderly are usually mentioned here, the main reason being that they suffer most from heat stress and that green spaces can have a great positive effect on their health. In the two municipal green plans, only these two target groups are often mentioned and not the vulnerable groups as a whole. In a number of urban districts, the municipality indicates that it knows where an older population lives, so this is taken into account. Groningen has conducted many different studies and added these to its green plan to map the current situation on topics such as the ecological and recreational network. These studies are used in the choice of locations for the plans.

The document analysis and the interviews show that especially the participation part of the procedural justice is becoming more and more self-evident, because of the Environment Planning Act in the Netherlands, among other things, the use of participation is becoming more common. Participation is also a recurring theme in projects both municipalities are working on. The focus is still too little on the vulnerable groups, because these groups are less likely to set up a participation project and need more guidance. Rotterdam is working on this issue by guiding participation projects throughout the entire project in order to achieve good end results.

This shows that all three dimensions are present to a certain degree in the decision-making process of the municipalities of Rotterdam and Groningen, but in order to achieve better and more equitable outcomes, more attention should be paid to the vulnerable groups.

3. How can the use of green infrastructure be improved to achieve more equitable outcomes?

Bennett et al. (2019) described that merely looking at the distributional justice is not enough to be able to work towards a sustainable transformation. It is necessary to add two other dimensions, recognitional and procedural. All three dimensions need to be taken place in the decision-making process. For both municipalities it can be concluded that all three dimensions take place in the implementation and preparation of green plans to work towards a sustainable and healthy city. Bennett et al. (2019) described several considerations and guidance for this process. They argue for strategic thinking and planning and that the definition for justice still needs a clear articulation to create a sustainable decision-making process. So far, the municipalities are working on all three dimensions to a certain extent, only for the vulnerable groups this can be developed further. It is important to cooperate with different policy areas, and in this case the social domain is an important area. This policy area has a lot of knowledge about the different groups in society, their knowledge and worldviews. However, this knowledge is still not used enough. This study shows that there is more than just a distributional dimension when looking

at environmental justice, and contributes to the studies of Walker (2009) and Bennett et al. (2019), among others, and further develops the theory of environmental justice by applying it to two case studies in the Netherlands.

For distributional justice, it is better to map out who lives in each neighbourhood and determine their social status, culture and worldviews, for example. These maps can then be used together with other maps, such as flooding maps, to see which neighbourhoods and places require the most priority. Green maps can also be used to see which neighbourhoods have little green space. This way, new green space with more quality is added less quickly to already green areas, but rather to areas where there is little or no green space. These new green spaces will then contribute to the expansion of green infrastructures through the city and can be connected to various other green spaces.

For recognitional justice, the municipalities need to formulate the vulnerable groups further than just the young and the elderly; many more aspects are needed to define these groups. For instance, during the choice of a certain location, the target groups must be considered who will benefit the most and who need the greenery the most. By making it clear from the beginning who the priority is, a purpose can be given to the green space; this is very important to do together with the different groups in society so that it becomes clear what the need is.

Procedural justice is about participation as well as inclusiveness in the decision-making process. The use of participation is becoming more and more self-evident in the municipalities and there is a lot of attention for this as well. By publishing the green plan and making it public, both municipalities have created more transparency and, as a result, the residents are more aware of what the municipality is working on. The inclusiveness of the decision-making process can be improved by looking more at the social contexts and the needs of the local population together with the various policy areas so that climate-related issues can be linked to social issues. In addition, it can be seen that vulnerable groups are less active during participation, and more attention could be paid to this by offering support for local capacity by improving knowledge and skills so that these groups can also participate effectively in the decision-making process. In this regard, it is further necessary for the municipalities themselves to further investigate procedural justice in the decision-making process in order to be able to understand this further.

Currently, the term or similar term of green infrastructure is used, this is often in combination with the publication of green plans by municipalities. In this study, the available green plans of municipalities in the Netherlands were used. The study showed that the term green infrastructure was not used by any of the municipalities studied, but that other terms such as green structure, green-blue network and green connection were often used instead. These terms are also used interchangeably in the green plans. All these terms used together fall under the term green infrastructure. In fact, green infrastructures can be seen as an umbrella concept, and this broad approach ensures that various sectors, policy areas and citizens can be addressed.

How can the decision-making process of implementing green infrastructure in the city be improved to develop more equitable outcomes to increase the public health and climate adaptation including the vulnerable groups in the Dutch municipalities of Rotterdam and Groningen?

Green infrastructure can contribute to climate adaptation and improve the health and well-being of residents. The theory, document analysis and interviews also show that it is true that as soon as these green infrastructures are implemented in neighbourhoods with little or no green space, they can contribute more than in neighbourhoods that already have a lot of green space. This leads to the first recommendation, which is to focus on neighbourhood and community green space in the decision-making process. This green space is closest to the residents and can best provide for climate adaptation and an improvement in the health and well-being of residents.

The vulnerable groups deserve more attention within the municipality; this group is included in the projects up to a certain point, but it is evident that this often happens at a later stage in the process. In the Netherlands, in recent years, more attention has been paid to a different way of working whereby the residents of the municipality can participate more. In addition, the use of green infrastructure is already being linked to many other things, such as health and climate adaptation, sometimes even to the social domain. The second recommendation is therefore to further develop the link with the social domain. In this way, knowledge from the various policy areas can be shared and together achieve more for the vulnerable groups.

By publishing the green plans, these two municipalities are already working on transparency towards the residents; the plans also make extensive use of participation. In the Netherlands, participation is increasingly taken for granted. However, it is necessary to ensure that everyone can participate and that everyone is aware of this. By carrying out various studies on the city, it is possible to find out what the distributions are of certain themes; this is already done to a certain extent by both municipalities. The recommendation is to develop this further. By working together with different policy areas, many more studies can already be combined. As soon as a study on water problems is placed over a study on the presence of greenery in neighbourhoods, it is very easy to prioritise certain places. This ensures that the locations are chosen where the green infrastructure can contribute a lot to the residents and the vulnerable groups are given more priority. The recommendations therefore show that the decision-making process is very important to look at, reflect on and improve in order to achieve more equitable outcomes. The framework of the three dimensions, distributional, recognitional and procedural justice, can be a useful guideline in this regard.

For the municipalities it is also recommended to start using the term green infrastructure with the corresponding definition used by the European Commission. At the moment this term does not appear in the municipalities' green plans, but by using this term it will be possible to improve the decision-making process for the implementation of green infrastructures and ensure more equitable results. The term green infrastructure makes it possible to include the given recommendations such as involving several policy areas and taking into account the vulnerable groups in the decision-making process and in the green plans.

5.2 Discussion

In this research the aim is to bring the considerations of environmental justice in the Netherlands to the forefront in policies and the decision-making processes for green infrastructures. This implies that in the decision-making processes for these green infrastructures questions such as who is involved, who

should be involved should be considered, with attention to different world views and cultures and the short- and long-term effects of the decisions that are taken. This is important because all decisions made by municipalities have both positive and negative effects on different groups in society.

The table below shows both municipalities side by side with the most important results, from which specific recommendations for the municipality have been formulated. It is clear that both municipalities are on the right path; on one topic one municipality is further along than the other and vice versa. In this way, they can learn from each other. Besides the fact that the recommendations discussed are for the municipalities included in this study, they can also apply to all other municipalities in the Netherlands to improve the approach to achieve an equitable and sustainable transformation.

Table 1: Comparison of the results of the municipality of Rotterdam and Groningen

	Municipality of Rotterdam	**Municipality of Groningen**
Location choice	For the choice of locations, the municipality of Rotterdam mainly uses places with an iconic meaning, mostly this are places like squares. Most of these places does not have directly influence on the neighbourhoods around it. In addition, the locations are chosen where space can be made available, such as by reducing the number of lanes for cars. Only afterwards various themes such as climate adaptation and health are linked to the projects.	The municipality of Groningen has a list of projects that they want to implement. This list is first subjected to a prioritisation based on various themes, which results in a certain score and the projects with the highest score are implemented first. The themes of health and climate have been included in this prioritisation system.
	The choice of a certain location has a great effect on the final result; whereas the municipality of Rotterdam often opts for locations where space can be created, the municipality of Groningen is more concerned with prioritisation, indicating places where it is most needed to add greenery. It is recommended to look at the most important prioritisation like the one used by the municipality of Groningen. This way, more positive benefits are achieved during the addition of green infrastructure because it is added in places where it is urgently needed.	
Distributional studies	The municipality started with a study to see the distribution of the high schools in the city to see if this could be improved for a fairer distribution. This is a good start, but the municipality can gain a lot more from this by looking not only at the schools but also at other aspects such as the distribution of green space, and then also looking at the type of green space and its quality.	Groningen is focused on the prioritisation of projects with attention to vulnerable groups. The municipality is already on the right path to mapping this out through various studies and analyses that have been carried out. This makes it clear what is going on in the city, and the various themes can be used together to set priorities.

	In addition, the municipality can also look at the various neighbourhoods and the groups that live there. For example, in Rotterdam it is already known in which neighbourhoods more elderly people live, and this can be further elaborated in order to further specify this group so that the need can be identified. This information can be taken into account in the choice of locations for new projects.	
	The recommendation here is that more studies could be carried out to show the distribution in the city on several themes. Studies can be used to find out what the costs and benefits are and how they are distributed over the city. Groningen already conducted several studies that they use in their projects. Rotterdam has begun to realise what these studies can contribute. For both municipalities, it is important here to further focus these studies on the vulnerable groups and what the effects of the studies are between different groups.	
Target groups	The municipality of Rotterdam uses different groups as target groups in its green plan; the municipality refers to young people, the elderly and the disabled. These groups often have a greater interest in green space to improve their health, to be better able to cope with climate change and for the green space to be accessible to all.	In the green plan, the municipality of Groningen mostly mentions the elderly and young people, as they are often the ones who benefit most from the addition of climate-adaptive measures and the improvement of health and well-being through green space.
	To be able to recognise the target groups it is necessary for the municipalities to further elaborate what these groups exactly entail, stating that elderly, young and disabled people are the priority here is not enough. This needs to be further elaborated on what these groups specifically entail on a local scale because the vulnerable groups include a larger group of people and even within these groups the extent to which they are vulnerable can vary.	
Collaboration between policy areas	The municipality of Rotterdam works together with various policy areas in the initial stages of the seven city projects by organising various sessions with project leaders and by asking for feed-back from the social domain. This is shown in the seven city projects, where each project	The studies conducted by the municipality of Groningen contribute to the view on the city through various themes. The green plan does not specify collaboration with various policy areas, but it does show that there is a strong connection between themes such as

	indicates how it contributes to the five perspectives. Between the social domain and the seven city projects, mutual consultation takes place on what is still missing and what can be added based on the five perspectives in the projects through the plan of requirements.	green space, health and climate adaptation.
	The recommendation, as Rotterdam already demonstrates, is to work together with different policy areas, in order to gain more knowledge but also to look at different decision-making processes. For example, the social domain can contribute a lot by indicating what is needed for vulnerable groups, since this domain has a lot of knowledge about this group. By adding this at the beginning of all projects, it is possible to apply improvements.	
Participation	Rotterdam makes good use of the guidance during participation projects. For example, Rotterdam has let several schools come up with designs for a green playground. They have realised that if there is no proper guidance, the schoolyards end up being less green. By guiding these projects well and ensuring that the maintenance is done by the municipality itself, it is possible to achieve better end results.	In the preparation of the green plan, Groningen conducted many different studies, including surveys with residents. As a result, less attention was paid to participation in the later stages of the projects, although participation was very important in the initial process, i.e., during the decision-making process.
	Both municipalities are on the right path by working transparently, because the green plans are public, the residents can have a part in shaping the green plans and in this way the residents can gain more knowledge about themes like health and climate adaptation and it becomes easier for them to participate. For the municipality of Groningen, it is advisable to further elaborate on participation so that it is still present later on in the projects and not only based on information obtained from the studies. An example of this is the municipality of Rotterdam, which is very specifically focused on participation, especially guiding the participation, so that everything continues to run smoothly and qualitative projects are implemented.	

The green plan of the municipality needs to be improved on a number of aspects related to the three dimensions of environmental justice. For distributional justice, this means examining in advance how different groups are affected by changes by looking at the costs and benefits. The emphasis is on how these costs and benefits are distributed within groups, but also across space and time, i.e., not only in the short term but also how it will appear in the long term. As mentioned before, the vulnerable groups deserve more recognition by the municipality, for this the different traditional practices, cultures and worldviews need to be identified in order to understand them better. Stakeholder analysis and other research methods can be used to document this on a local scale. Procedural justice can ensure good

governance for which transparency, responsiveness and accountability are important. In addition, the municipality's plans must be able to adapt to the different contexts and needs of residents. The use of green infrastructures as a policy strategy provides the connection between the vulnerable groups and the policies for green plans of the municipality, which allows for more attention to be paid to these groups. This research can further lead to a more equitable way of working by municipalities in the Netherlands. For this purpose, the recommendations discussed in the conclusion can be used, in addition, the municipalities can also learn from each other, for this purpose, the table above is a good tool.

As soon as a comparison was made between the various municipalities, it became apparent that the term green infrastructure did not occur once in the green plans, whereas this term is used in the strategy of the European Commission. Although, alternative terms are used, the terms differ from municipality to municipality and also differ in the green plans themselves. This makes it more complicated to compare and analyse the municipalities; in the available plans the municipalities have substantiated it in such a way that it is clear that they are working towards green infrastructures in which green structures or a green network are frequently used terms. This has led to new insights in the research because the term green infrastructures are not very common in the Netherlands and needs more attention in order to become a well-functioning system. However, the study did clearly show that working towards equitable outcomes can go hand in hand with the further development of green infrastructures at the municipal level. A new insight that can be drawn from this study is that green infrastructure can help as a guide to fairer outcomes for all groups in society. It is recommended to consider green infrastructure as an overarching and connecting policy strategy. The overarching approach of green infrastructures combines the various useful policy areas, making more knowledge available that provide better and integrated solutions. The multifunctionality of green infrastructures can be a valuable policy instrument and contribute to the achievement of municipal policy goals.

5.2.1 Research limitations and recommendations for future research

The study is country-specific as it was conducted in selected municipalities in the Netherlands. The selection is based on the possibilities for an interview with the municipality, which resulted in two options. In order to be able to give a better answer for the entire country, it would have been better to interview more municipalities. During the research it was found that not enough municipalities were willing to be interviewed at that time, which can be explained by the corona crisis, among other things. This has led to a conclusion about environmental justice based on the analysis and results of two municipalities, which in turn has led to a certain limitation in answering the research questions. To give a better picture of environmental justice and green infrastructure in the Netherlands, the document analysis of green plans of other municipalities can contribute to this. Several studies of municipalities in the Netherlands are needed to be able to describe a more generalised picture of the Netherlands based on environmental justice. However, the results are consistent with the previously discussed theories. The results may contain a form of bias, because the codes contain own interpretations. By using the grounded theory analysis, the codes are partly based on the used theory, which makes the results more valid.

In order to get a broader picture of environmental justice in the Netherlands, a follow-up study will have to examine how the various municipalities take the vulnerable groups into account in the decision-making process. It is also a useful approach to focus directly on the various policy areas that are related to green infrastructure in order to gain more insight into them. This research also shows that it is possible for municipalities to evaluate and improve their own decision-making process by conducting research

that pays specific attention to the vulnerable groups in society. To be able to research this, it is necessary for more municipalities to work with green infrastructures and make it accessible for everyone to read, in this way municipalities can also learn from each other. This research used in the interview and the document analysis all green plans that are currently open available.

5.2.2 Reflection on research

The methodology shows that this research was in need of insights on the different processes of municipalities. Therefore, municipality representatives were interviewed. However, a better understanding of the municipality structures revealed that it would have been more useful to interview more representatives from the municipalities from different policy areas. Due to the fact that different policy areas can have different decision-making processes that include the vulnerable groups in different ways. Although the current methodology reached a level of saturation, additional interviews within the studied municipalities could have given more insights about the injustice processes in the Netherlands. Especially since the study shows the need to work together with different policy areas, but due to time limitations and possibilities for interviews with municipalities, it has not been included further in this study. As only two municipalities were interviewed, the findings about the difference between municipalities in the Netherlands may be biased. The language barrier, as the interviews were conducted in Dutch, may also have affected the interpretation of the data, as it had to be translated and specific data may have been lost in translation.

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Appendix A - Interview guide

Voorstellen + introductie onderwerp scriptie

1. Zou u zichzelf eerst verder willen voorstellen wat uw functie is binnen de gemeente
2. Zou u iets meer kunnen vertellen over het Groenplan van de gemeente?
    a. Wat zou u geven als de achterliggende gedachte waarvoor dit groenplan is opgestart?
    b. Hoe wordt het plan gefinancierd?
    c. Wie leidt en beheert het project?
    d. Op welke wijze worden de lokale gemeenschappen bij het project betrokken?
3. Wat is uw rol bij dit plan?
4. Voor het plan wat is de achterliggende visie/strategie?
    a. Hoe werd deze visie ontwikkeld?
5. Voor mijn scriptie richt ik mij op de term groene infrastructuren, dit wordt niet specifiek gebruikt in het plan, wat wordt in plaats van deze term voornamelijk gebruikt binnen de gemeente?
    a. Wordt er ook gewerkt met de term groene infrastructuur binnen de gemeente? Waarom wel/niet?
6. Er is steeds meer academische literatuur beschikbaar over de positieve effecten van groen op de gezondheid van inwoners, in hoeverre is dit meegenomen in dit groenplan?
    a. En worden in het groenplan ook de kwetsbare groepen meegenomen?
7. Hoe wordt de keuze gemaakt waar dit groen wordt toegevoegd?
    a. Waar zijn deze keuzes op gebaseerd?
8. Bij de focus op gebieden met gezondheid als aandachtspunt dus voor groen in wijken voor de gezonder ouder worden wordt hier het klimaat of de kwetsbare groepen (door klimaat) ook bij in meegenomen?
    a. Waarom niet/wel?
    b. Wat dan wel?
9. Zijn er al specifieker plekken gekozen voor het realiseren van het plan?
    a. Wat is de hoofdreden om voor deze locatie te gaan? Is dat klimaat, gezondheid of andere redenen?
10. In welke stadium zijn de projecten nu?

- Dank de geïnterviewde voor zijn / haar medewerking.
- Vraag of de geïnterviewde vragen heeft over het interview en / of de verwerking van de (opgenomen) gegevens.
- Vraag of de geïnterviewde op een later moment tijdens dit onderzoek gecontacteerd kan worden voor verdere vragen over dit interview.
- Vraag of de geïnterviewde nog andere contacten heeft voor een interview
- Bedank de geïnterviewde nogmaals en neem afscheid.

Appendix B - Codebook for research question 1

Table B1 – Codebook for research question 1

Code	Code Specification	Description
Term		The term used in the green plan from municipalities and the corresponding definition given.
	Green structure	Term used in municipality green plan
	Green meander	Term used in municipality green plan
	Green Connection	Term used in municipality green plan
	Green blue network	Term used in municipality green plan
Value of Green		The value of green space that is recognised by the municipality in the green plans and why this is recognised.
	Climate Adaptation	The underlying reason to which the value of green space is related by the municipality.
	Health	The underlying reason to which the value of green space is related by the municipality
	Biodiversity	The underlying reason to which the value of green space is related by the municipality

Appendix C – Codebook for research question 2

Table C1 – Codebook for research question 2

Justice dimension	**Code**	**Code Specification**	**Description**
Distributional	Location Choice		The choice made for the location where a certain project will take place.
		_Available Space	The underlying reason chosen for the project location; in this case this is the locations where space can be freed up.
		_Public Health	The choice of location where health plays a role.
		_Climate Adaptation	The choice of location in which climate adaptation plays the main role and ensures more water collection and less heat stress.
	Neigbourhood and community green		Greening the city with a focus on neighbourhood and community green space.
	Priority		When there is a mention of a priority for a certain district or area.
		_Focus areas	The focus areas for the projects to take place or to add green spaces.
Recognitional	Target group		The various target groups that are identified and addressed when greening the city.
		_Youth	The young people specifically mentioned as target group in projects.
		_Elderly	The elderly are specifically mentioned as a target group in projects.
		_Vulnerable Groups	The vulnerable groups that are specifically mentioned as target groups in projects and where a definition is given of what this group includes.
	Approach		The approach used by the Dutch municipalities on how they are greening the city by the use of green plans.
		_Health	The focus on health in the approach to greening.
		_Climate Adaptation	The focus on climate adaptation in the approach to greening.

		_Available Space	The focus on the space released in the approach to greening.
		_Ecological	The focus on an ecological approach in greening.
		_Greening	The focus on greening in the approach.
Procedural	Participation		The participation of residents in the neighbourhoods within the municipalities during the projects.
		_Low	Low participation in certain neighbourhoods and districts and what causes this.
		_High	High participation in certain neighbourhoods and how the municipality has carried this out.

Appendix D - Codebook for research question 3

Table D1 – Codebook for research question 3

Code	**Description**
Approach	The different approaches used by the municipality in the green plans and the decision-making process.
Health	The municipality's motives and reasons for the importance of improving the health and well-being of residents.
Climate adaptation	The municipality's motives and reasons for the importance of improving climate change.
Greening	The municipality's motives and reasons for the importance of adding green to the city.
Term	The term used by the municipality and the corresponding definition given.