Urban Greening in Arnhem City

A Matter of Environmental Justice

Urban Greening and Environmental Justice

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Preface:

Upon completing my master's in Spatial planning at Radboud university, I am presenting this research about urban greening in Arnhem city as a matter of environmental justice. By understanding the urban greening justice issues in Arnhem city, this paper aims to formulate recommendations for Arnhem city council to reduce the injustice matters in Arnhem city and promote inclusion concerning the urban greening topic.

I chose the idea of this research in collaboration with my supervisor, who kept supporting my academic progress. Moreover, later many parties got involved; on the one hand, the city council became interested in getting more insight into the urban greening justice issue in Arnhem city and the recommendations that might be helpful to deal with these issues. On the other hand, Buurtgroenbedrijf and Ruimtekoers, organisations that deal with greenery in Spijkerkwartier and Malburgen, respectively, showed similar interest as the city council.

I want to thank my supervisor for his adequate and continuous guidance until I completed the research. Also, I would like to thank Radboud university, especially my study advisor, the student councilor team, and the social workers' team, who supported me during my hard time, especially while dealing with the consequences of the problems in my homeland Lebanon. Last but not least, I appreciate the participants in this research whom I conducted the interviews with, and I would like to thank them for the information that contributed to the completion of my research.

Furthermore, to my parents in Lebanon, I would like to thank them for their continuous support despite the long distance between us. They tried to keep me motivated and remind me of the messages behind my study and hard work. Also, I am grateful to my Dutch partner and his family, who always offered me a sense of support and inclusion.

Ali Saad

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Abstract:

Urban greening has been a major strategy in the Netherlands to deal with climate change issues. Local Dutch authorities are focusing their planning on greening strategies to improve the green infrastructure. Despite these efforts, urban greening still encounters environmental justice issues detected from different perspectives. This paper aims to understand to what level the green infrastructure contributes to the environmental justice in Arnhem city. This research used environmental justice theory to understand the justice issues in urban greening in Arnhem city based on five different concepts: distributional, procedural, recognition, rights, and responsibilities. The analysis of these concepts was conducted based on the interviews, maps assessment, and the analysis of the documents. This methodological aspect enabled us to understand the disparities in the distribution of the green infrastructure and its procedures and decision-making processes in both study cases. The outcomes of the previously mentioned concepts and the socioeconomic analysis contributed to revealing the recognition issues in each neighbourhood. Moreover, urban greening was distinguished as a duty matter rather than a legal issue for rights and responsibilities concepts. The conclusions of the five concepts showed that urban greening in Arnhem city encounters justice issues. Finally, understanding these justice issues was helpful to formulate some recommendations to reduce the disparities in urban greening across Arnhem city mainly. In general, it can be used for future research to understand the justice issues that might exist in other cases.

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1. Introduction

1.1. Climate Change, Urban Greening and Equity Issues

Extensive research in Europe about the climate field has shown an alarming change in the climate worldwide. These changes can be explained by the increasing warmth weather conditions and decreasing cold ones (Bärring et al., 2007). As part of Europe and concerned about environmental issues over the last decades, the Netherlands has raised climate change dilemmas at governmental and municipal levels. One of the main concerns in the Netherlands is the rising temperature that is causing heatwaves. According to Ams Institute (2020), "A regional heatwave occurs when it reaches 25 degrees or warmer in a specific area for at least five days in a row, with the temperature even rising to a minimum of 30 degrees on three days. To be able to speak of a national heatwave, this must be the case specifically in De Bilt." (Homan, 2020). This issue requires urgent actions to deal with both the short and long term. Sustainable actions that are highly raised and being implemented are Urban Greening strategies that researchers, urban planners and policymakers consider a proper sustainable approach that can be helpful to deal with urban heat waves.

This brief description of the case brings us to the main concept of Urban Greening as a recommended strategy for climate change adaptation and mitigation. Urban areas are known for their higher temperature than rural areas due to the built infrastructure, diverse materials and less greenery. Strategically adding greenery to urban areas would help to improve cooling in the city and decrease the impact of heat stress. This strategy is a sustainable and natural way to climate-proof the city instead of being highly energy-dependent (Bowler et al., 2010). A study in Munich showed outstanding results when Urban Greening's footprint increased. The study indicated that with the current situation of less urban green infrastructure (UGI), the levels of heat stress are still high. However, by using Envi-met, a microclimate simulation software, it is possible to analyse different scenarios of UGI to show how the heat stress level differs by using the greenery as a variable element. The results showed that the trees and green facades indicate a high potential in reducing the heat stress level, in which increasing the footprint of trees alone can reduce the heat level by 13% (Zölch et al., 2016). Such research indicates that Urban greening, with its diverse applications, is an effective strategy for dealing with climate change and mainly the heat stress caused by these changes.

In the Netherlands, Urban greening has gained a significant focus over many decades. The Dutch Government and many municipalities have initiated environmental policies that include urban greening as a main part of the planning strategies (Syahid et al., 2017). Many little details are also taken into account by some Dutch municipalities that can play very important roles from a collective perspective. For example, lately in Rotterdam, many buildings have turned their tiled front spaces into green frontage, increasing the city's green footprint. According to the city council, this was one of the strategies for dealing with climate change issues and emission reduction (Baazil, 2021). Also, in Amsterdam, attention was raised towards urban greening. Financially, the budgets

increased for greening strategies, and the 2020-2050 Green Vision was published. This vision sets some main goals, mainly preserving the existing greenery and planning for improving it (Gemeente Amsterdam, 2021).

Despite all the mentioned attention to greenery and its merits, many issues have emerged mainly related to justice and equity. These issues vary and can be perceived from different perspectives, such as socioeconomic, cultural, advantaged and disadvantaged groups' perspectives (Cooke & King, 2018). A research was conducted in the Netherlands that relates urban greening levels to the analysed socioeconomic status of different neighbourhoods. The results showed that in most cases, there are differences: areas with a high socioeconomic level have significantly higher greenery levels, and the opposite applies as well (de Vries et al., 2020). In another study conducted in an Australian city to discuss the thermal discomfort caused by climate change, one of the outcomes was that the neighbourhoods with poor green infrastructure suffered more from heat stress issues (Byrne et al., 2016). This outcome shows how the disparities in urban greening can lead to thermal inequality issues; in other words, the risks and disadvantages caused by poor greening are not distributed equally among the studied neighbourhoods, thus producing disadvantaged, vulnerable groups. In his research about greening cities to be socially inclusive, Haase et al. (2017) have focused on a significant justice issue that emerged from urban greening called eco gentrification. This phenomenon occurs when residential areas get greener, the housing value gets more expensive, and the middle and low-income groups cannot afford to stay in these places. So these groups, in most cases, have to move to another area with affordable prices while the rich take over (Haase. D et al.,2017). Consequently, Urban greening in such cases is a curse instead of a blessing to the vulnerable groups and submits another form of inequity.

1.2. Research problem statement

Like many other Dutch cities, Arnhem city is making efforts to deal with climate and heat stress issues through urban greening. For example, the city is working on reducing the use of asphalt and increasing the green landscape areas (Boffey, 2020). In addition, greenery through trees is effective for both outdoor spaces and houses at the same time in Arnhem because most of the neighbourhoods in Arnhem are a maximum of three-floor height which trees can shade. Another study by Wageningen university explained that green roofs and facades could be a potential urban greening strategy in Arnhem if the areas suitable for trees are limited (Wageningen University, n.d.).

In 2013, the future cities network report included Arnhem as one of their study case cities (Future Cities, 2013). The study showed that Arnhem has plenty of green spaces that are not equally distributed because of the different ranges of indicated heat stress levels. They concluded that urgent actions are needed to reconsider the urban greening strategies and improve their implementations (Future Cities, 2013). In this document, the analysis of heat impact showed huge disparities among the different neighbourhoods in Arnhem city. By relating heat analysis to greenery levels analysis, it showed that some areas with poor green infrastructure have high heat impact, and the case is opposite in the regions with high greenery levels. So the distribution of risks due to greening disparities is also problematic in Arnhem. Furthermore, Arnhem city has chosen specific neighbourhoods to implement cool green routs, such as Spijkerkwartier (Arnhem

Gemeente, 2020), which already has nine gardens and high trees (Webteam Spijkerkwartier, n.d.). However, in other neighbourhoods, such as Malburgen, voices were raised in 2019 due to high heat stress and lack of greenery (M, 2021). This brings us to the core problem discussed in this paper: justice and equity issues in urban greening. Urban greening is one of the sustainability targets, but this relation is still lacking because greenery alone cannot represent sustainability, and the term extends further to social sustainability. In other words, to achieve social sustainability, equity in urban greening should be achieved. This brings us to question who benefits from urban greening and how the risks of greening are distributed (Gilbert, 2014).

So the problem statement in this research focuses on the city of Arnhem in the Netherlands to discuss the equity and justice issues in the urban greening fields in the city. And as mentioned previously, there are many hints in the document Future Cities emphasising urban greening justice issues in Arnhem City. Hence, the research takes this as the main problem to be discussed.

1.3. Research Aim and Research Question

1.3.1. Research Aim

As discussed in the first part of the introduction, urban greening is an important strategy that the Arnhem city council has already listed on the agenda. This attention can be seen in the latest project they are working on, the green urban cool routes. However, urban greening based on heat stress levels and quantitative analysis related to temperature cannot stand alone to approach sustainable planning; It is also a social issue that should be related to environmental justice as a social issue (Gilbert, 2014). Based on this ideology, the main purpose of this research is to better understand the justice issues in Arnhem city regarding urban greening through different aspects. This research will approach justice by assessing the extent of equal distribution of greening in Arnhem city, its procedures, and emphasising the responsibilities and rights towards urban greening and the recognition matter. By understanding the justice issues related to urban greening in Arnhem city, I will be able to formulate a set of recommendations for the city council regarding their urban greening strategies and their implementation that have the potential to impact heat stress levels. So they will be able to address environmental justice issues and work on reducing these issues contributing to approaching social sustainability. For that purpose, I chose two neighbourhoods in Arnhem city: Malburgen area and Spijkerkwartier area.
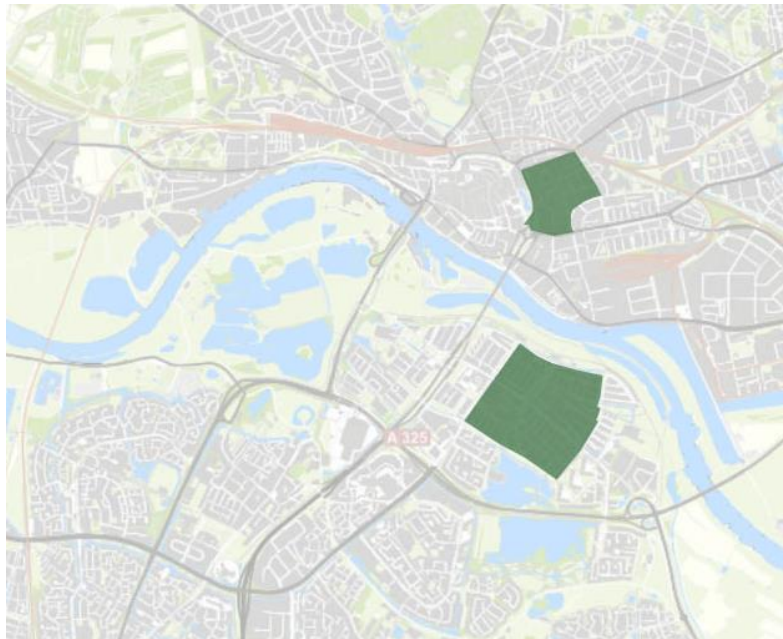
Figure 1 Chosen neighbourhoods in Arnhem City (Atlasnatuurlijkkapitaal)

1.3.2. Research Question

To put the stated problem and research aim in a defined scope, the research will be centred around the following main research question regarding urban greening and environmental justice in Arnhem city, followed by three sub-questions that will clarify different points related to the main research question.

- **Main research question:**

Do the green infrastructure and urban greening strategies in Arnhem contribute to environmental justice?

- **Secondary questions:**

1. How does the distribution of greenery in Arnhem city vary?

2. Upon which strategies and procedures is the greenery designed and distributed (self or public)?

3. How are the current responsibilities and rights regarding urban greening distributed among the people and the city council for implementing greening processes? And to what level this distribution reflects the environmental justice notion?

4. Are all groups and spaces recognised equally in terms of greening? And what factors would impact this recognition?

1.4. Research relevance

1.4.1. Societal Relevance

As explained in the introduction, heat stress is an increasing phenomenon in the Netherlands due to climate change, which was extremely evident during the last three years. However, the disparities appear in society because not all people are equally benefiting from the implemented and planned greening strategies. So presenting the inequality issues in this paper, especially by showing the disparities of urban greening benefits for citizens, is necessary for reconsidering the distribution of urban greening and the related decision making processes. Also, distinguishing the recognition issues is a societal matter needed to formulate an understanding of the vulnerable groups in the society concerning urban greening (Angelo, 2019). In addition, Arjen Buijs (2017) discussed that urban inequalities within the environmental field are increasing, such as the unequal distribution of greenery across cities, the eco gentrification caused by urban greening, the unequal distribution of green spaces across cities, and the limited chances of some social groups to benefit from urban greening. So, understanding the justice issues in urban greening is relevant to the increasing interest in improving urban greening in the Netherlands. These examples support the relevance of the environmental justice topic concerning urban greening. Furthermore, the recommendations formulated based on the results will contribute to reconsidering and reducing inequalities in the urban green field.

1.4.2. Scientific Relevance

A wide range of literature is available on urban greening and the importance of greening. However, if we relate it to environmental justice, there is a scarcity of research that presents greening from the justice perspective and specifically the recognition aspect (Bulkeley et al., 2014). In his book 'Defining Environmental Justice Theories, Movements, and Nature', Schlosberg (2007) mentioned that most literature discusses environmental justice issues based on the distributional conception. This approach is suitable to a certain extent but still limited, in which more justice-related concepts should be included and discussed to reach a thorough understanding of the environmental justice issues (Schlosberg, 2007). Both Rawls (1999) and Schlosberg (2007) also highlighted the conflict of interrelating different justice concepts to understand environmental justice thoroughly. For instance, theorists who rely only on distributive justice were not familiar with integrating recognition as part of their studies, making these existing kinds of literature lack a comprehensive approach to the justice theory (Rawls, 1999, & Schlosberg, 2007).

This paper would contribute to the scarcity of literature related to the multi conception of environmental justice in urban greening through the case of Arnhem. Moreover, it will explain the distribution concept of justice and other concepts, namely procedural justice, recognition concept, rights and responsibilities as justice matters regarding urban greening. Combining these concepts will contribute to a comprehensive understanding of justice issues.

1.5. Reading Guide

This thesis consists of six chapters. The first chapter is the introduction that includes a brief introduction to the topic, problem statement, the aim of the research, main research question with a set of sub-questions, and research relevance. The second chapter starts with a more focused literature review, and then the environmental justice theory will be explained as being the theoretical framework for this paper. Chapter 3 is the research methodology. In the beginning, I will explain the research philosophy and strategy, give a detailed explanation of the data collection methods and data used, and discuss the validity and reliability of this research. In chapters 4 and 5, the cases of Malburgen and Spijkerkwartier will be analysed, respectively. Chapter 6 will present the main conclusions of the research and engage in a discussion on the results and limitations of the research. The thesis concludes with a set of recommendations to those involved in planning urban greenery.

2. Theoretical framework

This chapter will start with a literature review about urban greening and some related justice issues to better understand the topic of this research. The literature review is divided into two parts, one about urban greening as a climate adaptation approach and the second explaining justice-related issues within the urban greening field. Then the theory will be explained based on five related concepts that will also be discussed in detail to form the main structure of this research. The last part of this chapter will present the conceptual model and the operationalization of the used theory and concepts.

2.1. Literature review

For this paper, it is necessary to understand the concept of urban greening, its benefits and implications that show why it is necessary to earn more focus. Therefore, I will present literature focusing on urban greening definitions and other literature that explain how this concept is perceived in different cities. Lastly, I will present some literature that explains urban greening as a matter of justice, even though this topic is still not widely present in the academic literature.

Urban greenery as a climate change adaptation approach

A wide range of studies indicated the potential of greenery, especially urban trees and green facades, in reducing heat stress outdoors and in the indoor place where the trees and green facades perform proper shading (Lee & Mayer, 2018). A study was done on two neighbourhoods to show the impact of greening on the temperature levels. In this study, the green scenario dominated by trees showed efficient results in reducing the impact of high temperatures due to the shading effect from the trees. However, the other scenario was also green, but the grass was the dominant green element; it showed less impact on the temperatures than in the first scenario (Bowler et al., 2010). So urban greening is a wider field than only having greenery; it also relates to typologies of greenery and its dimensions. Another case study was conducted in China to assess the effect of decreased urban greening on the ecological system due to the urban sprawl. One of the conclusions of this case study was that more green corridors should be integrated into the city plan to retain the balance in the ecosystem and decrease the heat island effect (Li et al., 2005).

Urban greening and justice issues

Justice is a very wide notion, and it appears as a controversial matter in different fields that already occupy a significant part of existing literature. However, concerning the urban greening field, the justice matter still needs more attention to realise and understand the existing issues in urban greening (Rutt & Gulsrud, 2016). An article published by the Nature of Cities has explained the existence of injustice in urban greening by explaining the notion of socio-ecological conflicts (Kemer, 2020). This conflict relates the uneven urban greening distribution to the gaps in social levels that exist in every society, for example, low income and high-income people, race, ethnicity etc. (Kemer, 2020). In his article "Climate Justice and the Right to the City", Cohen (2018) highlighted a significant aspect of some urban greening strategies that cause the increase in real estate values leading to gentrification. This brings us again to another justice issue derived from

urban greening. In other words, it can be called green gentrification (Cohen, 2018). Other literature has explained the justice issues related to urban greening in the United States are related to forms of ethnic and racial oppression (Wolch, Byrne & Newell, 2014). In addition, policymakers, in most cases, avoid the justice issues when dealing with urban greening strategies (Haase et al., 2017). This fact necessitates a better understanding of the relation between urban greening and the derived social impacts. These social impacts in some studies were represented by the disparities of benefits experienced by the society from the urban green strategies (Haase et al., 2017).

In some cases, greening strategies are planned according to profit-oriented urban projects, which indirectly relate to society's high-income groups, presenting another issue of justice in urban greening (Byrne 2017). A study in Australia showed that the vulnerable groups in the society are becoming less caring about climate change because they are being marginalised, thus performing fewer efforts to be involved in greening strategies (Ambrey et al., 2017). Rubin (2011) argued that many urban greening movements are working on spreading knowledge about the importance of greening and, most importantly, shed light on the inequalities in urban greening by working on the existing justice issue and promoting re-greening communities and cities justly and equally. Many environmental movements also supported these movements due to the shared issues related to greening justice (Rubin, 2011).

Some recent literature has related the issue of urban greening in the Netherlands to the environmental justice issue. In the literature entitled "Environmental Justice in The Netherlands: Presence and Quality of Greenspace Differ by Socioeconomic Status of Neighbourhoods", de Vries, Buijs & Snep (2020) have mentioned a significant ideology in planning for the transition toward sustainability. In order to achieve sustainability, the transition should be just in terms of responsibilities and benefits. In this literature, urban greening was assessed with the three socioeconomic layers of neighbourhoods in the Netherlands, and the main indicator is income. The result was that neighbourhoods with lower status also have less greenery and the opposite for higher status neighbourhoods. However, there are some real limitations to measuring greeneries and the indicator for the socioeconomic measure, so this requires further studies and research (de Vries, Buijs & Snep 2020). Moreover, the report done by Future Cities about the climate in Arnhem correlated the existence of heat islands in Arnhem, causing heat stress mainly in areas that lack greenery. On the other hand, areas with more availability of greenery showed less impact of heat stress on residents (Burghard et al., 2010).

2.2. Environmental Justice Theory

Over many decades, justice has gained much attention in the theoretical field that is considered a broad term in theory and can be discussed from many social, political, cultural and other perspectives. John Rawls, an American philosopher in politics and ethics, attempted to build the justice theory to shed light on inequalities and injustice in different fields and to draw out an approach to a just society (Davies, 2018). In his book 'A Theory of Justice', Rawls (1999) started by describing "Justice as fairness" it is taken as a concept that can be applied to a variety of scenarios and domains. The justice theory by Rawls aimed to approach a substitution for the utilitarian ideology because he believes that utilitarianism cannot offer a valid and just account of

basic rights for the citizens to individuals with equal freedom, rights and responsibilities (Schlosberg, 2004). Rawls also formulated a set of principles for justice that, according to him, should be considered a basic structure in a just society, and they can be used as measures for justice. Many processes were developed through the justice theory to understand what is just and what is not through many conceptions rather than distributive justice. Besides the distributive conception, Rawls has distinguished the procedural justice and recognition conception; also, he explained how the rights and responsibilities could be perceived from the justice point of view (Rawls, 1999). For this research, Rawls's book serves as a departing step for the theory chapter so that I can start the theoretical framework by using Justice theory and the interlinked concepts to build a conceptual framework that relates to the main research question and form an integrated base to conduct the research and answer the main question.

From the generic justice theory, I will use a more specific approach, namely the environmental justice theory, that is related to the main topic of this research. Starting in the United States in the 1980s, many activists in the environmental domain initiated an environmental movement after dumping toxic wastes near a low-income neighbourhood inhabited by African-American citizens in North Carolina, and the aim was to shed light on the environmental issues, including inequality concerns (Lehtinen, 2009). This emergence of the movement has influenced philosophers and theorists to put more focus on the justice discourse within the environmental field (Byrne et al., 2002). The environmental justice theory provides a framework to examine the justice issues and the environmental inequalities related to the social realm through a variety of concepts (Johnson, 2012). David Schlosberg (2014) described environmental justice movements as follows: "*Environmental justice movements explore, represent, and demand justice—fair distribution, recognition, capabilities, and functioning—for communities as well as individuals*" (p. 5), so the movements use different concepts to emphasize the justice and injustice concerns. Likewise, in theory, environmental justice theory can be used according to a pluralistic character by using many concepts like procedures, recognition, capabilities and rights besides distributional justice, which enables to obtain a comprehensive analysis and understanding of justice issues from a wider viewpoint (Schlosberg, 2004).

In order to make use of the environmental justice theory, a comprehensive conception is needed, which means many interrelated concepts should be used to build a framework that can lead to an answer to the research question. If we start with the classical conception, four main concepts will be used to draw a justice framework which is the distributive, procedural, responsibilities and rights. This model would be two dimensional as Bulkeley et al. (2014) conceptualize it as justice in terms of responsibilities and rights that are decided upon existing procedures and distributions. So on one axis stands the rights and responsibilities as the first dimension and on the second axis stands distributions and procedures (Bulkeley et al., 2014). This conception of the environmental justice theory, according to Schlosberg, is still missing the recognition concept in order to build a concrete theoretical framework. Schlosberg (2004) stated that "*a thorough notion of global environmental justice needs to be locally grounded, theoretically broad, and plural – encompassing issues of recognition, distribution, and participation*" (p. 518). Likewise, Fraser (1997) has discussed that justice distribution and procedures as concepts cannot stand alone to produce a concrete framework for understanding environmental justice, where recognition is also needed with

them (Fraser, 1997). These critiques helped improve the classical two-dimensional frameworks to become a three dimensional one, in which the first two dimensions are similar to the classical model, the third dimension is occupied by the recognition concept, and these three dimensions are presented on a multi-faced pyramid (Bulkeley et al., 2014). The pyramid conception is shown in figure 2, and it will be further explained in the last section of this chapter in the conceptual model and operationalization, where I will also explain the conceptual model for this research.
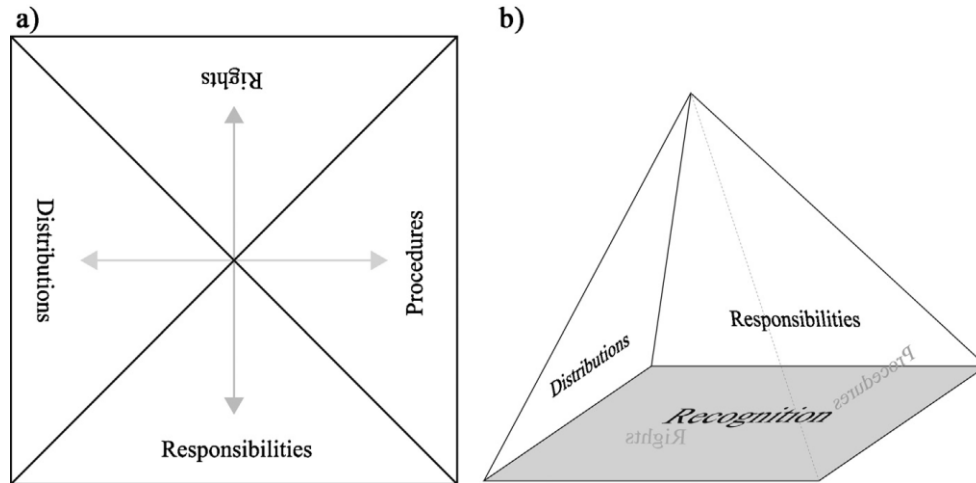
Figure 2 The three-dimensional climate/environmental justice pyramid (Bulkeley et al, 2014)

The theoretical framework of this research is inspired by this pyramid framework. In this research, the main question, "Do the green infrastructure and urban greening strategies in Arnhem contribute to environmental justice?" is directly related to the environmental justice framework, which makes the choice of the theory suitable for answering this question, but it is important to draw a specific scope for the theory by using specific interrelated concepts because as mentioned the justice theory previously is a broad framework and in every topic, a specific conception or group of them should be adopted to be able to conduct the study clearly and minimize the shortcomings in the study. So the five concepts presented in the pyramid will be used to frame the chosen theory and conduct this research.

2.2.1. Distributive Justice

Davoudi and Brooks (2014) used the statement "who gets what?" as a brief representation of the distribution concept; it is concerned with distinguishing the equal and unequal distribution of advantages and disadvantages in any related field (Davoudi & Brooks, 2014). The distribution concept was one of the main concepts in Rawls' work on justice theory, especially when he defined justice as fairness. However, there was a conflict in framing the notion of fairness; according to egalitarian theories, fairness is defined as equality, libertarians call it equity, and for utilitarians, it is welfare. For Rawls' welfare, the utilitarian thoughts were the adequate representation of fairness, and this definition entails that the distribution in the society should be based according to the needs of the people in that society (Rawls, 1999). So moving systematically from bottom to up, from welfare to fairness to justice, distribution was the key element used to measure welfare. The concept refers to the distribution of goods and bads in society, which also applies to the environmental

justice field regarding either equal or unequal distribution of environmental bads and environmental goods (Haase et al., 2017).

It is challenging to use the distributional concept because it includes a quantitative and qualitative assessment, the first uses numerical data, While the qualitative assessment evaluates virtual matters such as choices, opportunities, goodness and disadvantages (Boone et al., 2009). The distribution concept in this research will be used by measuring and evaluating the distribution of greenery, which represents the goods, and the distribution of the heat stress, which represents the disadvantages, in both case studies. According to the results obtained from the distribution analysis, it will be possible to partially discuss the environmental justice issues based on distribution.

2.2.2. Procedural Justice

Another concept for justice is procedural justice which can be broadly understood as equality in the procedures, specifically in this topic, the decision-making processes related to greening and environmental matters and the level of participation. Procedural justice is related to democracy in how participation is involved in the decision making processes (Schlosberg, 2004). In other words, democracy here means the ability of people to know about decisions and impact them, whether by evaluation or even altering the decisions for collective benefits. Moreover, the environmental field's decision-making is related to a great extent to the participation processes that involve both the citizens and the authorities (POLICYMIX, 2011). Participation represents a measure of the inclusiveness of procedures, and it refers to the level people are being heard and whether they can impact decisions or not. So, inequalities in procedures lead to environmental justice issues, such as creating vulnerable groups who encounter risks or do not receive the benefits (Heydon, 2020).

Alone distributive justice cannot deliver a comprehensive understanding of environmental justice, so together, procedures and distribution can offer strength for the justice argumentation. As Young (1990) discussed, the just or unjust distribution is the production consecutively of just or unjust procedure, meaning that distribution can be an outcome of the procedures. So approaching justice is not only about how things are distributed but also about the processes and strategies that lead to this distribution, which expands further the study of environmental justice. Participation is part of these strategies that can impact decision-making. According to Pretty (1995), there are seven types of citizen participation in decision-making, as shown in Table 1. Analysing and comparing the typology of participation among different cases and how they are impacting decision-making contribute to the realisation of procedural justice issues (POLICYMIX, 2011).

To unpack the procedural concept in this research, we need to understand the decision-making processes for urban greening and the participation typology in each case. First, I will explain the strategies and procedures used by Arnhem city council for urban greening in the chosen cases based on the decision-making processes. Then, I will investigate the typology of citizen participation that reflect an understanding of the decision making processes. So, this concept will contribute to understanding the urban greening procedures and the role of citizens and the city council in this process. By comparing the procedural aspects of both neighbourhoods, we will be able to understand the procedural justice issues.

Table 1 A typology of participation: how people participate in development programs and projects (Pretty, 1995)

Typology	Characteristics of each type
1. Manipulative participation	Participation is simply a pretense, with "people's" representatives on official boards but who are unelected and have no power.
2. Passive participation	People participate by being told what has been decided or has already happened. It involves unilateral announcements by an administration or project management without any listening to people's responses. The information being shared belongs only to external professionals.
3. Participation by consultation	People participate by being consulted or by answering questions, External agents define problems and information gathering processes, and so control analysis. Such a consultative process does not concede any share in decision making, and professionals are under no obligation to take on board people's views.
4. Participation for material incentives	People participate by contributing resources, for example, labor, in return for food, cash or other material incentives. Farmers may provide the fields and labor, but are involved in neither experimentation nor the process of learning. It is very common to see this called participation, yet people have no stake in prolonging technologies or practices when the incentives end.
5. Functional participation	Participation seen by external agencies as a means to achieve project goals, especially reduced costs. People may participate by forming groups to meet predetermined objectives related to the project. Such involvement may be interactive and involve shared decision making, but tends to arise only after major decisions have already been made by external agents. At worst, local people may still only be coopted to serve external goals.
6. Interactive participation	People participate in joint analysis, development of action plans and formation or strengthening of local institutions. Participation is seen as a right, not just the means to achieve project goals. The process involves interdisciplinary methodologies that seek multiple perspectives and make use of systemic and structured learning processes. As groups take control over local decisions and determine how available resources are used, so they have a stake in maintaining structures or practices.
7. Self-mobilization	People participate by taking initiatives independently of external institutions to change systems. They develop contacts with external institutions for resources and technical advice they need, but retain control over how resources are used. Self-mobilization can spread if governments and NGOs provide an enabling framework of support. Such self-initiated mobilization may or may not challenge existing

2.2.3. Recognition as a Justice concept

As an entry in this chapter, it is worth highlighting Hegel's general consideration about recognition in which freedom and justice for the individual can be achieved as long as they are recognized by other individuals or the state itself that has the power (Coolsaet & Néron, 2020). In this research, the recognition concept will be discussed within the environmental justice scope, which can be briefly explained by the notion of "who counts?". In society, different classes receive differentiated

environmental benefits and risks, and the level of this differentiation reflects the justice or injustice in recognition (Davoudi & Brooks, 2014). Referring to Heydon (2020), who is affected by Fraser, he defines recognition within the environmental justice framework as the extent to which the individuals in the society and different places are recognized when dealing with environmental issues. To talk about just recognition, the equal opportunities of individuals, social groups, and places is a major condition (Heydon, 2020). Another researcher Walker (2009), inspired by Fraser, stated that "Second justice as recognition (Fraser 1997; Honneth 2001) in terms of the processes of disrespect, insult and degradation that devalue some people and someplace identities in comparison to others" (p. 615).

In both cases, the concept of recognition in this research will be unpacked after distinguishing the distributional and procedural patterns of green infrastructure. This concept will lead to conclusions regarding how both neighbourhoods, as residents and places, receive the benefits of sufficient greening or the impacts of less greening. So, the different distribution of these benefits and impacts can be evidence of misrecognition. Rubin (2011) has related the recognition matters to the socioeconomic gaps in society. For instance, low-income groups are the vulnerable and disadvantaged in most cases. Also, different ethnicities, origins, and cultural backgrounds can be a reason for misrecognition (Schlosberg, 2007).

The three concepts of justice, distributional, procedural and recognition, are briefly explained within the urban greening perspective by Anguelovski et al. (2020), and their work was inspired by Schlosberg (2007). Table 2 (Anguelovski et al., 2020) explains how inequalities and justice issues can be perceived through each of the three concepts.

Table 2 Unpacking traditional approaches to understanding justice in urban greening (Anguelovski et al, 2020)

Traditional types of justice	Injustices in urban greening
Distributional justice	• Inability of greening projects to address past inequities in green access and historical environmental justice concerns • Vulnerability to and presence of green gentrification and climate gentrification • Health benefits of greening inequitably distributed and undermined by physical and sociocultural displacement threats
Interactional or recognition justice	• Privileging of large green infrastructure and other flagship projects attracting higher income and socially privileged residents and investors into marginalized geographies • Invisibilization of complex socionatures and past experiences of historically marginalized groups in regard to urban greening • Inability of urban greening planners and decision makers to recognize structural inequalities in access to high-quality, livable neighborhoods and address historic green and housing segregation
Procedural and participatory justice	• Exclusion of input and decision-making power by historically marginalized groups in the planning, design, and management of greening and of ecosystem service protection interventions • Tabula rasa of neighborhood histories, identities, and experiences for historically marginalized groups • Challenge of creating true participation with traditional planning tools and guaranteeing intersectoral collaboration

2.2.4. Rights and Responsibilities as Justice concepts

While the previously discussed concepts occupy two dimensions of the theoretical framework, the third dimension stands for rights and responsibilities. Both principles are fundamental matters in Rawls' (1999) justice theory. Rights and responsibilities share a reciprocal relationship, as Schlosberg (2007) explained. For instance, citizens have the right to access a healthy environment, and at the same time, they are responsible for taking care of the environment. Also, Schlosberg (2007) discussed the interdependence of rights and responsibilities with the three concepts (distribution, procedural, and recognition). Democratic participation represents the right that emerges from the procedures and characterizes the recognition aspect; in that sense, we can understand the interdependence mentioned previously. Furthermore, within justice framing, the distributional aspect of rights reflects the fairness of rights in society (Schlosberg, 2007).

The rights/ responsibilities matters can be framed by access and allocation. Access represents the right to gain advantages from something; in terms of justice, equal and unequal access is the main discussion. In comparison, allocation refers to the responsibilities toward something or the duty to let something work properly or reduce its disadvantages and vulnerabilities (Grecksch & Klöck, 2020).

This framing is suitable for my research to relate environmental justice and urban greening to the rights and responsibilities matters. I will investigate in this study the existing rights of the citizens to access urban greening and the environmental and spatial rights stated by the city council. Also, I will try to distinguish the allocated responsibilities toward urban greening: who is responsible for implementing urban greening for improving environmental and citizens' matters. It can be the state's responsibility or the citizens' or even shared differentiated responsibilities.

2.2.5. Objective and Subjective Matters

Objective and subjective matters are the tool used to formulate the conceptual model for this research that will be explained in the last part of this chapter. Objectivity in this study refers to quantified data and facts that cannot undergo different points of view, so it carries a clear reality. For example, the data from the maps represent the greenery distribution and its measures as a quantity. In this concern, objectivity within the distributional and procedural contexts represents measurable data, which in later stages reveals a subjective character when judging its fairness. However, subjectivity is based on perceiving things from different points of view. Surveys and interviews tend more to present subjective realities and viewpoints.

Regarding justice in the urban greening topic, citizens' points of view might differ from others' and the state's perspectives (Xu et al., 2021). Explaining the five concepts in this research based on objective or subjective matters will be challenging because both can apply to the same concept. The research examines the fairness of greening in two case studies based on the following concepts: distribution, procedures, recognition, responsibilities and rights. According to Fraser (2003), distribution and partially procedures can guarantee an objective side of justice, and at the same time, they include some subjective matters. However, recognition, rights, and responsibilities

reflect the intersubjective pattern, which represents a similar subjective point of view among a group of conscious minds (Fraser, 2003). The five concepts are interrelated and will be discussed interdependently according to either objective or subjective patterns, and in some concepts, both can apply. So, by discussing the five concepts based on objective and subjective matters, we will be able to reach a comprehensive understanding of environmental justice issues in urban greening.

2.3.   Conceptual Model and operationalization

The conceptual model by Bulkeley et al. (2014), presented previously, is a starting point and inspirational model to draw the conceptual model of this research. Bulkeley used the five concepts to approach justice by locating them on the prism in her model. By zooming into the prism, it is clear that the allocations of the concepts are not random. According to the researcher, the choice of the prism is due to the refraction phenomenon. This metaphor here refers to the interlinkage between the five concepts. In the model, distribution and procedure are placed as one dimension facing each other because they are interrelated, and the same applies to rights and responsibilities. However, recognition is placed in the base to show that all the other four concepts refract to the bottom base, showing a relation between recognition and other concepts (Bulkeley et al., 2014). The basics of this model, represented by the use of five interrelated concepts to frame justice, will be essential for the conceptual model for this research. I developed a conceptual framework to better understand the operationalisation of the environmental justice framework through the five related concepts, as shown in figure 3. First, this research will focus on two neighbourhoods in Arnhem city that will undergo the assessment, namely Malburgen and Spijkerkwartier areas. For each case, I will analyse each of the three dimensions separately, and later the conclusions will interrelate all these concepts together to reach a comprehensive understanding of the environmental justice issues for the chosen cases.

The analysis of the five concepts in both cases will lead to a comparison scheme to distinguish the disparities in urban greening between both cases in terms of distribution, procedures, recognition, rights and responsibilities. The existence of disparities indicates environmental justice issues, which is the main concern of the research question. Finally, the last step will be formulating some recommendations for the city council.

Conceptual framework diagram:
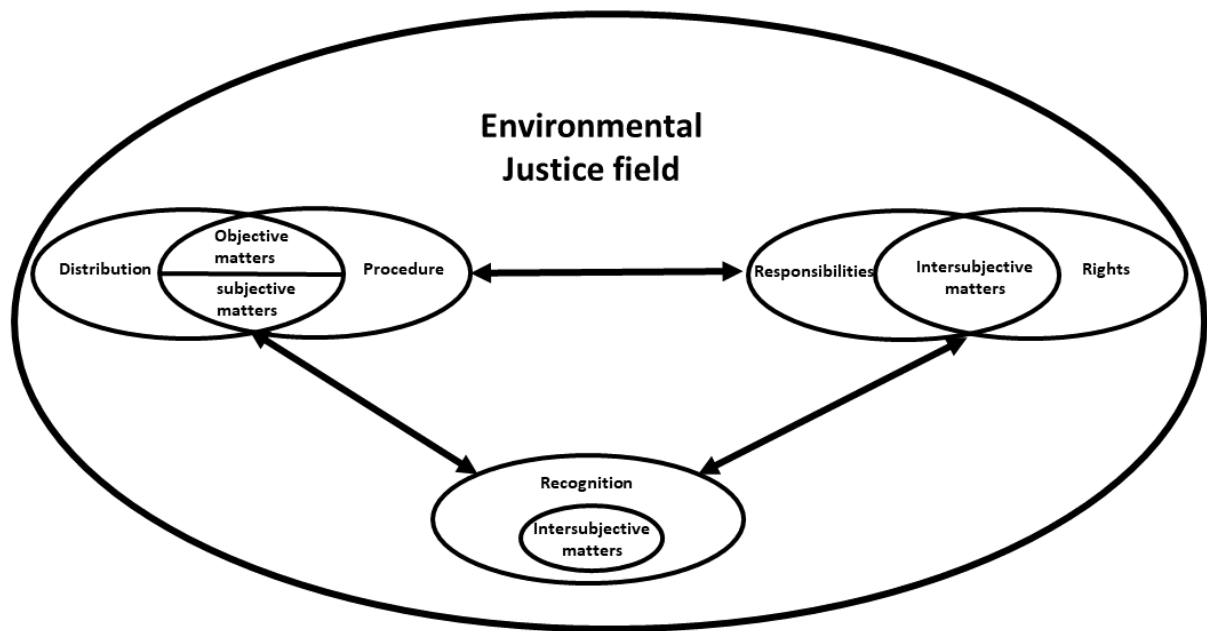
Environmental Justice field

Distribution — Objective matters / subjective matters — Procedure ↔ Responsibilities — Intersubjective matters — Rights

Recognition — Intersubjective matters

Figure 3 Conceptual Model (by researcher)

3. Methodology

This chapter explains the methodological framework for this research. Starting with the research philosophy, I will explain which philosophical interpretive framework is followed for conducting this research. This will help decide the research strategy that will lead to a clear decision on the methods for data collection and analysis. In the last part of this chapter, I will discuss the validity and reliability of the research.

3.1. Research Philosophy

Research philosophy deals with three main philosophical assumptions: ontology, epistemology, and methodology (Guba & Lincoln, 1994). Both ontology and epistemology are essential principles for which paradigm or interpretive framework the research follows, so it is crucial to interpret both principles for this research to the philosophical base that will drive this research. The methodological assumptions will be explained in the coming sections. Objective and subjective stances are one of the major factors that characterize the ontological and epistemological patterns of the research. Subjectivists argue that reality and knowledge are built and known through the social actors' intervention, depending on individuals' beliefs and experiences that can differ based on the different situations and experiences. On the other hand, objectivists believe that reality and knowledge are constructed independently of social factors and individuals' interventions (Saunders et al., 2019).

Researches about justice are part of the ethical studies that deal with social issues such as marginalized groups, domination and oppression, and advantaged and disadvantaged groups, which is supported by the subjectivists' theorists (Rawls, 1999). The main topic of this research is about understanding the environmental justice issues related to the urban green infrastructure under the concepts of distribution, procedures, recognition, rights and responsibilities, also including targeted groups in the society to conduct the research. So there exist substantial notions, for instance, dealing with inequalities that create vulnerable groups and marginalized places. The justice issues can be distinguished by studying society's experiences (states and citizens), which makes it dependent on the social actor. So, the knowledge in this research will be constructed through the beliefs and intervention of both state and citizens. An important consideration for this research, it does not necessarily fit in other cases or municipalities because different experiences, realities, and knowledge might apply. As Creswell (2017) discussed in his study about research philosophy, the transformative paradigm approaches injustice and marginalized groups in an attempt to lead to some changes. In addition, postmodernist studies try to understand the recent realities through different perspectives. Creswell (2017) also explained that both paradigms share similar philosophical beliefs where reality is often subjective and, in some cases emergence of objective realities can take place, and the knowledge is constructed in multiple ways (Creswell, 2017).

3.2. Research Strategy

Research strategy is the trajectory plan that introduces the methodological plan of research. It reflects coherent and interlinked choices that trace in what ways the research will be processed,

aiming to answer the major questions related to the research topic (Saunders et al., 2019). The main topic of this research is to understand environmental justice issues regarding urban greening better. A case study in Arnhem city is a suitable strategy that will help answer the main research question and fulfil the aim of this research.

The case study is characterized by a holistic approach that applies in real-life perimeter dealing with a specific issue or phenomenon. Usually, it has a specific focus that needs collecting much data because a case study focuses on the depth and quality of dealing with the issue rather than the quantity of these issues and phenomena (van Thiel, 2014). So, the case study is suitable for this research and matches the research aim. The main focus of the case study in this research is urban greening in Arnhem city within the equality and justice scope, and it requires in-depth understanding. Therefore, this study will use a qualitative approach, supported by quantitative data.

The main idea of urban greening will be assessed according to environmental justice in two neighbourhoods, the Spijkerkwartier and Malburgen, and the choice for these two cases will be explained later in this chapter. So in the first step, I will investigate the layers of greening, heat levels distribution and socioeconomic levels. These three layers will be overlapped to distinguish the existing relations among them, and this step will contribute to the distributional justice concept by showing whether the distribution is equal in both cases or disparities exist. The next step will be the assessment of procedures, recognition, rights and responsibilities, mainly based on the interviews that represent data from different perspectives. So this will allow understanding of the justice issues related to the four concepts mentioned above.

In this research, the case study needs qualitative data collected through interviews, desk research and observations, and quantitative data taken from maps. Both inductive and deductive pieces of research can be studied through a case study research strategy. Deductive research is more driven by theory, while in inductive research, usually, the data guide the research (Saunders et al., 2019). This research follows a deductive approach, it starts with a built theory about environmental injustice, and the theory will be the main driver to reach the conclusion which either proves the existence of justice issues or not.

3.3. Research Design

This diagram below schematizes the research design of how the conceptual model will be used to analyse both case studies and relating them together in order to answer the main research question.

Urban Greening Domain
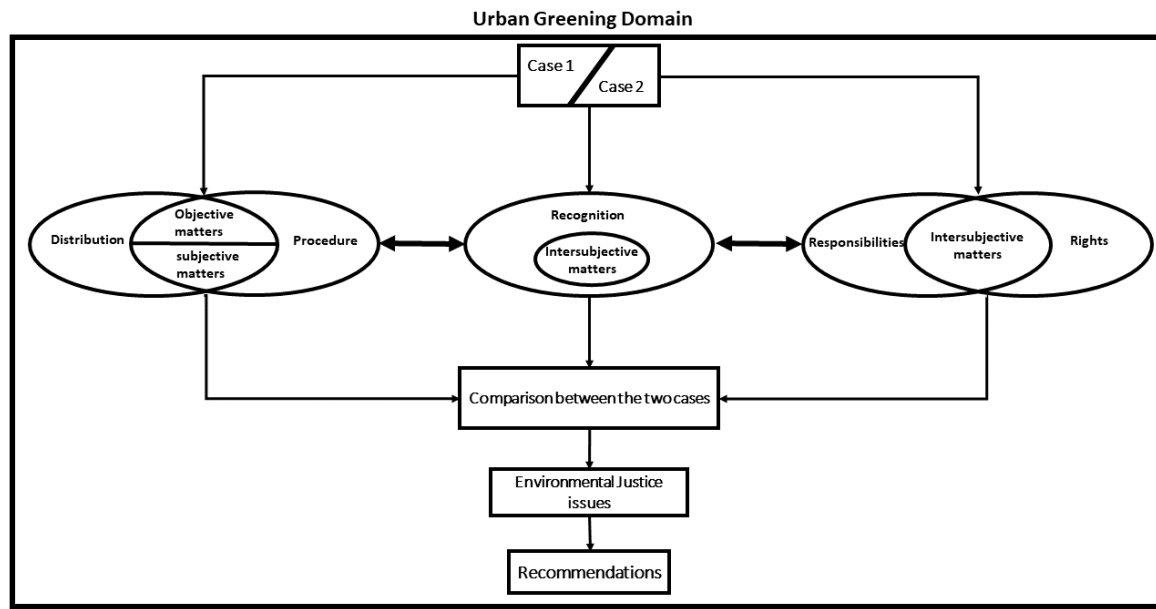
Figure 4 Research design

3.4. Data collection

In this section, I will first explain the choice of the case studies and the measures behind planning this decision. After that, I will elaborate on the data collection methods. In case study research, a triangulation of data collection strengthens the process, and it is applied by using mixed methods for data collection (Van Theil, 2014). So, to explain the five concepts used in this research, I will use the triangulation method to collect the data. By applying a triangulation strategy for data collection, I will use the following methods of data collection: observation, interviews, document analysis, and GIS maps (Klimaateffectatlas and Atlasnatuurlijkkapitaal).

3.4.1. Case studies and selection

One of the main characteristics of a case study is that it translates the concepts within the theory into real-life settings. So these concepts can be studied through experiences and existing examples (Van Thiel, 2014). Two neighbourhoods in Arnhem city will be chosen according to the following criteria: (1) the demand for greening by the community where voices are raised concerning urban greening related issues and (2) municipal attention to improving the green infrastructure. Previously, I mentioned why choosing Arnhem; however, the challenge here is choosing the two neighbourhoods. The main indicator I am looking for is the variable in demand for greening. Also, I am looking for two neighbourhoods where opposite scenarios apply regarding urban greening, one receiving further attention regarding greening, while the other voices are being raised due to problems related to the green infrastructure. Based on these criteria and the documents I read about greening in Arnhem, I chose the neighbourhoods Malburgen and Spijkerkwartier as the two case studies for my research.

These two areas were chosen based on the two different scenarios related to the two key indicators mentioned previously. First of all, as mentioned in the latest document for climate adaptation by

the Arnhem city council, the Spijkerkwartier area is among the three areas in the city chosen by the city council to implement green urban cool routes as a process to mitigate heat stress impact within the residential areas (Arnhem Gemeente, 2020). In addition, Spijkerkwartier is known for its nine gardens that offer a green character to the neighbourhood and the trees canopies along some of the streets there (Webteam Spijkerkwartier, n.d.). However, in Malburgen, the case is different; in 2019, the neighbourhood residents were protesting against the construction of residential flats in the absence of proper green planning that would contribute to the heat stress issue. These raised voices led the city council to plan a green public space in the neighbourhood that is not applied yet for more than three years, and it was considered weak because the chosen location is away from the houses and close to the main road (M, 2021). Opposite to the Spijkerkwartier case, in Malburgen, voices are being raised due to the lack of greenery and serious municipal attention. So the two indicators show a contradiction in scenarios between Malburgen and Spijkerkwartier, which make these cases suitable for this research.

3.4.2. Greenery data methods

The first step of data collection will contribute to answering questions about the distributional justice concept. For this part, I designed a double-check strategy for the distribution of greenery in both neighbourhoods. This strategy consists of two phases. I will observe the actual greenery level through photos and the existing satellite GIS maps in the first phase. In the second phase, I will assess the green infrastructure through maps that show greenery through colour key indications and numerical settings. These greenery data will be collected using the Atlasnatuurlijkkapitaal (ANK) platform, an official platform used by the Dutch government containing data about natural capital and ecosystem services, including data about the green infrastructure in the Netherlands (Rijksinstituut voor Volksgezondheid en Milieu, 2018). This extra step for assessing greenery level by using more than one way is to ensure whether the data match or not. If they match, then the distribution concept can be distinguished in both cases by relying on both existing GIS maps from the two previously mentioned platforms and observation of reality. However, when the real observation does not match the map's indications, this indicates the shortcomings of deciding on projects based on GIS studies only to redistribute greenery and improve green infrastructure. In that case, the real-life observation should be applied because it better represents reality.

Besides the distribution of greenery, I will use maps to collect data about the distribution of heat levels. These data will be collected by using the Klimaateffectatlas platform, which is a platform that contains maps showing climate data and heat stress levels for the Netherlands (Kennisportaal Klimaatadaptatie, n.d). These data must be overlapped with greenery levels to get a more comprehensive understanding of the distribution concept. Here I am adopting both observation and data from maps for the data collection methodology. This part of the data collection methodology will include some quantitative data in the ANK and Klimaateffectatlas platforms besides the qualitative data.

3.4.3. Desk Research and Document analysis

Desk research refers to using already existing data from previous research and documents. These existing results and data can be used again to serve further studies on related topics or even part of a topic (Van Thiel, 2014). Although the main dominant methodology for this research is the interview, using the document analysis is a secondary data collection method here. It is used to get more in-depth for the study and reduce the shortcomings that might affect validity and reliability. The concepts that will be tackled by the document analysis method will also be studied through the interviews to ensure triangulation and confirmation of the collected data. The procedural and recognition concepts will be revealed by using content or document analysis. For example, documents from the city council that explain the procedures for implementing green infrastructure in both neighbourhoods also documents showing insights about the socio-economic levels and the origin of the residents in both neighbourhoods may inform the analysis based on the recognition concept. In addition, I will use documents that explain how basic rights and responsibilities regarding greening are being structured in Arnhem city and check whether it applies in each of the neighbourhoods.

3.4.4. Interviews

The interviews will be the main data collection method for this research, in which the majority of concepts will be investigated through the interviews, namely the distributional, procedural, recognition, responsibilities and rights. For this research, I will conduct semi-structured interviews related to the topic and connect with the five concepts so that the aimed answers are within the scope of the chosen framework. The aim of the interviews is to find answers regarding the distribution and procedures of urban greening in both neighbourhoods, how the places and residences of both neighbourhoods are recognized concerning the greening process, what are the responsibilities of both state and citizen, and finally, whether the residents of both neighbourhoods share same rights or not. Twelve interviews were conducted in total. Two interviews were conducted with city council employees, and ten interviews were conducted with the citizens from both neighbourhoods (5 interviews in each neighbourhood). So, two interview guides were planned, appendix 3 showing the interview guide for the city council and appendix 4 showing the interview guide for the citizens.

Selection criteria of the respondents:
- City Council respondents were chosen based on their experience in the environmental and Urban greening field and their knowledge about the green infrastructure in the relevant neighbourhood.
- Citizen respondents were chosen mainly for living or working in the corresponding neighbourhood, in addition to either of the following qualifications:

- interest in urban greening and being aware of the problems encountered in the greening domain

- played a role in a greening or environmental project in the neighbourhood, for example, initiating a greening initiative, participating in an initiative, or forming an organisation to deal with the neighbourhood's green infrastructure or environmental issue.

Respondents:

Table 3 Interview's Respondents (by Researcher)

Name	neighbourhood	Role and interest
Henk Wintenk City council	Spijkerkwartier	Policy advisor on the topic Urban Green and Climate adaptation in Arnhem city council, he work for whole Arnhem, with a focus on the city center including Spijkerkwartier
Esther Hogendoorn city council	Malburgen	Education in gardening and landscape design and she works at Arnhem city council for greenery and maintaining the public space specifically for south east that includes Malburgen
Walter Klien Nienhuis / **Floortje Dekkers** Citizens	Malburgen	Manager of the Bruishuis in Malburgen, and having interest in improving greenery and public areas around the building
Alie Sijtsma / **Rebecca** citizens	Malburgen	The founders of Heel Arnhem Schoon, and interest in keeping a green environment in Arnhem city and their focus is more on Malburgen
Mirjam Alexander Citizen	Malburgen	Activist in different fields and mainly greenery and biodiversity in Malburgen, many tree mirrors were adopted by her in the neighbourhood to enhance greenery and biodiversity there
Vincent 't Hart Citizen	Malburgen	Initiator of Hof Van West, his project aims to improve greenery and biodiversity in Malburgen by creating a green passage along Malburgen
Ruimtekoers **(by Renne Jansen)** Citizen	Malburgen	Organisation that focuses on creating or establishing participation within urban themes, including greenery and public spaces, based in Malburgen and focusing on improving the neighbourhood through involving citizens and connecting with the city council, and Renne is a project manager at Ruimtekoers
Daan Kruissen Citizen	Spijkerkwartier	Volunteer in the initiative of adopting public garden to take care of, aiming to make the neighbourhood greener and nicer
Buurtgroenbedrijf **(by Bart Zoutenbier)** Citizen	Spijkerkwartier	Organisation that is citizen initiative to make Spijkerkwartier Greener and more resistant against climate change, and Baart work for Buurtgroenbedrijf with aa growing interest about improving the green infrastructure in the neighbourhood
Katja Krediet Citizen	Spijkerkwartier	Living in Spijkerkwartier and interested in cultures, due to the realization of the importance of greenery she volunteered in maintaining one of the none public gardens in the neighbourhood

Annemieke Kleijn Citizen	Spijkerkwartier	Interest in Urban greening is embedded in her family in which her family are tree nurses, participated in many greening initiatives in Spijkerkwartier, and she is the one who is responsible for the School garden in the neighbourhood.
Louise Drosten Citizen	Spijkerkwartier	Interested in Urban greening specially in Spijkerkwartier, her personal experience with her son who have different needs make her realize the importance of greenery and the need to improve it

The interviews will be analysed using Atlasti software, and the analysis will be done by coding the interviews. Different codes will be used to code the five concepts mentioned previously in the conceptual framework, and every concept will be coded in different colours for both Malburgen and Spijkerkwartier's interviews. So, there will be five main codes with different colours for each of the two neighbourhoods. Many memos will branch from it to comment on the main ideas related to the main concept. Every concept will have to coded colours, one representing the data from the city council and the other representing the data from the citizens.

3.5. Data Analysis

As discussed before, the data collected are mainly qualitatively supported by some quantitative data in the early stage, so mainly I will follow qualitative data analysis where the quantitative information is embedded. The research is exploratory, exploring environmental justice issues using the case study strategy. For the data analysis, first, through ANK, I will get the first layer that shows the level of the green infrastructure in both areas and compare it. Then, the second layer heat stress map will be overlapped on the green layer, so a second comparison will be conducted between the two neighbourhoods regarding green infrastructure distribution and how it affects the level of heat stress. Furthermore, for the real observation, I will describe the set of captured photos to give an insight into the distribution of greenery.

The next analysis step is to code the interviews to start analysing the data related to the five concepts. In this step, I will apply narrative analysis to the conducted interviews. This approach enables gathering the stories related to the research topic and analysing them to seek the implicit and explicit meanings (Rucker, 2016). Then I will compare the stories from the interviews that represent different points of view (interviews from Malburgen area, interviews from Spijkerkwartier area, and the city council). The results will help to understand the gaps and disparities between both neighbourhoods regarding the green infrastructure. Consequently, we will be able to reach an understanding of the contribution of green infrastructure to environmental justice in Arnhem city and reflect on the environmental justice theory.

3.6. Research Validity and Reliability

3.6.1. Validity

This research will be conducted through a case study, so the researcher has to take it as the main challenge to deal with the validity issue, which is referred to as transferability, which means that the conclusions can be generalized (external validity), and plausibility (internal validity) (Van Theil, 2014). To deal with this challenge, I will follow a triangulation strategy for the data collection and analysis. As explained previously in the methodology, scientific facts will be used in the first phase to collect data (heat stress measure, greenery availability). These indicators will be used for the analysis representing existing reality. Then in the second step, I will conduct a series of semi-structured interviews to collect qualitative information that would confirm the results in the first phase or oppose it. However, dealing with justice issues itself is still a challenging approach, so to achieve validity, there should be a constructed base for the definition of justice that will be used. In addition, to deal with personal bias, similar interview content will be conducted in both neighbourhoods so that the main difference will be the answers from different respondents. Also, interviews with the city council are an additional step to involve perspectives from different levels to construct a holistic conclusion about the issue.

3.6.2. Reliability

The notion of reliability refers to the repeatability and accuracy of the research, which means obtaining the same results and conclusions if the research is repeated, and the measure is related to the comprehensibility of the analysis (Van Theil, 2014). As was explained in the validity section, triangulation also contributes to the reliability of the research. The reliability of collected data in my research refers to the scientific data collected in the first step, the greenery measure and the heat stress level; these data are obtained from reliable instruments and software, which can be linked to the accuracy of the research. On the other hand, the second step in the research will be the semi-structured interview, so consistency in conducting topic-oriented interviews during the next steps ensures the reliability of this research.

4. Malburgen case study

This section will focus on the Malburgen neighbourhood by analysing the green infrastructure based on the previously discussed concepts. Malburgen neighbourhood is located in the southern part of Arnhem City, and it was the first extension for the city south of the river Rhine. The construction in the neighbourhood started in the late 1930s, being the first part of Arnhem south to be constructed, and the plan was to build houses with much greenery, so the area was known for its green character and classified as one of the greenest neighbourhoods in Arnhem (Gemeente Arnhem & Wijkbeheer Malburgen, 2018). However, the second world war led to the destruction of a big part of the constructed houses. After the war, many workers were needed to rebuild the city, and Malburgen was the chosen area to build houses for these workers. Consequently, the previous plan of green Malburgen faded away, and much social housing was constructed to supply the market demand for houses for the middle class and poor people, of which the majority were construction workers. As the shortage of houses still existed, more houses were being built and later in the 1970s, social problems started to appear, such as crimes, violence and drug-related issues, which gave the neighbourhood a bad reputation, and greenery was not a main concern for the residents there.

Later in 2000, there were many attempts by the city council and some locals to improve the social aspect of the neighbourhood, and one of the decisions was to add 2500 housing units in the neighbourhood surrounded by much greenery. However, the green plans were not seriously included within the constructed areas. The greenery was more focused in the public spaces, for example, on the Rhine side, where a huge field was used only for greenery that serves as a flood plan protection called room for water (Gemeente Arnhem & Wijkbeheer Malburgen, 2021). Construction of new buildings and houses kept increasing where the concrete character overcame the green character, especially in the built areas, and that fact drove some residents in Malburgen to protest against the construction projects that lacked proper planning of the green infrastructure. Eventually, greenery became an essential concern for the residents, requiring more attention (M, 2021). The following section focuses on the Malburgen case by discussing the green infrastructure through the following concepts: distribution, procedures, recognition, responsibilities and rights.

4.1. Distribution of greenery and heat stress

Analysing the distribution of greenery in Malburgen is the first step to revealing the distribution concept and its relation to heat stress levels. The analysis will be focusing on the greenery within the inhabited zones of Malburgen neighbourhood and not the open green areas to align with the purpose stated in the introduction of the research, which focuses on greening as a tool to reduce heat stress that citizens encounter in their houses, working places, and areas of mobility. Greenery will be analysed based on the neighbourhood's real observation, and the green index will be based on the Atlasnatuurlijkkapitaal GIS platform. This analysis of the distribution concept is important to prove whether the greenery index reflects the reality of how greenery is distributed or not and to understand if there are limitations to using the greenery index as a reference to decide whether the green infrastructure is good enough or needs more improvements. While reading the documents

from the city council to decide where to plan the green cool routs, in their analysis, only the greenery index was used as a reference to evaluate the quantity of greenery.

4.1.1. Distribution of greenery according to real observation

In the real observation, 24 photos were taken from different streets all over Malburgen, as shown in figure 5, where the black sign shows the location from where the photo was captured. The criteria for choosing the location for these photos were based on two main factors. First, the location of each photo is at the beginning or at the end of the streets. Second, I tried to choose the long streets all over the neighbourhood. Both factors aim to maximize the content captured in the photo. The set of 24 can be found in appendix 1, and the green character represented in these photos represents the greenery between houses from the objective perspective; in other words, it represents the existing reality.
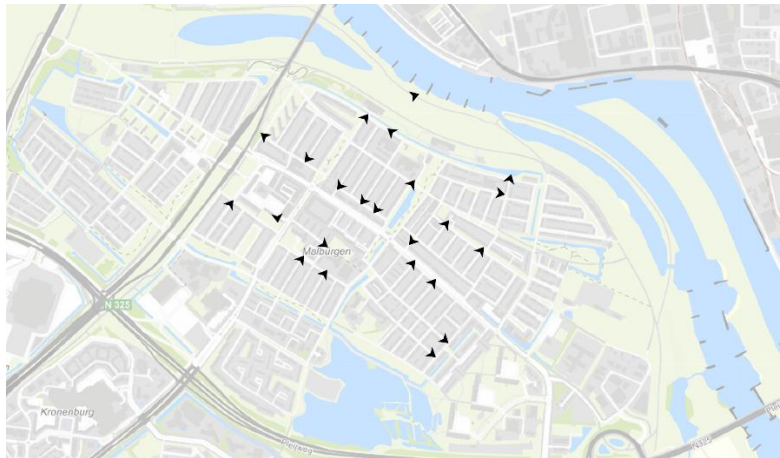
Figure 5 location of the taken photos in Malburgen (Atlasnatuurlijkkapitaal)

As mentioned previously, this observation is mainly focused on the green infrastructure within the constructed areas. In addition, some images from the green fields, mainly the edge side of Malburgen, will also be shown to understand how greenery is distributed within the neighbourhood. As shown in Figure 6 from appendix 1, an average of four to five trees are planted on each street, as shown in figure 7. The average distance of those streets is 160 meters based on the measurements from Atlasnatuurlijkkapitaal (figure 8). According to this measurement and the number of houses per street, around 20 houses are constructed on each side of the street. So from these data, we can notice that five trees are planted along 160 meters which means that for every eight houses one tree. In figures 7 and 8, the maps were taken from Atlasnatuurlijkkapitaal using the infrared effect map, and the red colour represents the green infrastructure. These data represent the objective distribution of trees in the inhabited areas of Malburgen. Moreover, figure 6 is an example that shows the scarcity of greenery in general in Malburgen, and there can be observed more parking places and less greenery. If we observe the set of photos in appendix 1, we can see that the stone and parking places are dominant over the green infrastructure.

Figure 6 Bereklauwstraat and Grondelstraat - Malburgen (google maps)

Figure 7 Streets between the houses – Malburgen (Atlasnatuurlijkkapitaal)

Figure 8 Street length (Atlasnatuurlijkkapitaal)

However, the scenario of greenery at the peripheries of Malburgen and mainly the northern part is quite different. As shown in figure 9, the space by the riverside is dominated by greenfields and many lanes of trees. Figure 10 also shows the elongated green space along the riverside where no houses are constructed.

Figure 9 photo for the northern part of Malburgen (Google maps)

Figure 10 top view showing the northern part of Malburgen (Google maps)

Based on these data taken from the Klimaateffectatlas software and the real observation of photos from Malburgen, it is clear that greenery is not distributed equally in Malburgen. And in the constructed zones, the green infrastructure is scarce. However, the concentration of greenery is spotted on the edges and three main streets; this finding is explained visually in figure 11. To conclude this part, based on what was observed, the green infrastructure in Malburgen is not distributed equally inside the neighbourhood. In the coming sections, the analysis of the other concepts will help us to find out the reasons behind the inequality in distribution.

Figure 11 The infrared map of Malburgen reflecting the green infrastructure (Atlasnatuurlijkkapitaal)

4.1.2. Distribution of greenery based on the Green index

The green index is the indicator used in the city council documents for the urban green cool routes project. This index shows the per cent of greenery, so the decisions for the locations to implement these green routes were based on many indicators, and the green index is one of them rather than the real observation. From the real observation, it was possible to distinguish where the greenery is concentrated and where there is a lack of greenery and trees. In the following assessment, we will analyse the greenery index based on the four indicators presented in the Klimaateffectatlas GIS map: greenery per neighbourhood, trees per neighbourhood, greenery in public spaces, greenery in private spaces. The first index, greenery in general, shows that the whole neighbourhood shares the same percentage of 20 to 30 % as observed in figure 12.a, but this index contradicts the findings in the real observation, where the peripheries of the neighbourhood are greener than the inside, so it cannot be used as a precise indicator to show greenery distribution in the neighbourhood. However, if we go more specific in the greenery index, another three realities apply based on the other three indicators. First, observing the trees per neighbourhood indicator shows that trees are more in the northeast part of the neighbourhood with a 20 to 30 %; however, in the remaining parts of Malburgen, it's 5 to 10 % as shown in figure 12.b.

*Figure 12.a green index in Malburgen (Klimaateffectatlas)
(Klimaateffectatlas)*

*Figure 12.b Trees index in Malburgen
(Klimaateffectatlas)*
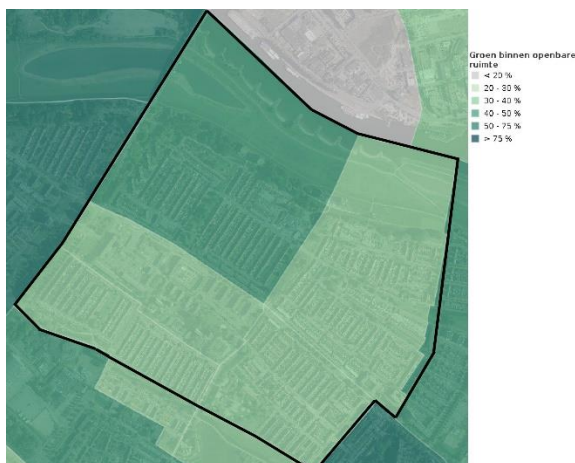
*Figure 13.a greenery index in public spaces
(Klimaateffectatlas)*

*Figure 13.b greenery index in private spaces
(Klimaateffectatlas)*

The third indicator is greenery in public spaces, as shown in figure 13.a. This index indicates the approximate quantity of greenery in places mainly under the city council's supervision, such as streets and public gardens. As shown in the figure, the northwest quarter of the neighbourhood contains 40 to 50% of greenery in the public spaces, and the remaining part has less greenery, which is 20 to 30%. These different values indicate that greenery is not distributed equally in the public spaces in Malburgen. And the last indicator represents the index of greenery in the private places, for example, the front and back gardens, and the land plots that are privately owned, as shown in figure 13.b the index shows the lowest value of greenery in public spaces in almost two-third of the neighbourhood which is less than 20%, and for a small part, the index ranges between 40 and 50 %. In comparison, the northwest quarter of the neighbourhood shows an average index that ranges between 30 and 40 %. Malburgen is mainly a residential area, and the neighbourhood residents mainly own the private spaces represented in the last indicator. According to the indicator of greenery in private spaces, more than half of the neighbourhood shows a low greenery index in these private spaces, and this finding indicates that most residents do not pay attention to greenery.

4.1.3. Heat stress analysis and the greenery impact

By observing the differences in heat level during heatwave periods all over Malburgen and the quantity of greenery, we can relate to whether the lack or absence of greenery, primarily trees, affects the heat level. This observation reflects an objective understanding based on the measurements presented in the Klimaateffectatlas, so the distribution of heat stress in this part is analysed as an objective matter. Figure 14 shows the temperature all over Malburgen during a heatwave period, and the colours on the map indicate the different values of the temperatures that are indicated numerically in the legend, the darker red colour being indicated, the hotter the place is, while the more the colour moves to the purple scale then it represents a cooler place.
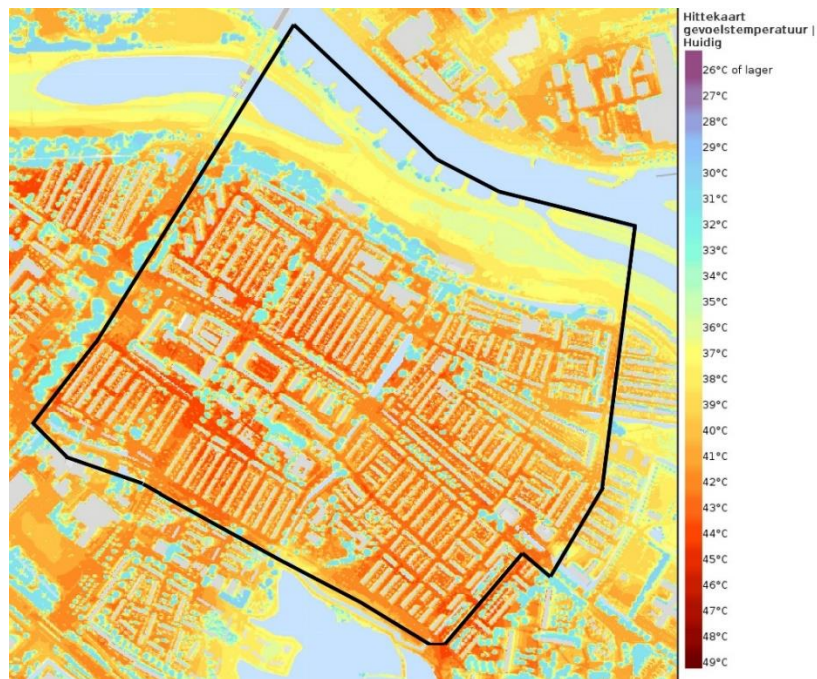
Figure 14 Heat level in Malburgen during heat wave (Klimaateffectatlas)

In the map above, we can see the domination of the red colour range inside the neighbourhood and the blue colour is detected mainly in the northern part where the trees are concentrated as analysed in the real observation and greenery index. This means that the neighbourhood suffers from heat stress with temperature values that go above 40 degrees to reach 48 degrees, especially between the buildings where there hardly is greenery. In figures 15.a and 15.b we can see the red aisles alongside the buildings, and the blue colour can be very rarely observed in these aisles, which indicates the high heat levels around the houses and buildings in the neighbourhood. These findings prove that greenery has an obvious impact on the heat level. So the availability of greenery can reduce the heat stress impact as shown at the edges of the neighbourhood, the blue colour indication, while the entire neighbourhood suffers from heat stress.
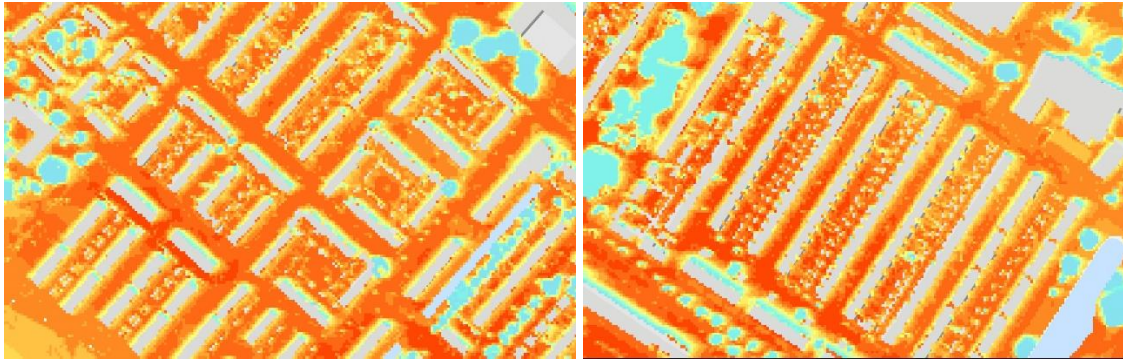
Figure 15.a & 15.b Close up map for the heat level in some parts of Malburgen (Klimaateffectatlas)

4.2. Urban greening procedures

To better understand the procedures of implementing and improving the green infrastructure and taking care of it in Malburgen, six interviews were conducted with citizens working or living in the neighbourhood with insight toward greenery. One interview was conducted with an employee from the city council Esther Hogendoorn whose work is related to the public spaces and green infrastructure in Malburgen, and five interviews were carried out with citizens who also have interest and insight into the greenery in the neighbourhood. The respondents shared a few similar facts regarding the procedures of urban greening in Malburgen that are considered objective. However, the subjective matters regarding the procedures are more related to the different perspectives on citizen participation, the role of the city council and the decision making processes in the field of urban greening.

The procedural concept was presented objectively in some parts of the interviews when all the respondents shared similar facts about the procedures. First, regarding the basic procedure of urban greening in Malburgen, Esther mentioned in the interview that the city council has a signed contract with Dolmans landscape to take care of the green infrastructure and public spaces in the neighbourhood and improve it. Likewise, all the other interviewees in Malburgen have mentioned this information. Besides the official contract, there is a citizen initiative in the neighbourhood for creating a green passage where people can plant vegetables along this passage and share them. This project is named called "Hof Van West". Vincent, the project initiator, said, "We started this initiative as citizens, but of course, later we have to talk with the city council and take permission because we are using public space, and at some points, the city council offered some help…". Another initiative was presented by Alie, Rebecca and Miriam, who adopted tree mirrors as an attempt to enhance the greenery in the neighbourhood. Rebecca and Alie said that few trees were standing on the street before starting this initiative, which was awful. Then when they started taking care of the tree mirrors, the space became much better. However, Miriam was worried about the lack of biodiversity in Malburgen, so she adopted some areas to enhance the biodiversity in the area. In addition, Renne Janses, the representative of Ruimtekoers, claimed that part of their mission is to improve the green infrastructure and public spaces in Malburgen by involving citizens in the process. Renne pointed out that their current focus is to make the shopping centre in Malburgen greener, and she added: "We have formed like a green team around it, like friends of

the green Drieslag we call them, it is slowly building, we started like one man, and now there are like seven or so". Walter, the manager of the Bruishuis building in Malburgen, and his wife Floortje work on keeping the surrounding of the building green and attractive, as they said. They added some green pots along the street and built a public garden with lots of greenery in front of the building. These were the most important initiatives in Malburgen for improving the green infrastructure by either the city council or the citizens.

During the interviews, the respondents mentioned some procedural issues that stand in two categories: the contribution of current procedures to the green infrastructure and the procedural shortcomings. Both categories can be placed as subjective matters that can be judged differently. Starting with the contributions, as Esther mentioned, her main job is to supervise the work of Dolmans landscape and collaborate with citizens who want to participate in greening projects or start initiatives; this part of the procedure is the official management. Also, the initiative "Hof Van West" by Vincent got some financial and administrative facilities from the city council, so there was a collaboration with the city council. Vincent noted that he started a foundation and then suggested the initiative in the name of this foundation which made his initiative more concrete. In that sense, he said: "…it represents more commitment and also for longer periods, and as a form of Stichting (foundation) it shows responsibility when speaking to the city council.".

On the other hand, the procedural aspect of urban greening in Malburen faces many problems, according to the city council and the neighbourhood citizens. A frequently mentioned issue by all the respondents in Malburgen was the low level of participation, which means that most citizens are not involved in the greening projects and decision-making processes. Walter said that while working on greenery around the Bruishuis in the public areas, it was very hard to find people who would participate. Also, Miriam Alexander, who worked in Malburgen before and has been living there for five years, mentioned that involving the citizens of Malburgen in public spaces and greenery projects is still new. Likewise, Vincent mentioned that it was very difficult to find people to participate in his initiative, knowing that this initiative is for the whole neighbourhood. Similarly, Ruimtekoers shared the same concern; when I asked Renée about the citizen response and involvement, her response was, "it is not easy at all". This opinion was also similarly shared by the city council. Through the interviews, many responses reflected the reasons behind the participation issues. The major issue is the communication gap between citizens and the city council. In that sense, Rebecca said, "I think everybody can adopt, but the communication is terrible, there is nobody in the neighbourhood who knows that you can do that, it is not in the newspaper, not in a flyer, you know, there is nothing". To deal with the communication gap, Vincent had to start a foundation and then suggest his initiative to reach the city council. Otherwise, the personal initiative would encounter obstacles when reaching the city council. Besides communication, three respondents shared that logistic and administrative concern stands behind the lack of participation. First, Renée said that Ruimtekoers faced a logistic issue with the city council when they wanted to install pots with plants in the shopping center Drieslag, the city council first supported the idea and prepared a budget for it, but later they recognised that in case these pots fall and hurt someone then who will be responsible. So they cancelled the financial support, and Ruimtekoers had to do it themselves at the time the city council was still against the idea; Walter also shared this incident. Walter also shared the second incident about a restaurant whose owner wanted to make the public

square in Drieslag greener with his own money. However, the city council refused for safety reasons. For example, if the restaurant owner is working in a public space owned by the city council and any accident happens, then the city council is responsible for that risk. Rebecca also shared her experience with installing a green roof. She was eligible for a subsidy from the city council for this initiative, which anyone can get. However, Rebecca said that the process was complicated, and she added, "we had to do a lot of administration work and many documents to submit, then I had to pay everything myself, and 3 or 4 months later I received between 300 and 400 euro." So even the process of applying for a subsidy can be a barrier for people to participate in green initiatives.

As Esther mentioned, the city council faces difficulties to reach people and getting them involved. An important issue she focused on is that the gardens for the houses are private areas, so it is not easy to deal with these areas as the city council want. In addition, Esther said that the city council is working on biodiversity, but most of the citizens in Malburgen are not used to that because they are used to the organised greenery. So the city council is founding strategies to let people adapt to these changes.

4.3. Rights and responsibilities towards Urban Greening

In this research, the notion of rights is framed by the ability to access and allocate urban greening. According to Arnhem city council, Esther has mentioned that in Arnhem it is not stated directly by law or constitution that people have a legal right to access or enjoy the greenery, in other words, there are no specific standards for the green infrastructure in Arnhem to be applied. However, it's more of an embedded right and bonded to the right of access to a healthy environment, and that's why Arnhem city council put greenery on their agenda and working on improving it as Esther said, and she added *"...it's not written down that everybody should have a certain square meter of public greenery. And I think if you go deep in human nature, greenery is a need..."*, so in Malburgen the city council deal with greenery more as an ethical perspective that citizen should enjoy. Access to a healthy environment is a fundamental right in the Netherlands as stated in the constitution article 21, however, this right is not a personal right it is more about the governmental mission that should be achieved for the sake of the citizens and the nature (Verschuuren, 1994), and based on this right Esther claimed that improving the green infrastructure is a tool to achieve the right of access to a healthy environment. Apart from the city council's response toward the rights, the citizen also shared their point of view, the respondents showed similar perspectives toward the right notion, they considered that if greenery is granted as a full legal right for the citizens, then they might step back and feel less responsible for thinking about greening issue, so there could be balance for example as Walter suggested: *"...so I think the rights can be in form when constructing the houses the companies that build have to be responsible for a minimum standard of greening that is stated as a right for the people who will live there."*

Besides the rights, in this paper, we will discuss the responsibilities toward urban greening as a matter of environmental justice. Esther has summarized the responsibilities in a hierarchical aspect. The first responsible party is the city council because it is the authority and the center of decision making, then the citizen and the housing companies come next in holding responsibilities. All the three parties share differentiated responsibilities. For example, the city council is responsible for

improving greenery in public spaces, the citizen responsible for greenery in their own private spaces, and the housing companies are responsible for following the standards set by the city council. By applying this theme in Malburgen and based on the distributional and procedural analysis, we can observe that the Malburgen city council team's responsibility is not totally fulfilled because of the uneven distribution and lack of green infrastructure in public spaces within Malburgen territory. Likewise, in the private spaces belonging to the citizens living or working in Malburgen, the greenery in most of the private areas was very low. For the housing companies, the story is quite different because a big part of Malburgen was built urgently after the war, and there was an urgent need for housing and less focus on greenery. So all these factors led to the current situation. Renee, the representative of Ruimtekoers, shared the same opinion as Esther, and she went beyond the direct responsibility of only improving the green infrastructure. In that sense, she said, *"...the basic responsibility should be on the city council, but also the local government need to implement in education for instance laws that all schools need to deal with green and teach the kids about it. So I think we need to make a societal change that should be implemented from the governmental level to eventually get the citizens to start also taking responsibility. However, we cannot now expect from the citizens to start taking responsibility because it is not in any more our society that we teach each other to care about nature anymore. So it starts with the city council being responsible and then later responsibilities are distributed on different levels."* Renée freed the citizen from direct responsibility through her words, and she called for societal change that would eventually produce responsible citizens. Vincent, Walter, Rebecca and Alie also claimed that the responsibilities should be shared on different levels, which, according to them, are still not fulfilled in Malburgen due to the lack of citizen participation as analysed in the procedural aspect.

In conclusion, the rights and responsibilities were discussed as an intersubjective matter rather than objective and subjective perspectives. As discussed in the second chapter, rights and responsibilities are controversial topics that cannot stand in one fact; however, sharing a similar subjective opinion among conscious minds makes this opinion intersubjective. In other words, this opinion becomes objective for this specific group.

4.4. Recognition as a matter of Urban Greening

The last concept to be discussed in Malburgen case is the recognition concept, and the focus will be on both citizen and spatial recognition. In other words, we will try to distinguish whether all social groups in Malburgen benefit from urban greening, likewise for the spaces whether greenery is allocated spatially in a similar pattern.

First, for the spatial allocation, the distribution analysis showed a lack of greenery inside the neighbourhood, while the area around the neighbourhood is richer with green infrastructure. Floortje confirmed this when she said, "*now near the river and at the boundaries of Malburgen it is green, but in the middle, a lot of concrete and construction*". Mirjam Alexander also shared a similar opinion as Floortje, and that was one of the main reasons that let her adopt some spots in Malburgen to make them greener, as she said. Also, the greenery distribution inside the neighbourhood is distributed differently, and that was shown through the three indicators of the greenery index in public spaces, private spaces and the distribution of trees. All these indicators

showed irregular distribution when analysed previously. Consequently, spatial misrecognition in Malburgen exists where some places are greener and get more greenery attention than others.

To fully unpack the recognition concept, we need to investigate citizen recognition in terms of urban greening, and this will be analysed through the following aspects: the socioeconomic factor that includes the procedural analysis and cultural backgrounds. Starting with the socioeconomic factor, Esther Hogendoorn and all the respondents mentioned that most people living in Malburgen are poor, and the neighbourhood itself has a lot of social problems. The respondents related this issue to urban greening through different frames. Mirjam Alexander thinks that people should first feel involved, then they can feel that ability to influence, which leads to a sense of ownership, and this ideology would trigger people to be more active and participate in improving the green infrastructure in their neighbourhood. However, this feeling of involvement does not apply to the citizen of Malburgen she said. Similarly, Walter said, "*in poor neighbourhoods like Malburgen, people are less organised. What we see is that the Turkish community they are organised within themselves…, and this applies to kinds of different groups, the Turkish group, the Moroccan group, the Dutch group… and all live separately together in the same street, but they do not have anything with each other.*" So he thinks that failing to be organised and united makes their voice weak. So the absence of a robust stance for improving the neighbourhood's green infrastructure results in marginalized groups who cannot benefit from a proper green infrastructure. Rebecca and Alie discussed that poor people in Malburgen cannot benefit from the subsidies offered by the city council for greening initiatives due to the long administrative process and the obligation of paying the whole amount in the beginning, and then they get back a small part of what they paid. In that content, Rebecca said, "*…But a lot of people, for example, cannot pay in advances the whole amount. So I want these procedures to go easy, and make place for everyone to participate…*". Renée also mentioned that being poor and having social problems will reduce the chance of having active citizens who would keep tracking the improvement of the green infrastructure because it is not a priority for them which is the case in Malburgen. For the cultural background aspect, all the respondents agreed that Malburgen is a multicultural neighbourhood, so people from different countries live there. Rebecca said, "*…some mothers like to clean their houses and gardens a lot, so they bleach the garden and ruin the green parts, so the backgrounds affect. But still, I cannot say this is typical for people from Turkey, Morocco or any other country.*" Esther's point of view also meets with Rebecca in this regard, and she mentioned that different cultures and habits affect how people recognize greening.

4.5. Conclusion

Through the analysis of the five concepts, we found out that they have a reciprocal relation to how they impact each other. For example, the distribution of greenery is due to specific procedures and the assignment of rights and responsibilities. At the same time, the way greenery is distributed can lead to changes in the procedures, including the decision-making processes, which will influence how rights and responsibilities are assigned. Also, during the analysis of greenery, it was necessary to relate the greenery distribution and its procedures. These concepts drove a set of conclusions about urban greening in Malburgen based on subjective, objective and intersubjective matters. So

the set of conclusions in this section is related to the five concepts about greenery in Malburgen Neighbourhood.

First, regarding the distribution concept, based on the real observation and the greenery index, the green infrastructure in Malburgen is not distributed equally. Within the neighbourhood, most public areas, mainly the streets and between the houses, showed scarcity in greenery, while greenery was more available around the neighbourhood. In addition, the low green index in private spaces is evidence of the low interest in greenery from the citizens' side. This finding was also reflected in the heat stress analysis that showed that high heat levels dominate the neighbourhood. So the right to access a healthy environment does not fully apply in Malburgen because there is no access to the benefits of greenery, which is about reducing heat stress.

Moreover, based on what was discussed in the procedures, the absence of a proper participation level proves the low interest that we talked about. The basics are being delivered for urban greening from the city council side by hiring Dolmans landscape company. However, the collaboration between the city council and the citizens to improve the green infrastructure is still weak. Three main reasons stand behind this finding. First, the communication gap between both parties leads people to be ignorant about the available procedural opportunities. For example, locals do not know about subsidies, or the related procedures are unclear. Second socioeconomic problems in the neighbourhood are another barrier that drives people to remove greenery from their priority list. Third, the community in Malburgen is scattered and divided into groups based on their cultural belonging, which means they are not united under specific goals that can include greening the neighbourhood. So failing to be united reduces the opportunity to create an identity for the neighbourhood. Thus no robust voices will be raised for the city council to improve green infrastructure.

In addition, the discussed responsibilities do not match the reality in Malburgen, which means that the findings of greenery distribution and procedures showed that the responsibilities are not distributed equally in the neighbourhood. The reason behind that is the low participation from the citizen side, which was explained in the procedural section. One more important finding is regarding the initiatives in Malburgen that are contributing to the green infrastructure. However, they still face obstacles for two main reasons based on the findings. The first reason is the low participation due to the difficulties in reaching the citizen. And the second is the miscommunication with the city council that sometimes opposes some of these initiatives due to logistic or safety reasons, as the owners of the initiatives claimed.

5. Spijkerkwartier case

Similar to the Malburgen case study, the same data analysis steps will be applied to the Spijkerkwartier neighbourhood in this section. However, the latest has different facts and historical data. Spijkerkwartier is located in the northern part of Arnhem, on the right side of the city center, and it was built in the early 20th century, characterized by its condensed historic urban fabric (Stichting Bewoners Spijkerkwartier, n.d.). At the beginning of the 21st century, the neighbourhood underwent radical changes. After being a neighbourhood dominated by violence and prostitution, it became an attractive neighbourhood with a friendly environment for all social and age ranges interested in living there. In addition, Spijkerkwartier, after those changes, gained a robust social structure, where many artists and active citizens moved to live there and some of them used to live there, and all together worked on improving the neighbourhood from different sectors and mainly the green infrastructure aiming to produce a healthy and beautiful environment in the neighbourhood (Omroep Gld, 2016). Spijkerkwartier is well known for its green activities, and its nine hidden gardens specialize it despite the intense urban structure of the neighbourhood. Some people call them the secret gardens of Spijkerkwartier. These gardens are growing based on the biodiversity theme, and they are located as courtyards for the houses, which form a green canopy for the houses in the backyard side. These gardens are kept and preserved by the citizen who takes continuous care of these gardens. Also, many streets in the neighbourhood have trees that form a green canopy along the street (Webteam Spijkerkwartier, n.d.). Furthermore, as mentioned previously in the first part of the research, a green cool route project is being studied to be implemented in three city parts, one of which is Spijkerkwartier. In the following sections, the five concepts of greenery conceptualized from the theoretical framework will be analysed using the data related to the greenery in Spijkerkwartier, and the same strategy will be used as the one for Malburgen case.

5.1. Distribution of greenery

5.1.1. Distribution of greenery according to real observation

In order to describe the green infrastructure in Spijkerkwartier, 24 photos were taken from different positions in the neighbourhood. These photos can be found in appendix 2, and their locations are shown in figure 16 below. Similar criteria as Malburgen was used here to choose the locations of the photos. The photos' locations objectively represent the existing greenery in Spijkerkwartier and mainly the public green infrastructure in the public spaces, such as the streets, gardens, and parks.

Figure 16 Locations of the taken photos in Spijkerkwartier (Atlasnatuurlijkkapital)

As shown in the photos from the appendix, most of the streets in Spijkerkwartier have greenery and mainly trees with a green tree mirror at the bottom of each tree. For some of these streets, the alignment of the trees forms a green canopy over the street. By observing figure 17.a and most of the photos in appendix 2, we can see the tree alignment on both sides of the street that forms a green cover over the street and a shaded part of the facades.

Figure 17.a Prins Hendrikstraat in Spijkerkwartier (google maps)

Figure 17.b Spijkerstraat in Spijkerkwartier (google maps)

One of the ways to evaluate the availability of greenery is to distinguish the number of trees over a specific part of the street. Figure 18 shows a street that measures 177 meters contains 26 trees, 12 on each side of the street, planted in front of 28 houses on each side of the street, which means an average of 2 trees for every four houses. However, not all the streets have this standard of trees in the neighbourhood; some have more, and others have less. In figure 17.b we can see that no trees are available on the street Spijkerstraat due to the spatial matters, but at the same time, we can observe the greenery climbing on the walls of the buildings.

Figure 18Street length – Spijkerkwartier (Atlasnatuurlijkkapital)

Spijkerkwartier also has a special urban structure, in which the buildings are constructed like quadrilateral forms that are eventually centred with an open court. As shown in figure 19, these courtyards are marked with green colour. They planted with trees and other types of plans which make greenery their dominant character. In addition, the houses gain direct benefits, like shading from the trees in the courtyards, because these constructions are directly connected to the courtyards. From this real observation, we concluded that Spijkerkwartier has a green character within its special urban fabric, and the level of this green character will be better understood after unpacking the other concepts.

Figure 19 greenery in the courtyards and the back gardens (Atlasnatuurlijkkapitaal)

5.1.2. Distribution of greenery based on Green index

Similar to Malburgen case, we will analyse the greenery by using the four green indexes for Spijkerkwartier. For the first aspect, figure 20.a shows two different indications for the greenery in Spijkerkwartier. The northern part indicates an amount of greenery that ranges between 10 and 20

%, while the southern part shows higher indications between 30 and 40 %. Based on the first indicator, we can see that greenery is not equally distributed across the neighbourhood.

Figure 20.a greenery index in Spijkerkwartier (klimaateffectatlas)

Figure 20.b trees index (Klimaateffectatlas)

Second, the trees indicator indicates the whole neighbourhood as one zone, and it shows that trees occupy between 20 to 30% of the neighbourhood area. This indication of the index of the tree can be considered an average amount due to the historical congested urban structure in Spijkerkwartier. However, the weakness of this index is that it shows the whole neighbourhood has the same range, which contradicts the real observation as shown previously in figure 19. Some parts of the neighbourhood have much fewer trees than other areas. For example, the red colour representing greenery in the figure is detected less in the northern part of the neighbourhood than in the southern part.

Figure 21.a greenery index in public spaces (klimaateffectatlas)

Figure 21.b greenery index in private spaces (Klimaateffectatlas)

For the third indicator, greenery in public spaces ranges between 20 and 30 % all over the neighbourhood, as shown in figure 21.a. In comparison, the indicator shows a higher amount of greenery in private spaces ranging between 40 and 50 %, as presented in figure 21.b. When we say private spaces, this means places owned by the citizens. So the indication of the greenery in private spaces in Spijkerkwartier shows to what extent the citizens pay attention to the greenery in their places, which can also impact their attention to the greenery in the whole neighbourhood. These

aspects will be further understood in the coming sections after analysing the green infrastructure in the neighbourhood through the other concepts.

5.1.3. Heat stress analysis and the greenery impact

The same strategy of analysing heat level for Malburgen case will be applied in this section for Spijkerkwartier. In figure 23, we can see the heat map for Spijkerkwartier. The red colour on the map shows the high heat level, which reaches its maximum of 49 degrees at some small spots on the northern side of the neighbourhood. This finding indicates that some parts of Spijkerkwartier suffer from heat stress, especially in the north. However, this scene is different in the southern part, where the mix between the blues colour (lower temperature) and the red one (higher temperature) is observed more, so the availability of greenery in the southern part helped in reducing heat level, in which the blue colour is detected within the areas where trees are available. In addition, the courtyards marked in green in figure 19 are dominated by the blue colour, as shown on the map below, and these courtyards are green areas, most of which serve as public gardens for the neighbourhood. Also, the map shows many streets with the alignment of blue spots where the trees are planted. These alignments indicate the impact of tree canopies in reducing the heat levels. At this stage, we can conclude that Spijkerkwartier suffers from high heat levels, but the existing green infrastructure saves the neighbourhood from wide ranges of high heat levels.

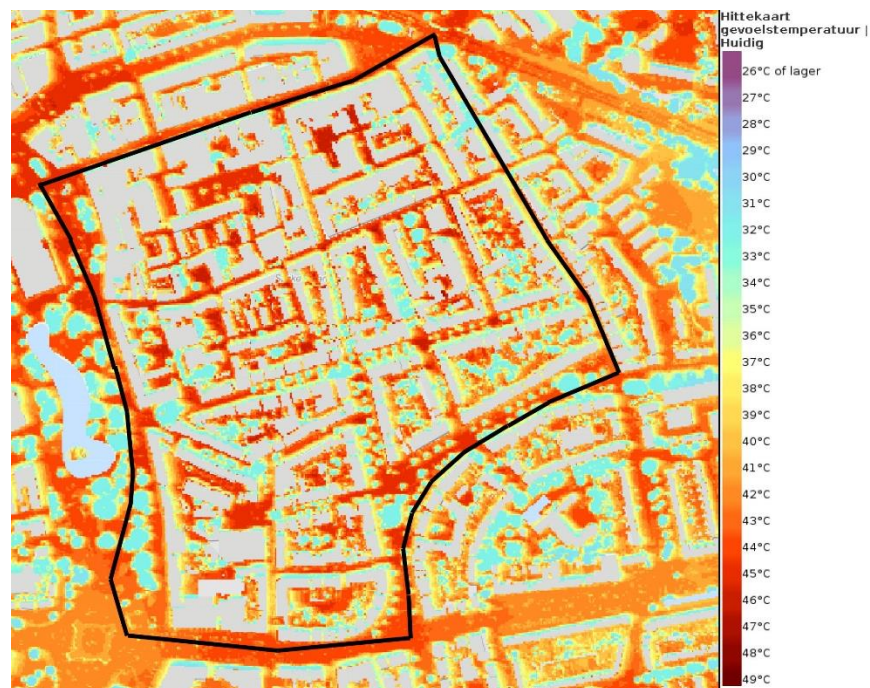*Figure 22 Heat level in Spijkerkwartier during heat wave (Klimaateffectatlas)*

5.2. Urban greening procedures

In this section, we will analyse the procedures of urban greening in Spijkerkwartier by referring to the six interviews. One of these interviews was conducted with the city council team in Spijkerkwartier represented by Henk Wintenk, who works on greenery and climate change issues

in Arnhem city council, focusing on Spijkerkwartier. And five interviews were carried out with citizens living or working in the neighbourhood who are involved in urban greening there. Similar to Malburgen case, objective and subjective data about procedures that were shared by the respondents will be used in this section to understand the justice issues related to the procedural concept.

Three main facts that apply in Spijkerkwartier regarding urban greening procedures were mentioned by all the respondents, which represent the objective matters. First, in Spijkerkwartier, the city council have a signed contract with Sight landscaping to take care of the green infrastructure, as Henk and four other respondents mentioned. Second, Henk mentioned that Buurtgroenbedrijf is an organisation that started as a citizen initiative and focuses only on greenery in Spijkerkwartier. The third fact is unique for Spijkerkwartier because it was only applied there, where the city council team Leefomgeving in Spijkerkwartier has more authority than others in different neighbourhoods. In that regard, Henk said, *"...it's pretty unique, they can make their decisions regarding the Spijkerkwartier neighbourhood, and make money from the parking taxes, and get budget from the city council, but all this money have to be used for the neighbourhood not for private use, so they have the authority to make the decisions in the neighbourhood*." And he added that their procedures also include taking care of the green infrastructure. These are the main procedural aspect of urban greening in Spijkerkwartier under the objective matters theme.

On the other hand, many subjective aspects were distinguished during the interviews about the urban greening procedures in the neighbourhood. The greenery work in the neighbourhood is done through a collaboration pattern. Sight company have to collaborate with Buurtgroenbedrijf, and the citizens, as an attempt to keep tracking what people want to improve in the green infrastructure and what are the possible opportunities as Henk explained. In addition, Spijkerkwartier is known for its nine community gardens, that the volunteers from the neighbourhood take care of. Baart from Buurtgroenbedrijf said "*these are the main public gardens in Spijkerkwartier, and they are maintained by the citizens. They have a small budget from the city council, and they can ask them for help if they need it, for example when some stuff need to be taken away.*" Annemieke, from Spijkerkwartier, is also involved in improving the green infrastructure in the area and responsible for the school garden. Daan also adopted a spot in Spijkerkwartier and turned it into a garden to enhance the green infrastructure. Besides Buurtgroenbedrijf, Annemieke has mentioned that there is another organisation in Spijkerkwartier called Dazo initiated by a group of citizens living in the neighbourhood and very experienced in the green infrastructure. Annemieke added that sometimes Team Leefomgeving ask Dazo to do some greening stuff in the neighbourhood. Another active citizen in the neighbourhood, Louise Drosten has mentioned that in Spijkerkwartier there is Spijkgroenwijk team which represents the people who adopt the tree mirrors in the neighbourhood to keep it green. So in Spijkerkwartier citizens are very active and their participation is a major part of the procedural structure, that was emphasized by Annemieke when she said "*we have a hundred thirty volunteers in this area to participate in the greenery, but when you are a volunteer you can lift some stones infant of your home and keep that garden infant of your house, others participate in one of the gardens, and others adopt boom spiegels.*" Katja also shared the same opinion regarding citizen participation, when she said that in Spijkerkwartier, many spaces were adopted

by citizens and were integrated into the green infrastructure. Most of these adopted spaces would stay stones if citizens didn't do these initiatives.

The procedural aspect of urban greening in Spijkerkwartier will be explained in two categories: the procedural shortcomings and the contribution of current procedures to the green infrastructure. The respondents were satisfied with the citizen participation in Spijkerkwartier based on what they said. However, Annemieka has pointed out a weakness in this process because it is not easy to find fresh volunteers for the greening activities recently, and most of the current volunteers have lived in the neighbourhood for 20 years or more. Spatial challenges were another procedural issue mentioned by Henk, such as the narrow streets that characterize the historical urban structure of Spijkerkwartier. So, it is not possible to remove part of the sidewalk tiles to replace them with greenery in some places. In that regard, Henk said, *"...we have an organisation for people who are disabled, and they say to me "oh no, we need at least one-and-a-half-meter standard for somebody who is on a wheelchair to pass another person, and that in Spijkerkwartier is almost impossible. So when people ask to replace the tiles, we say, "wait, you have to count five tiles which are equal to one and a half meters this you cannot remove" then they say, "yes, there are only five, so what should we do" so in fact in some places in Spijkerkwartier it is not possible because I got a big discussion with people who are disabled complaining that they cannot pass..."*. Annemieke and Katja also commented on the spatial issue, but from a different perspective, they think that Spijkerkwartier has narrow public spaces, and parking plots are being prioritized over greenery. So this indicates that the procedures in Spijkerkwartier face spatial obstacles, which can be a reason why some parts have less greenery than others.

On the other hand, the procedural aspects have many contributions to the green infrastructure in Spijkerkwartier based on what the interviewees mentioned. First, I would like to start with the story of the gardens that Annemieke has mentioned. As she said, in the late eighty's, these spots were planned as parking plots for the neighbourhood. However, the citizen hugely refused this idea, and they wanted these spots, which are shown in figure 19, to become green gardens instead of parking. After many protests that Annemieke was part of, the citizen won the battle, and these spots became the gardens of Spijkerkwartier under the condition that the citizens had to take care of them. This example indicates the involvement of Spijkerkwartier inhabitants in the greening processes and their ability to influence the decision-making processes, which all the interviewees agreed on. Another procedural contribution to the green infrastructure is the good communication between the city council and the citizen through the greening organisations, mainly Buurtgroenbedrijf and Dazo. So here we can see the triangulation in the procedures where three parties are committed to greening the neighbourhood and work in collaboration. The respondents mentioned many experiences and opinions that prove this finding. For example, Baart from Buurtgroenbedrijf said: "*well, we listen to what people want and what the city council wants, and we have our ideas, and those three together should be implemented in public space.*". Also, Daan agreed with this fact when she confirmed that Buurtgroenbedrijf is a sort of intermediate between the city council and the citizens. As for the city council, Henk explained the triangulation role between the three parties when he said, "*they have to do their tasks, and one of their important tasks is to talk and communicate with Buurtgroenbedrijf and with the community about what they want and with us because we still have some responsibilities. For example, we were talking about trees, so when Buurtgroenbedrijf*

started their work, they said, "okay, the big trees we cannot maintain, we do not have the knowledge, and we do not have the equipment to go twenty meters high to cut trees" so we said "okay, we will do that, but you will have to think with us how you can learn these things" so this company also teaches them sometimes things, and they can borrow equipment, and we pay the cost…" in this statement Henk explained the harmony between the citizen, Buurtgroenbedrijf and the city council that hired Sight. This collaboration is part of the procedures that contributed to improving the green infrastructure in the neighbourhood. Another procedural contribution in Spijkerkwartier is through the social factor. According to Daan, the greening activities that included social activities were an incentive for her to get involved. She said that she received the letter of participation from BuurtGroenbedrijf as a local initiative from the citizen side. When she started working, the neighbours were interested in helping her, and then she started socializing with them and getting more active in developing the garden that she adopted. Daan added, "*many people do participate, and I also feel like everyone is inspiring each other.*" This social cohesion in Spijkerkwartier is a part of the procedural process for urban greening development. Louise Drosten also related her interest in greening to the social factor. She has a son with different needs, and the only time she can socialize is when she goes out to the park or the gardens in the neighbourhood where her son can be with her. There, she can see people and talk to them. That's why she gets interested always to participate in the neighbourhood meetings that are related to making the neighbourhood greener.

5.3. Rights and responsibilities towards Urban Greening

As explained previously in Malburgen case about greenery as a legal right, the same applies to Spijkerkwartier because both neighbourhoods are located in the same city. So in Spijkerkwartier, greenery is a duty of the city council that has to keep improving to guarantee the right to a healthy environment. Henk confirmed this when he said that in Arnhem, greenery is a matter of duty that the city council should take care of in collaboration with different parties such as the citizens. He also mentioned that there are no specific legal rights that grant a specific standard of greenery for the citizen. However, Henk illustrated the city council's role in dealing ethically with urban greening when he said, "*well, I think we are maintaining the city as a municipality, so we must make it possible that everybody has a green spot…".* So again, measuring the citizens' right to access greenery depends on the distribution of greenery and procedures that show the involvement of the community and the city council in improving the green infrastructure.

As discussed in the distributional and procedural sections, the respondents were satisfied with the greenery in Spijkerkwartier and the community involvement in greening the neighbourhood despite the spatial challenges. However, Baart was not satisfied with the greenery in the neighbourhood, and his answer was, *"actually, no, it can always be more; there is a lot to gain despite the lack of space.".* Hence, Baart, who is representing Buurtgroenbedrijf, blames the urban structure of the neighbourhood planned with narrow spaces that cannot fit greenery as wished, leading to unequal access to the green spaces. Henk added that the city council is currently trying to convince different parties to improve the green infrastructure, but this is taking a long time. So in the future, the city council might force some steps in the urban greening field to ensure equal access to the green infrastructure in the community. In that sense, Henk said, "*...for now, try to convince people and*

try to convince the developers, it is a better approach, same level, talk with one another, but we are talking for four-five years now and we still not seen proper cooperation from the developing companies that build houses regarding greenery. So I think we might need to force it more by law. It is one of the biggest discussions in this house now. Are we going to force it, or are we still going to make agreements and convince them that it must be greener?" To sum up, the right to access urban greening is at an improved level in Spijkerkwartier; however, it is still not equally ensured for the whole community, and many choices are on the table to ensure that right, such us forcing by law.

On the other hand, Urban greening should be discussed as a matter of responsibility besides being a right. As a responsibility, Henk has confirmed that working on the green infrastructure is a shared responsibility among the city council, citizens and the developing companies. In that regard, Henk said, "*in the broadest perspective it is shared, about 25 per cent of the spaces in whole Arnhem is the responsibility of the city council, it is public spaces, we have to take care of that. However, the rest 75 per cent is in private hands, private property…".* So the matter of private and public is a logical reason used by the city council to distribute responsibilities, but not by forcing as mentioned in the previous paragraph. Also, all the other respondents from Spijkerkwartier agreed that it is a shared matter. However, they all ensured that the city council should offer incentives for citizens to let them be more involved in improving greenery, at least through their own private spaces. For example, Katja said: "*regarding construction companies, I think it is important for the municipality to focus maybe more on that to make sure these companies are green-sustainable and adding enough greenery not only stones, and I think the municipality should have a facilitating role in the neighbourhood, like encouraging people to have greenery and support them maybe financially, but it would be better when it is very clear who is responsible for which part*." According to the procedural analysis in Spijkerkwartier, we found that the urban greening tasks are distributed among the three parties, the city council, citizens and some greening organisations. So it can be concluded that the responsibilities in Spijkerkwartier are, to a certain extent, assigned properly to ensure the continuous improvement of the green infrastructure there.

5.4. Recognition as a matter of Urban Greening

To understand the recognition matter in Spijkerkwartier, we will focus on two references, the citizens and the spaces, first which spaces are being recognized to gain greenery improvement in Spijkerkwartier, second who are being involved or making use of the greenery. The analysis in this section will reflect the intersubjective matters of the recognition concept, as explained in the second chapter.

The spatial recognition can be distinguished and evaluated using the distribution analysis. As the real observation showed, most of the streets all over Spijkerkwartier have much greenery, especially the trees alignment that forms a canopy in some neighbourhood places. In contrast, few photos, especially from the northern part of the neighbourhood, showed the scarcity of the green infrastructure compared to other streets. However, based on the photos, most of the streets in Spijkerkwartier have a sufficient amount of greenery. The respondents confirmed this finding when they showed satisfaction with the existing green infrastructure, but they also considered that

continuous improvement for greenery is always needed. For example, when Katja was asked about how satisfied she is with the green infrastructure in Spijkerkwartier, she answered, "*yeah, I do, but it is never enough, but I am quite happy with it….*" Similarly, Annemieke, Louise, and Daan shared the same opinion, while Baart from Buurtgroenbedrijf said that it's not enough and still needs more improvement. Later during the interview, he showed satisfaction with the current procedures when he said, "*we are doing well with greenery in Spijkerkwartier, and we still want to do better…*". So the respondents consider that most of the places in the neighbourhood have sufficient greenery. However, some spaces still need much more attention, and the blame is mainly on the narrow spaces where it is very challenging to add more greenery. Also, the green index, discussed in the distribution section, has shown that greenery in the southern part is richer than that of the northern one, which also confirms the interviewees' responses in this regard. Consequently, in Spijkerkwartier, there is spatial misrecognition mainly due to the urban structure of the neighbourhood.

Besides spatial recognition, it is necessary to analyse citizen recognition in terms of urban greening that contributes to understanding urban greening justice issues. Two main indicators will be used to carry out the citizen recognition analysis: socioeconomic factors and the cultural backgrounds of the people living in the neighbourhood. According to the city council represented by Henk, Spijkerkwartier is a very mixed neighbourhood, with poor and rich all living next to each other. So the benefits of greenery eventually are distributed among people with different socioeconomic levels there. Henk confirmed this by saying, "*I think the neighbourhoods should always have a mixture of the rich, middle class and poor, to reduce the benefits gap among these groups…*". All the other respondents agreed that it is a very mixed neighbourhood where many scenarios can apply. For example, Baart and Louise revealed that it is possible to see expensive houses and social housing in the same street next to each other in Spijkerkwartier. This indicates less social socioeconomic segregation in the neighbourhood where both poor and rich have access to greenery. To that end, Baart said, *"it is mixed because you have social housing next to big houses where wealthy people live…"* this means that there is no visible segregation between both rich and regarding the public greenery in the neighbourhood. However, Daan said, "*…rich people most of the time have their garden a bit more individualistic, while poor people add more value at the social level, sharing look for each other*". So, according to Daan's experience, people with a low economic level in Spijkerkwartier are involved in the urban greening processes through the social factor, which can be a social activity that includes greening purposes. Katja also agreed that interest in Urban greening could be triggered through social factors.

On the other hand, regarding the cultural background, the respondents from both sides, the citizen and the city council, agreed on the diverse cultural backgrounds of the neighbourhood residents. So Dutch people and people from different countries live together. However, according to the respondents, this cultural diversity does not seriously impact the greening processes in Spijkerkwartier case, and it is more than that. To that end, Henk said, *"…Spijkerkwartier is a little exceptional. The people there are well-educated people who know how to talk and to whom they have to talk to make it possible…*". Louise added, "*the bigger thing that would affect the city council is the number of voices raised in protest, so if you have people that are willing to campaign for their area, I think this has more effect because you get that into the local newspaper, so that has more effect than whether the area is rich or poor. And one important thing I think is when people*

participate, even if they are a small group and start doing something, the minute they start bringing an identity to the neighbourhood, whatever that identity is, you can activate the citizens and bring more to be involved." This idea was also supported by Annemieke, Katja, Daan and Baart when they talked about the influence and involvement that inhabitants of Spijkerkwartier have. In conclusion, based on the data from the interviews, most citizens have access to urban greening and its benefits in Spijkerkwartier due to their continued involvement and influence.

5.5. Conclusion

In conclusion, the green infrastructure in Spijkerkwartier showed challenging aspects, in which all the respondents were satisfied with the greenery in the neighbourhood. However, at the same time, they showed collective intentions to keep improving greenery despite the spatial, social and environmental challenges. The five concepts analysed previously contributed to understanding the green infrastructure situation in Spijkerkwartier and its dynamics in terms of distribution, procedures, rights, responsibilities and recognition.

Starting with the distributional aspect, despite the respondent's satisfaction with the general greenery in the neighbourhood, the analysis showed that some parts of the neighbourhood have less greenery than others, especially in the northern part. However, the available green infrastructure is distributed within the built-up areas. The nine gardens are also located at the backside of the houses. So greenery in Spijkerkwartier is not distributed equally, but all the respondents were satisfied with the current greenery situation. This distributional aspect is historical and spatial, based on what the respondents mentioned. In other words, the historical condensed urban structure of the neighbourhood produced narrow spaces where many services like streets, parking lots, and greenery have to fit in. Consequently, the residents and the city council aim for more even distribution of greenery in the neighbourhood despite the challenging urban situation.

For the procedural aspect, Spijkerkwartier showed a unique strategy for dealing with the green infrastructure because all parties are involved in the decision making processes. First, the city council assigned Sight company to take care of the basics. Second, the citizens are very active in the greening field. The third party are the organisations initiated by the citizens, Buurtgroenbedrijf and Dazo. These organisations focus on greenery and organise the connection and communication between the citizens and the city council. In addition, the procedural analysis has shown a commitment of the citizens' involvement through the organisations or individual participation drive, enabling them to influence and get the city council's attention. However, a social challenge was distinguished in the procedural aspect regarding involving new citizens in greening processes. An important conclusion could be added here that Buurtgroenbedrijf started seven years ago to take care of greenery and protect the participation and involvement ideology in the neighbourhood.

Besides the procedures and distribution, the recognition issues in Spijkerkwartier were distinguished at a spatial level, as discussed previously. However, the neighbourhood's mixed socioeconomic and cultural background characters did not show a serious citizen misrecognition regarding greenery, wherein the same street lives the rich and poor and people from different

cultural backgrounds. All have equal access to the advantages of the green infrastructure and the same for the disadvantages. A more in-depth conclusion was distinguished from Spijkerkwartier's case about recognition: socioeconomic is not a direct indication of recognition consequences. However, people with low socioeconomic levels have other serious priorities, so they deviate their attention from greenery toward personal and social issues. Consequently, there will be less involvement and influence, and when the influence in the urban greening field is absent, the city council also might have less focus on greenery in those areas where they deal more with citizens' priorities. This conclusion was shared among all the participants from Spijkerkwartier. Based on their experience, they think that involvement and influence stand behind greenery recognition.

For the last concepts of rights and responsibilities, we can see that the three parties in Spijkerkwartier deal with greenery as an embedded right. So, in Spijkerkwartier, most residents have access to urban greening that has already gained much attention. Likewise, for the responsibilities, differentiated responsibilities are distributed properly among the three parties. As claimed by the respondents, all parties are responsible in Spijkerkwartier to take care of greenery. For example, the citizens are responsible for the nine gardens, and they collaborate with the city council and the greening organisations to distribute responsibilities. However, there is no serious responsibility for the construction companies there due to the historical urban character of the neighbourhood, where there is no space for new developments.

6. Conclusions and Discussions

The conclusion of the research will rest on the comparison between both cases, which will contribute to a better understanding of the urban greening justice issues in Arnhem city based on the concepts derived from the theoretical framework. This understanding will lead to an answer for the sub-questions leading to an answer for the main research question. Then in the research implications, there will be a reflection on the research and mainly used theoretical framework. Also, it will be necessary to discuss some limitations that were faced during the process. In the end, a set of recommendations will be formulated based on the distinguished conclusions. These recommendations might be useful for the city council, citizens, and organisations interested in urban greening, and they might trace ways to deal with urban greening and minimize the existing environmental justice issues.

6.1. Case studies comparison and results

Previously, chapters four and five identified a set of conclusions about urban greening as a justice matter in each of Malburgen and Spijkerkwartier separately. In the final step here, we will see how urban greening differs between both cases and what are the similarities. This comparison is based on the following aspects: distributional, procedural, recognition, rights and responsibilities. Comparing each aspect will lead to an answer for the sub-questions. After that, it will be possible to conclude with a final answer to the main research question.

Distribution

Malburgen case has shown scarcity in the green infrastructure within the neighbourhood while the peripheries were richer with greenery according to the real observation. Moreover, the greenery index was analysed based on four different index references. The general index showed a single indication all over the neighbourhood, which contradicted the real observation findings, but the other three references were more specific. They showed close results to the real observation, and the most significant index was the greenery in private spaces, which indicated the lowest value of greenery in two-thirds of the neighbourhood.

However, for Spijkerkwartier, different results were obtained. First, in the real observation, more greenery was observed within the neighbourhood, mainly the trees forming canopies along most streets and the nine gardens between the houses. The real observation showed that the northern part of the neighbourhood has less greenery than the southern part. The results of the real observation were, to a certain extent, compatible with the greenery index analysis for Spijkerkwartier, and the most significant contradiction with Malburgen was the index of greenery in private spaces, which registered a high percentage compared to that in Malburgen.

This distributional aspect reflected an impact on the heat stress analysis. Both neighbourhoods were affected by the high heat levels causing heat stress. However, in Spijkerkwartier the map showed some streets with low heat levels due to the tree canopies, which was different from Malburgen

where the red colour representing the high heat level dominated the streets between the buildings. Consequently, based on these two cases, the greenery in Arnhem city is not distributed equally among the neighbourhoods, leading to uneven distribution of the heat stress and creating vulnerable groups in some areas, which represents the disadvantages.

Procedures

In both neighbourhoods, the city council follows a basic strategy by hiring a specific company to care for the green infrastructure. Further than this step, many procedural differences were distinguished between the two neighbourhoods. First of all, citizens' participation and involvement in Spijkkerwartier are more active than in Malburgen. Also, in Spijkerkwartier, there are many organisations initiated by citizens focusing on improving the green infrastructure. Furthermore, their other important role is to reduce the communication gap between the city council and the citizens. They reduce this gap by connecting and negotiating among all involved parties and communicating their ideas to achieve unified goals for improving the green infrastructure. In addition, in Spijkerkwartier, citizens are very active in the greening field, which was shown by their influence to create the nine gardens instead of parking areas. These gardens are still well maintained today, totally by the citizens with a yearly budget from the city council and coordination by Buurtgroenbedrijf. This example can show how dynamic the procedural aspect is through the involvement of all parties.

On the other hand, in Malburgen, citizens are less active in the greening field, and there is a lack of communication between them and the city council. Few greening initiatives have already started in Malburgen, but they still encounter some obstacles, such as some restrictions set by the city council, while some were successful. Like Buurtgroenbedrijf, Ruimtekoers is an active organisation in Malburgen, part of its focus is greening public spaces in the neighbourhood and improving citizen involvement in the process. Some of their projects succeeded, but it is not easy to reach the citizens in Malburge, and they do not always receive cooperative agreements with the city council. Based on this comparison, it is possible to say that Arnhem city encounters procedural justice issues, in which the opportunities are not distributed equally among the neighbourhoods, so the response to urban greening will be different.

Recognition

As discussed in both cases, the recognition concept was divided into spatial and citizen recognition concerning urban greening. Its understanding was based on the analysis of the distributional and procedural aspects. The results showed that spatial and citizen misrecognition exists in Malburgen. On the one hand, for the spatial aspect, the inside part of the neighbourhood is less green than the surrounding, and two-thirds of the private spaces recorded the lowest indication of the greenery index. On the other hand, the majority of people are poor or middle class, and the socioeconomic problems dominate the neighbourhood. This situation leads people to focus on their serious issues rather than getting involved in greening matters which is less priority for them. So, they will have less influence, and fewer voices will be raised to improve

green infrastructure. This conclusion means that the absence of citizens' power decreases the required attention for urban greening from the city council and some greening organisations.

For Spijkerkwartier, the analysis of the distributional and procedural aspects revealed a different scenario. The historical urban structure stands behind the spatial misrecognition issue in the neighbourhood. However, for citizen recognition, Spijkerkwartier has a unique mixture of people with different socioeconomic levels living next to each other, so they have equal access to the available green infrastructure and bare similar consequences in case greening issues exist. In addition, the procedural analysis has shown that citizens have influence in Spijkerkwartier for being always active in urban greening. Their influence makes their voices robust when being raised, thus getting the city council's attention. Based on these findings, spaces and groups are not recognized equally by the green infrastructure in Arnhem city. In some neighbourhoods, vulnerable groups are disadvantaged by the lack of greenery, and in other areas, some are privileged to enjoy the advantages of greenery abundance.

Right and Responsibilities

There were no direct legal matters that state urban greening in terms of rights and responsibilities in both cases. For the rights issue, the city council establishes urban greening as an embedded duty and the main pillar contributing to the right to a healthy environment. Considering this definition and the analysis of the previous three concepts, the citizen has less access to the benefits of the green infrastructure due to the scarcity of greenery in the neighbourhood. While in Spijkerkwartier, despite the condensed urban structure, the area indicated more accessibility to the green infrastructure due to the nine gardens between the houses and tree canopies formed along the streets. However, Malburgen showed less access to the green infrastructure in the residential zone, and the greenery was allocated unequally, with more greenery on the peripheries of the neighbourhood. So, by defining right as access and allocation of greenery, we can say that citizens in Spijkerkwartier have more access to the green infrastructure than in Malburgen.

For the responsibilities, the procedural aspect for urban greening in Malburgen showed disparities in the distribution of responsibilities among different parties. However, in Spijkekrwartier, there was harmony in the procedures among the three parties, the city council, citizens and the greening organisation. They all share greening responsibilities but on different levels. Again, in each neighbourhood, responsibilities were schematized differently. In Malburgen, the various parties do not share equal responsibilities toward urban greening, while in Spijkerkwartier, responsibilities were more evenly distributed among all parties. Consequently, rights and responsibilities results for both neighbourhoods indicate that these two aspects are not distributed equally in Arnhem city. In some areas like Malburgen, there are groups who still do not enjoy the right to access urban greening. Also, the responsibilities are not defined where one party has to hold more responsibilities than others.

Results and research question answer

In conclusion, the comparison of these five concepts was an approach to give a comprehensive answer to the main research question about whether the green infrastructure and urban greening strategies in Arnhem city contribute to environmental justice or not. Due to the disparities between both cases for each concept and the existence of vulnerable groups in some areas and privileged groups in others, we can say that there are urban greening inequalities in Arnhem. These findings indicate the weak position of the green infrastructure to contribute to environmental justice in the case of Arnhem.

6.2. Research implications and reflection

This research aimed to understand the environmental justice issues in urban greening. For that purpose, two neighbourhoods from Arnhem city were chosen as case studies. The urban greening justice matters were assessed based on five different concepts: distributional, procedural, recognition, rights and responsibilities. The assessment of these concepts was based aimed to answer the main research question: Do the green infrastructure and urban greening strategies in Arnhem contribute to environmental justice? And based on the conclusions that we reached, it was possible to answer this question and form an understanding of the justice issues in urban greening in Arnhem city.

As discussed in the introduction of the research, most of the available literature has assessed justice issues in urban greening by focusing on a particular concept, for example, distinguishing inequalities based on a distributional aspect only or a procedural one. On the other hand, there is a scarcity of literature that combine many concepts for the assessment of justice issues. To that end, the results of this research contribute to the scarcity of literature that offers a comprehensive understanding of the environmental justice issues through multiple and interrelated aspects. In addition, the results of this paper can be used by the city councils, in general, to understand more about the general justice issues in urban greening because of the multi aspects of the used framework. And mainly, Arnhem city council and greening organisations in Arnhem can make use of this paper that directly shows the greening justice issues specific to Arnhem. So they would be able to work on reducing these issues and make use of the suggested recommendations.

The theoretical framework for this research contributed to an in-depth understanding of the urban greening justice issues. On the one hand, the design of this framework consists of five concepts used to assess green infrastructure. These concepts contributed to explaining the topic of urban greening from different interrelated perspectives. For example, greenery distribution was related to greening strategies and procedures. In addition, the greenery procedures and distribution were necessary to understand the recognition matter. The same applies to rights and responsibilities, in which their assessment depends on the other three aspects. On the other hand, this framework allows for analysing each element through objective and subjective matters or intersubjective matter, facilitating access to broader information. This dynamic is useful for this research combines the justice topic and urban greening topic. The subjective matters dominate the justice topic, and an intersubjective pattern applies for certain measures. And for the Urban greening

topic, subjective and objective matters apply. In conclusion, using different interrelated concepts and assessing them through subjective and objective matters shows a dynamic aspect of the theoretical framework and makes it more efficient to study justice topics to obtain comprehensive results.

6.3. Limitations

This research attempts to understand urban greening in Arnhem city as an environmental justice matter. And we were able to formulate an understanding of these justice issues by investigating the green infrastructure in two neighbourhoods in Arnhem city through the theoretical framework explained in the second chapter. The green infrastructure was analysed through the five concepts derived from the environmental justice theoretical framework. However, certain limitations were encountered during the research process, and they are mainly theoretical and methodological limitations.

For the theoretical limitations, rights and responsibilities are very broad topics that need in-depth understanding, especially when related to a certain topic or field. This research required these two concepts to explain justice issues in urban greening. Due to the required content for this research and its time limits, it was impossible to go in-depth about rights and responsibilities. So the study settled on understanding how the city council and the citizens perceive them. In addition, no clear and direct legal matter was found in the literature that stated urban greening is a legal right for citizens in the Netherlands. Also, there were no clear legal responsibilities regarding the greening field. So, there is a lack of data that relates rights and responsibilities to the urban greening topic, which makes this theoretical limitation the main barrier to going in-depth for discussing these two concepts.

On the other hand, the research process encountered a methodological limitation about having more interviews with respondents representing the city council. For this research, it was planned to have more interviews with the city council representing Malburgen on the one hand and Spijkerkwartier on the other hand. However, due to the Covid-19 and lockdown stages and the time limit, it was not easy to reach more representatives from the city council to arrange meetings with them. So we tried as much as possible to obtain the primary and suitable data from the two city council respondents representing both neighbourhoods.
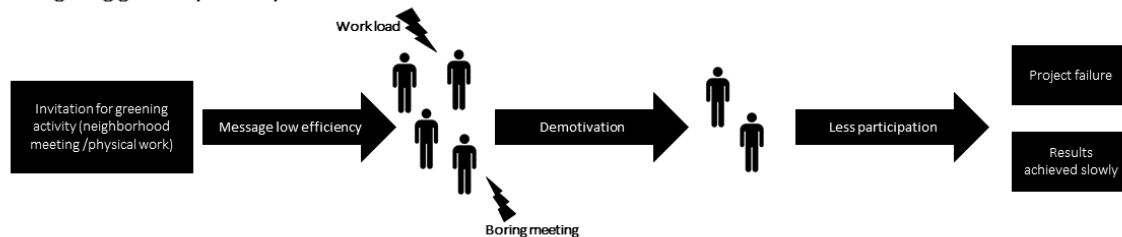
6.4. Recommendations

Based on the five concepts, the previous conclusions have revealed a set of justice issues concerning urban greening in Arnhem city. This paragraph will suggest some recommendations based on the current justice issues distinguished previously. In practice, these recommendations contribute to reducing the justice issues in urban greening by improving the urban greening procedures and distributions. This, in turn, strengthens recognition, responsibilities and rights matter. Indeed, the main target groups of these recommendations are the city council and the environmental and greening organisations. These organisations mainly belong to citizens who primarily focus on urban greening. In this research, Buurtgroenbedrijf and Ruimtekoers represent

these organisations. In addition, these recommendations can be useful for citizens interested in urban greening and seeking how to improve their contribution to this field. Bellow, the proposals will be stated and will be the closure section of this research:

- The communication gap between the city council and the citizen should be reduced. This gap exists in the Malburgen case. However, in Spijkerkwartier, Buurtgroenbedrijf and Dazo played an important role in reducing this gap. So city councils have to deal with such organisations as a blessing that connect them with the inhabitants to encourage their involvement in the greening processes.
- In Malburgen and other neighbourhoods with similar urban greening reality, the city council have to introduce more initiatives and subsidies that promote the improvement of the green infrastructure. And the procedures of these initiatives and grants should be simple and easy to avoid obstacles that discourage people from participating. These Subsidies can also be a strategy to improve the green infrastructure in private areas. However, proper communication is required to inform the citizens about these initiatives and subsidies. This issue was distinguished in Malburgen, where many people didn't know about the grants for creating a green roof.
- As learned from Spijkerkwartier case, the social factor contributes to the success of urban greening strategies. So in Malburgen, the city council or the greening organisations like Ruimtekoers might create social activities that indirectly serve the greening procedures. I have made the following sketch that would explain this recommendation:
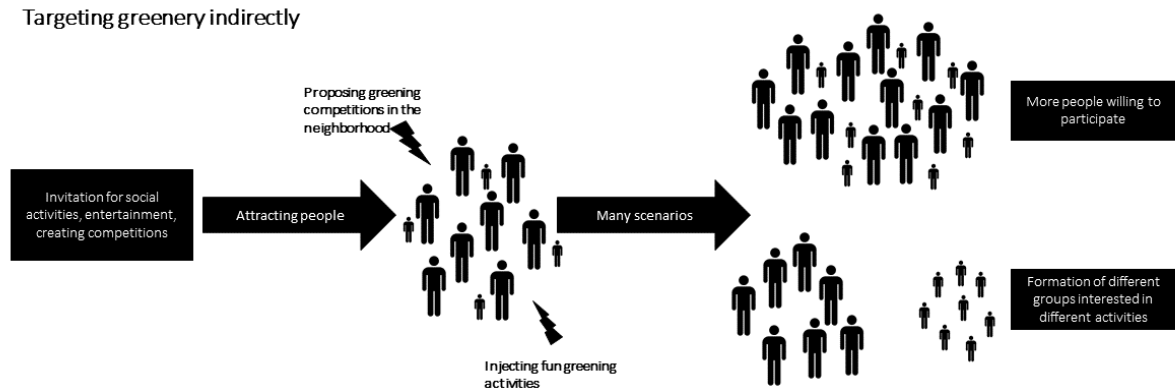

Figure 23 schematic diagram (by researcher)

- As mentioned in the first recommendation, the role of the greening organisations is important to connect both the city council and citizens to meet similar goals that serve urban greening. So, the city council might offer these organisations more flexible authority for co-deciding on urban greening processes, which can facilitate their work and achieve the results faster.

- Another recommendation is related to the rights and responsibilities. These two concepts should get a more robust character in which the city council might establish some basic rights and responsibilities as a legal matter concerning urban greening. For example, the city council might set some laws on the housing organisations about implementing minimum standards of greenery in any construction project. So, this means that rights and responsibilities might be used legally to involve different parties in the greening strategies, which can create a duty matter distributed equally among all.

- The last recommendation is more related to the procedural aspect. When the city council or greening organisations choose specific areas to implement greenery, it is not enough to use the general greenery index to analyse greenery distribution. However, they have to do a real observation to understand how greenery is distributed within the area, upon which they can make decisions that promote more the equal distribution of the procedures.

To conclude, the success of Spijkerkwartier in dealing with green infrastructure can be used to learn from their experience, especially regarding the procedural aspect. In that neighbourhood, the involved parties in greening are seeking more improvement for the green infrastructure in their area. That's why some of the suggested recommendations are taken from the experience in Spijkerkwartier, which showed a certain level of success in urban greening. This research can be an example reference for future research that would address justice issues, in which they can use the multi conceptual framework. Different concepts can be used rather than only limiting the topic to one specific aspect. For example, combining the distributional concepts with procedures, recognition, rights, and responsibilities reflects a more comprehensive understanding of the subject.

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Appendices

Appendix 1: Set of photos from Malburgen (Google maps)

Appendix 2: set of photos from Spijkerkwartier (Google maps)

Appendix 3: City council Interview guide

Master thesis: Urban Greening in Arnhem City, A Matter of Environmental Justice

Interviewer: Ali Saad

Interviewee:

Date of the interview:

Location of the interview:

Introduction:

- **Step 1: Introducing myself, ice breaking through side talk start**
- **Step 2: brief introduction: in this interview I would like to ask some questions that will help me complete my research about greenery in Arnhem city. In my research I am working on two neighbourhoods in Arnhem Spijkerkwartier and Malburgen to better understand how greenery is distributed and according to which procedures, in addition to the related rights and responsibilities. Your participation will contribute to get better knowledge about green infrastructure in relation to procedures, rights and responsibilities.**
- **Step 3: time frame, information privacy, permission for recording, the freedom to quit the interview, the freedom to skip any question not wishing to answer**

Questions:

The questions are divided into different themes that are related to the stated concepts in the research aiming to get answers that will be part of the data that will contribute for answering my research question.

Climate change and Greenery
1. As an expert in environmental and climate related issues, do you place these issues as a major part of the agenda that need urgent actions?
2. Can you briefly mention some main strategies that Arnhem city council applying or planning to apply to deal with the climate change issues?
3. Many cities are adopting urban greening as a major strategy, how far Arnhem city council taking these strategies into consideration? Can you elaborate more on how it's being invested?
4. How do you evaluate the greenery in Arnhem? Do you think it need more improvement?

Distribution of greenery
5. As a member of the city council, do you consider green infrastructure in Arnhem city is implemented and distributed similarly among all neighbourhood specially in the inhabited areas?
   a. If yes, so do you think this equal distribution is in both quantity and quality?
   b. If no, how do you explain the disparities in the distribution of the green infrastructure?

Procedures for implementing green infrastructure

This section of the interview is related to decision making and procedural matters regarding the green infrastructure in Arnhem city, so it is highly related to your field as a member of the city council.

6. What are the main greening strategies used by the city council to implement greenery?
7. From my previous work with Arnhem city council in 2018, I was introduced to the strategy that the city council follow by dividing the city into neighbourhoods, and for everyone a team is responsible to take care of different matters including greenery in the neighbourhood.
Does each team decide separately from other teams on greening strategies or is it a shared strategy among all? Can you elaborate more on how it works?
8. Does any of these strategies include citizen participation?
    a. If no, do you think citizen participation would facilitate the process and lead to effective outcomes that meet the intended goals of both citizen and city council?
    b. If yes, what is the scope of this participation? Does it affect the decision making processes?
    And does this participation include a practical intervention from the citizen or its only about hearing their voices?
9. Do you think that the current procedures of greening need more improvement or it is enough for the neighbourhood? Can you elaborate more (whether the answer is yes or no).
10. Do you have any idea of who takes care of the existing green infrastructure in the neighbourhood? (Spijkerkwartier/ Malburgen)

Recognition within the greening field
11. How do you describe the general socio economic level of the residence of this neighbourhood? (Spijkerkwartier/ Malburgen)
12. Do you think this factor affects how the residence react to greenery issue? For example, their intentions and interest to take actions regarding greening and be part of the process.
13. If you consider the existence of such relation, how do you explain it as an expert in the greening field and your work related to deal with residents of the neighbourhood?
14. Through your knowledge and work about this neighbourhood, are the majority of this neighbourhood from Dutch origin or expats who refer to other ethnicities?

Rights and Responsibilities concerning urban greening
Usually rights and responsibilities is a complicated topic on how both are distributed between citizen and the state.

15. Regarding rights for urban greening, how does the city council scope the rights of citizen to have urban green infrastructure? In other words, does the city council take into consideration that greening is a right the citizen should enjoy and to what level?
16. Does the greenery related issues included in the legal rights under institutional concerns? Or is it only and ideology or a statement when saying that citizen have rights for proper green infrastructure?
17. Besides rights, in the current situation who is mainly responsible for the greening processes? Can you explain more the boundaries of these responsibilities?
18. If we have to place responsibilities, is it the responsibility of the state or the citizen for the greening processes, or is it some shared differentiated responsibilities that would lead to a more proper outcome regarding greening?

Conclusion
Conclude with general overview about the content of the whole conversation.

Appendix 4: Citizen Interview guide

Master thesis: Urban Greening in Arnhem City, A Matter of Environmental Justice

Interviewer: Ali Saad

Interviewee:

Date of the interview:

Location of the interview:

Introduction:

- **Step 1: Introducing myself, ice breaking through side talk start**
- **Step 2: brief introduction: in this interview I would like to ask some questions that will help me complete my research about greenery in Arnhem city. In my research I am working on two neighbourhoods in Arnhem Spijkerkwartier and Malburgen to better understand how greenery is distributed and according to which procedures, in addition to the related rights and responsibilities. Your participation will contribute to get better knowledge about green infrastructure in relation to procedures, rights and responsibilities.**
- **Step 3: time frame, information privacy, permission for recording, the freedom to quote/ cite the interview, the freedom to skip any question not wishing to answer**

Questions:

The questions are divided into different themes that are related to the stated concepts in the research aiming to get answers that will be part of the data that will contribute for answering my research question.

Climate change and Greenery
1. **a.** In the last few years, are you experiencing an increase in the temperature specially during summer time?
   b. And do you hear complaints from your surrounding regarding this issue?
2. Climate and environmental studies lately are strictly confirming the change in climate and that heat waves will be more frequent which needs urgent actions to be taken.
   In your opinion, does improving and enriching the green infrastructure reduce the impact of the previously mentioned problems?
3. How do you evaluate the green infrastructure in Arnhem city in general?
4. Are you satisfied with the green infrastructure in your neighbourhood?

Distribution of greenery
5. Previously I asked about greenery in Arnhem city general, if we zoom in more, do you think this general situation of greenery applies equally to all neighbourhoods in Arnhem? or are there differences between the neighbourhoods regarding the green infrastructure?
6. **a.** On personal level, have you ever experienced during your movement in the city that some inhabited areas are greener than other ones?
   b. if yes, can you explain how do you perceive these differences, for example are there more trees, or the presentation of greenery is nicer in some areas or in any other form?

7. Do you think these differences between the neighbourhoods appear in the quality of greenery or its quantity?

Procedures for implementing green infrastructure
8. Within your own property, do you usually have an interest in making your house surrounded by greenery for example your own garden(s)?
9. Do you have any idea about the strategies and procedures of implementing the green infrastructure in your street/neighbourhood? If yes can you explain more about it?
10. **a.** Have you or any of the people you know in your area ever participated in projects or decision making processes to improve the green infrastructure in your neighbourhood?
b. if yes, was it a private initiative or related to the city council? Can you explain more about it?
c. if no, do you think citizen participation is important for you as a resident and your neighbors for improving the green infrastructure (in either practical projects or decisions, or even both)?

Recognition within the greening field
11. How long have you been living in the neighbourhood?
12. After this period, do you have any idea about the average of socio economic level of residence in the area (like mostly poor, intermediate, mostly rich)?
13. Are the residents of this neighbourhood Dutch or expats or mixed? In this question the idea is not about the nationality only, its more about the ethnic origins.

Rights and Responsibilities concerning urban greening
14. Do you consider green infrastructure should be a major right for citizen or a secondary issue?
15. How do you scope your right for urban greening?
16. Besides the rights for urban greening, who do you think is responsible for improving the green infrastructure (state or citizen), or both share different responsibilities to achieve the improvements? Can you explain more your answer concerning the responsibilities?

Conclusion
Conclude with general overview about the content of the whole conversation.