Who is allowed to see the trees?

A research into the distribution of urban green spaces in Groningen.

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Abstract

This research focuses on the distribution of public urban green spaces (UGS) in the city of Groningen. The research highlights the importance of UGS in various perspectives. It then looks into a potential spatial injustice in the distribution of UGS between neighbourhoods with a lower socio-economic status (SES) and neighbourhoods with higher SES. The main research question therefore is: 'How are UGS distributed in comparison to the spatial layout of socio-economic status in Groningen?'. In order determine the UGS distribution this study looks at two different indicators: the amount of UGS per person in a neighbourhood, and the percentage UGS of the total surface of a neighbourhood. The main finding is a pattern of inequality in UGS distribution between northwest and southeast neighbourhoods. The pattern shows the southern neighbourhoods generally have higher amounts of UGS than the northern. The overlapping pattern of this inequality with the spatial distribution of SES, leads this study to presume a potential form of spatial injustice within the distribution of UGS in Groningen. The study comes to these results by gathering data from different databases on multiple UGS and SES variables. Mapping out and analysing these variables determines the values of UGS and SES in the neighbourhoods.

Colophon

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Acronyms

CBS: Centraal Bureau Statistiek (English: Central bureau [*of*] Statistics)

GIS: Geographic Information Systems

SES: Socio-economic status

UGS: Urban green spaces

UWV: Uitvoeringsinstituut Werknemersverzekeringen (English: Employee Insurance Agency)

Acronyms

Content

1. Introduction

My birth city Groningen has recently been put in a very flattering spotlight. Engineering bureau Arcadis has determined that Groningen is the healthiest city in the Netherlands (Metro, 2020). The article points out that Groningen is already working on the physical environment since 1777 in order to prevent disease outbreaks like the black plague. The result they say is a healthy environment with enough greenery. But is this greenery accessible for everyone? Considering Nesbitt, Meitner, Girling, Sheppard and Lu (2019, p 1), who studied the accessibility of urban vegetation in ten cities in the United States, argue that: "For most cities, the more income and education you had, the more access you had to mixed or woody vegetation, while parks were more equitably accessible". The quote drew my attention and sparked my interest in justice in the spatial distribution of urban green spaces (from now on: UGS). Multiple questions arose: ''Why does this phenomenon happen?''; ''Does it happen everywhere?'' and ''Can it be done in a fair and just way?''. But above all: ''Is it done in a just way, in my praised hometown, Groningen?''

Justice is something mankind has always been preoccupied with, many philosophers are still looking for the true meaning of justice. Justice has come to us in many forms, in its formal sense as law, and informally as unwritten moral rules, that form social, economic and, political justice. Social scientists have been exploring social justice as a way of evaluating the distribution of wealth, income, free time, health care, and more (G.H. Pirie, 1983). In the same trend some geographers have been exploring the same notions, but on the basis of spatiality, thereby adopting the notion of spatial injustice. This type of injustice occurs in the lives of individuals and groups of people on the basis of their spatiality: where they live, work, travel, etc. And spatial injustice exists in many forms, from an unequal distribution of UGS to droughts in Chile as a result of lithium extraction (Liu, Agusdinata & Myint, 2019).

A major contributor to spatial injustice is climate change. Its effects are being unequally distributed as some populations are more vulnerable than others. Since urban green spaces are known to mitigate some of the consequences of climate change through for example regulating ambient temperatures, filtering dust, attenuating stormwater, and mitigating flooding (Byrne & Jinjun, 2009), the equal distribution of UGS is becoming ever more important. Therefore, I want to strike this issue while the iron is hot and take a look at the distribution of public UGS in my hometown Groningen to provide insight into its spatial equality. All the more, since the municipality and city administration have ambitious plans when it comes to creating a greener city (Groenplan Groningen, 2020), I will study if this 'green city' is for everyone and see who is allowed to see the trees.

In short, mankind attaches value to justice, and UGS are of increasing importance. This research, therefore, focuses on the distribution of public UGS in the city of Groningen. It looks into a potential spatial injustice between neighbourhoods with different socio-economic statuses (from now on: SES). The main research question is 'How are UGS distributed in comparison to the spatial layout of socio-economic status in Groningen?' In a broader scope its aim is to provide insight into 1) the spatial distribution of UGS in the city of Groningen, 2) spatial justice concerning UGS in Groningen and, 3) contribute to the bigger societal debate on spatial justice specifically concerning UGS. In the following sections, I will first be providing insight into the relevant concepts and theories in the theoretical framework. After that, I will provide the significant information of my case: Groningen. Then I will inform the reader of the methods I will be using, followed by my hypotheses. Hereafter I will be showing what the distribution of UGS in Groningen looks like, and then see what the different SES levels of the neighbourhoods are and how they are spatially positioned. This information will be connected in the final step of my results, and finally, I will close this research with my conclusions.

2. Theoretical framework

This theoretical framework will elaborate on three main concepts: spatial justice, SES, and UGS. After that, the three concepts will be linked together.

2.1 Spatial justice

In his book on the geographical aspect of justice, *Seeking Spatial Justice*, Edward Soja (2013) makes a distinction between Justice with a capital J, meaning the justice that comes from law, and there is justice in the broader sense, meaning the quality of being just or fair. The latter meaning of justice is adopted in this research. An early researcher to link justice and spatiality in his book *Social Needs and Resources in Local Services*, is Michael Davies (1970). He tries to measure how far differences in standards are related to differences in the relative needs of the population in different local authorities. This led to the first exploration of spatial justice. Later, Dikeç (2013) builds further upon the notion of justice and its relation to space and spatiality in his paper *Justice and the Spatial Imagination.* He says that the movements of the 1960s and 1970s brought new issues such as 'rights to the city*'* and 'social justice' to our attention. These issues he says, have been influential in almost every discipline including geography ever since. I will be building upon Soja's broad and inclusive notion of justice; Micheal Davies' linkage between justice and spatiality and Dikeç' finding that social justice is influential in geography.

A form of spatial justice is environmental justice. Environmental justice looks at the way everyday life is threatened by environmental risks. These risks, often called hazards, are unjustly distributed. A major example of this is the inequitable distribution of pollution in the United States, with poor people and people of colour bearing a greater share than rich and white people (Cole & Foster, 2001).

In their article on the theory and practice of environmental justice, Agyeman, Schlosberg, Craven and Matthews (2016), point out that environmental justice started out as a movement. Prior, Cole and Foster (2001) argued that it is impossible to point to a specific date or event that started the movement, as it grew from hundreds of local conflicts. They describe that there are three big contributors to the movement, 1) The Civil Rights Movement, 2) The Anti-Toxics Movement and, 3) Academic. Considering its groundworks, Agyman et al. (2016) do identify a national report called *Toxic Wastes and Race in the United States,* on the racial and socio-economic characteristics of communities with hazardous waste sites, as the first tangible source of data on which the movement based its foundation.

An influential environmental risk is the effects of climate change. The branch of environmental justice concerning climate change is likewise called climate justice. Crease, Parsons and Fisher (2018) argue that the impacts of climate change are not distributed evenly within communities in their study on climate and gender injustices in the Philippines. They also claim that the vulnerability to harm is differentially distributed. The term vulnerability refers to the degree to which a population manages to cope with the impacts of climate change (Adger, 1999; O'Brien, Nygaard and Schjolden, 2007). Therefore, differences in vulnerability will eventually lead to climate injustice. In their review on the discourse of environmental justice, Schlosberg and Collins (2014) argue that climate justice includes both distributive and procedural elements. Not only the distribution of environmental goods and harms between nations, but also the distribution of the impacts of climate change at national and local levels, and the need for recognition and participation in decision making for all parties. This research will take a short look at the way UGS plays a role in climate justice and look at the distributive elements that are pointed out by Schlosberg and Collins (2014) by seeing if the UGS distribution in Groningen is done in a just way.

2.2 Social-economic status

This research adopts Chu Lim and Omar Thanoon's definition of SES. They say that: ''*SES is defined as the position of an individual on a social-economic scale that measures factors such as education, income, type of occupation, place of residence, and in some populations, heritage and religion*''(2013, p.15). This status has often been associated with people's health (Contoyannis & Jones, 2004; Lantz et al. 1998). Already in an early meta-analysis on three studies, Marmot, Ryff, Bumpass, Shipley and Marks (1997), concluded that there is a social gradient in mortality studies; mortality, they say, rises with decreasing socio-economic status. But the scope of associations with SES is broader than just health, among others, it is also associated with the distribution of UGS. I will elaborate on this in the last part of this section.

In short, SES is a sizable predictor and indicator of other life factors. It often corresponds with health- and other indicators. That is why this research will be looking at the connection between the spatial appropriation of SES and UGS in the neighbourhoods of Groningen.

2.3 Urban green spaces

UGS is made up of public- and private UGS. This study uses the definition of Roy, Byrne and Pickering (2012, p. 352) on public UGS. In their review of costs and benefits of urban trees, they say it includes parks and reserves, sporting fields, greenways and trails, community gardens, street trees, riparian areas like stream- and river banks, green- walls, alleyways, and cemeteries. Private UGS refers to people's private property like their backyards. As these are not owned nor planned by the municipality, the study will not look into them. Public UGS (from now on when UGS is mentioned, I refer to public UGS) have a wide variety of environmental and social benefits. For instance, UGS function as a local climate stabilization (Jim & Chen, 2008), they have a cooling effect through the provision of shade (Bowler et al., 2010) that can have a positive effect on the urban heat island effects, which has also proven to be an issue in Groningen (RTV Noord, June 8, 2020). Other positive environmental effects are energy consumption reduction, noise reduction and carbon and water storage (Simpson, 2002; Bolund & Hunhammar, 1999). Also, social benefits include health improvements like relaxation and stress reduction associated with UGS exposure (Maas, Verheij, Groenewegen, de Vries & Spreeuwenberg, 2006). Furthermore, use of UGS can lead to an increase in the quality of life by providing a recreational area for passive and active activities (Byrne & Wolch, 2009).

Thus, UGS have a lot of positive effects on people's daily lives and cities in general. Therefore, I am going to take a look at different quantities of UGS in the Groningen neighbourhoods. But in their literature review on UGS, public health and environmental justice, Wolch, Byrne and Newell (2014), note that congestions can affect the usage of UGS. Simply put, not only the volume matters, but also the amount per person also matters. That is why many European cities provide threshold values for per capita UGS or minimum accessibility for a defined area of UGS. An example of a city using this kind of threshold is Berlin. According to Kabisch, Strohbach, Haase and Kronenberg (2016, P. 588), Berlin aims to provide at least 6 m2of UGS per person, while another German city, Leipzig, aims to provide 10 m2of UGS per person. And In the UK, it is recommended that city residents should have access to a natural green space of minimally 2 ha within a distance of 300 m from home (Handley et al., 2003). However, Larondelle and Haase (2013), in their cross-analysis on urban ecosystem services, find a limitation to the pure application of per capita UGS and UGS accessibility threshold value. They say it can provide a broad assessment of UGS provision, but does not indicate how UGS are distributed across
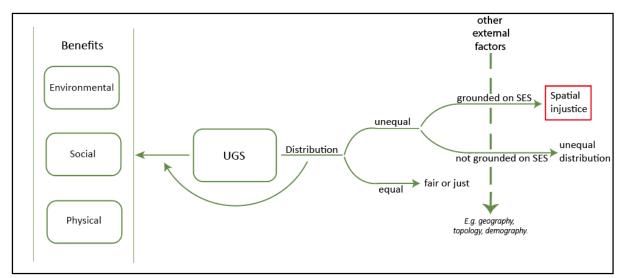
different groups of the society. This shows that it is hard to create the right distribution just by setting a threshold. Accordingly, this study will try to look at UGS distribution with a broader scope that includes more indicators on UGS.

Now that I have defined the three main concepts of UGS, SES and spatial justice, I will explain their connection and possible hiccups in the next section.

2.4 Spatial injustice in UGS distribution

The aforementioned positive effects of UGS highlight the importance of an equal distribution of UGS across cities to cater everyone with the same benefits. Unfortunately, we see that spatial injustice and access to UGS are often associated through differences in SES. For example, Wolch et al. (2014) state that studies reveal that the distribution of UGS often favours communities that are predominantly white and more affluent.

In their study on deforestation and forest degradation, Bowler et al. (2010) point out that with the current trend of urban densification, there may be less space for UGS. McPherson (1992), who studied the cost and benefits of UGS, add to that by arguing that it is harder to increase green infrastructure like UGS in dense cities. And to make matters worse, when cities do find a way of increasing the supply of UGS, it might even have a paradoxical effect on poorer neighbourhoods. This paradoxical effect, Wolch et al. (2014) argue, is that an increase in UGS may lead to an increase in property value and housing costs. This can lead to so-called 'green gentrification´. Just like regular gentrification, the increase in housing costs might push current residents out of their neighbourhoods, and into cheaper neighbourhoods which are in turn likely to have less. They point out that cities need to focus on strategies that are 'just green enough' in order to prevent green gentrification. The focus needs to be on small scale intervention, bottom-up green-space strategies supported by anti-gentrification policies like the provision of affordable housing and housing trust funds. We can conclude that the existence of spatial injustice in UGS distribution is verified, but with densification of cities, and potential green gentrification, it is harder than it looks to find possible solutions.

3. Conceptual model

Figure 1. Conceptual model.

In figure 1, you see the way the concepts interact with each other. In the middle is UGS, UGS creates certain benefits for society on multiple scales. But UGS can be distributed in a certain way, equally and unequally. This distribution affects the relation between UGS and the benefits; less UGS means fewer benefits. On the right end we see that when the unequal distribution is grounded on SES we might be able to talk about spatial injustice. And when it is not based on SES, we can assume that is a regular deviation from an equal distribution. But there is always external factors, like geography or topology, we have to take into account as they might play a role in the real-life distribution. When the distribution is done equally we consider it fair or just in the broader sense of the word mentioned in section 2.1.

4. Case: the city of Groningen

In figure 2 we see Groningen, positioned in the north of the Netherlands. It is the capital of its province, which is also called Groningen. The city has around 203.000 inhabitants (Alle Cijfers, 2020), with a significant amount of over 30.000 students (RTV Noord, 2018), due to its university and the Hanzehogeschool. The city has a total surface of 8372 hectare including 502 hectare of water surface.

Figure 2. Map Netherlands. Edited by author, based on ''Topo RD''
(Esri Nederland, 2012a).

The CBS (Central Bureau [of] Statistics) has divided Groningen into 14 neighbourhoods (2020). Within the scope of this research, I will exclude the neighbourhood Meerdorpen, as it has just recently grown into the agglomeration (Rambharos, 2016). Therefore, it is assumed that the planning of this neighbourhood is done differently and not by the city of Groningen. Since this is a research into the planning and structure of neighbourhoods in Groningen, including this neighbourhood would only blur the results. The remaining 13 neighbourhoods are shown in figure 3.
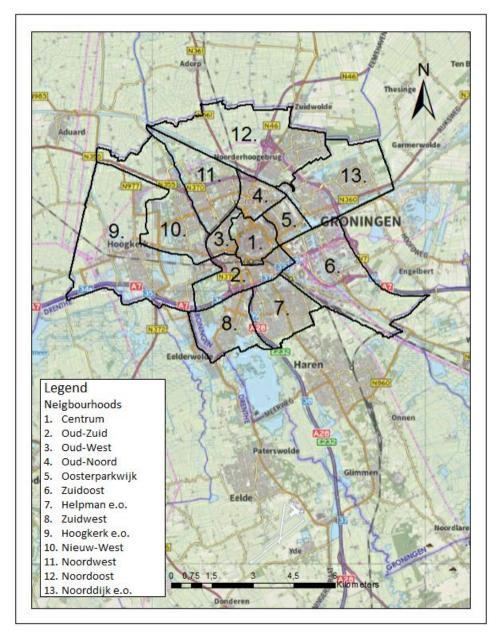
Legend

Neigbourhoods
1. Centrum
2. Oud-Zuid
3. Oud-West
4. Oud-Noord
5. Oosterparkwijk
6. Zuidoost
7. Helpman e.o.
8. Zuidwest
9. Hoogkerk e.o.
10. Nieuw-West
11. Noordwest
12. Noordoost
13. Noorddijk e.o.

Figure 3. Map neighbourhoods in Groningen. Created by author, based on ''Open Topo'' (Esri Nederland, 2016).

5. Method

In this section I will provide a stepwise overview of the way in which the study will reach its objectives.

Initially, I searched for secondary data on UGS and SES using multiple online databases from CBS. Since most of the data come from CBS, which is a governmental institution, I can assume that the data is reliable. The fact that I transformed the data to fit my spatial categorisation might cause some deterioration due to personal mistakes. This transformation and the rest of the data processing is shown, schematically, in figure 4. The CBS data is open and reliable data so there is no ethical consideration

concerning the data. Furthermore, in order to answer the main research question, no additional primary data is required.
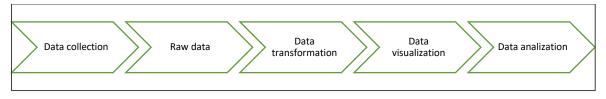

Figure 4. Schematic visualization of data treatment.

Then, I mapped out an overview of the UGS in Groningen and its general distribution. This map was used to make preliminary general assumptions about distribution and locations of UGS and other land uses.

Thirdly, I determined the specific distribution of UGS in the different neighbourhoods. First of all, I looked at the total amount of UGS. Since just the total amount of UGS does not tell the full story, I then looked at the percentage UGS take up of the whole neighbourhood surface. The amount of UGS per person, and the percentage UGS of the total surface for each neighbourhood. The produced data is shown in multiple figures, tables and maps using ArcGIS and Excel.

After that, the research examined the SES of the thirteen neighbourhoods. I used the variables *percentage of low education inhabitants*, *average household income* and, *percentage of work seeking inhabitants* as indicators for the SES of the neighbourhoods. The data is shown in multiple tables, figures and maps using ArcGIS and Excel.

Concluding this research, I have linked the results of the previous two steps to see if there is a form of spatial injustice to be found in Groningen.

6. Hypotheses

Since this study is more of a descriptive kind, I do not have any hypotheses. Nevertheless, I do have some upfront assumptions. Something that has played a major role in the development of the city is the fact that it is built on the last small tail-end of a ridge called 'de Hondsrug' (Huisman, 2003). This ridge, depicted in figure 6, is higher than its surrounding area, which caused this area to be built up first and, a better living area to keep dry feet than the surrounding peaty area. This historical fact still influences the city's layout to this day, with, as shown in figure 5, southern areas having higher housing prices. I presume that these southern areas are therefore more likely to have a higher SES. Furthermore, I expect that I will be able to find a pattern that is similar to the pattern described in the literature review. This research's thesis therefore, is that the southern neighbourhoods have higher SES due to its historically better positioning on 'de Hondsrug', creating a division between the south and north. And that, in line with the literature, inhabitants of these higher SES neighbourhoods in the south have more UGS to their disposal.
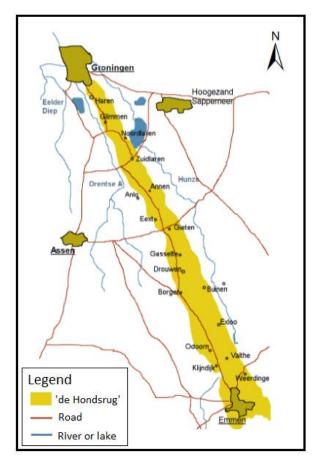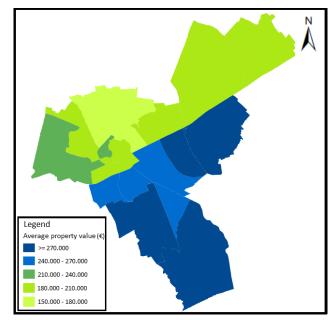
Figure 5. Map showing average property values in Groningen. Edited by author, based on ''Gemiddelde WOZ waarde'' (GronoMeter, 2020).

Figure 6. Map of 'de Hondsrug'. Edited by author, based on ''de Hondsrug'' (Aeroleelde, 2020).

7. Results

7.1 UGS distribution

In this section, I will be showing the distribution of UGS in Groningen. First of all, I will give an overview of the land-uses in the city. After that, I will provide a table that contains the amounts of different forms of UGS per neighbourhood. As explained in the literature review, these raw numbers do not tell the full story of UGS distribution. Therefore I will then provide information on the relative amounts that the UGS make up of the total surface for each neighbourhood and finally I will put the amount of UGS in contrast to the number of inhabitants of each neighbourhood. To conclude this chapter I will give an overview of the previous aspects of UGS to get a clear understanding of its distribution in Groningen.

The land uses are shown in figure 7. Looking at the map gives a good first impression of the locations of UGS in Groningen and the division of other land uses.

Figure 7. Land use in Groningen. Created by author, based on ''Bestand Bodemgebruik 2012'' (Esri Nederland, 2012b).

The most striking implications of figure 7 are listed below:

- The centre parts of the city seem to have little UGS.
- The outskirts of the city seem to have more UGS.
- Neighbourhood *6 Zuidoost* seems to consist mostly out of business parks and not much housing.
- A couple of neighbourhoods, *9 Hoogkerk a.s., 10 Nieuw-West, 12 Noordoost* and, to a lesser degree, *13 Noorddijk a.s.*, seem to include large plots of agricultural land.

Table 1 shows the distribution of different kinds of UGS across the neighbourhoods.

Neighborhood	Parks(ha)	Sports grounds (ha)	Public allotment (ha)	Day recreation (ha)	Residence recreation (ha)	Forest(ha)	Open wet natural terrain(ha)	Total UGS (ha)
01 Centrum	19	0	0	0	0	0	0	19
02 Oud-Zuid	71	29	14	0	5	0	1	120
03 Oud-West	2	0	0	0	0	0	0	2
04 Oud-Noord	18	0	0	0	0	0	0	18
05 Oosterparkwijk a.s.	21	0	0	0	0	0	0	21
06 Zuidoost	5	12	0	0	0	10	11	38
07 Helpman a.s.	29	14	9	0	0	10	0	62
08 Zuidwest	31	27	0	11	22	13	5	109
09 Hoogkerk a.s.	21	15	2	8	0	4	7	57
10 Nieuw-West	53	20	8	0	0	0	0	81
11 Noordwest	37	23	2	0	0	27	3	92
12 Noordoost	49	2	4	0	0	11	19	85
13 Noorddijk a.s.	84	45	1	8	0	41	11	190
Total	440	187	40	27	27	116	57	894

Table 1. Amounts of different UGS per neighbourhood (Source: OpenData CBS (1,), edited by author)
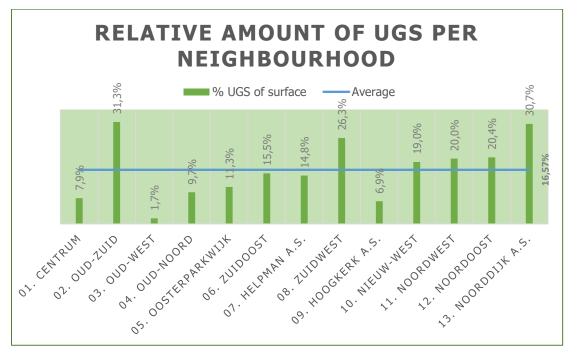
The main preliminary information that can be drawn from this table is the fact that total amounts of UGS do not seem equally distributed over the neighbourhoods. With a couple of very high and very low results, it seems that there is an unequal distribution of UGS in Groningen. We can see that *13 Noorddijk a.s.* and *02 Oud-Zuid* have the highest objective scores when it comes to the total amount of UGS. Furthermore, the neighbourhoods in the city centre: *01 Centrum, 03 Oud-West, 04 Oud-Noord* and also *05 Oosterparkwijk* seem to be the least endowed.

These divergent results are likely stimulated by diverse total amounts of surface that the neighbourhoods have. Presumably, the bigger neighbourhoods automatically have bigger amounts of UGS and the other way around. To check this presumption and to get a clearer picture of the amounts of UGS in a neighbourhood I take a look at two other variables. First, the amount of UGS divided by the total surface of the neighbourhood. Secondly, the amount of UGS divided by the number of inhabitants. For the first variable, it is expected that accounting for the total amount of surface will bring the results closer together. Also, we saw in figure 3, multiple neighbourhoods: *6 Zuidoost*, *9 Hoogkerk a.s.*, *10 Nieuw-West* and, *12 Noordoost*, contain large plots of agricultural land. As I want to know the percentages of UGS inside the neighbourhoods, the amounts of surface of the agricultural plots will be subtracted from the total amount of surface of each neighbourhood. This is shown in table 2.

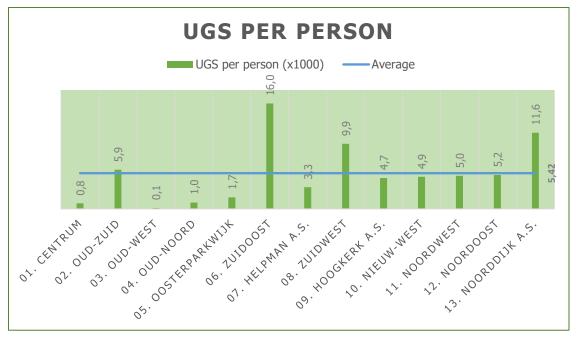| Neighborhood	Total surface (ha)	Agricultural surface (ha)	Surface used for percentage UGS (ha)
01 Centrum	241	0	241
02 Oud-Zuid	387	3	384
03 Oud-West	118	0	118
04 Oud-Noord	186	0	186
05 Oosterparkwijk a.s.	165	0	0
06 Zuidoost	1001	245	756
07 Helpman a.s.	439	13	426
08 Zuidwest	435	25	410
09 Hoogkerk a.s.	1555	734	821
10 Nieuw-West	745	318	427
11 Noordwest	524	64	460
12 Noordoost	1071	659	412
13 Noorddijk a.s.	806	186	620

Table 2. Overview of surface per neighbourhood (Source: OpenData CBS (1), edited by author).

Graph 1 gives us a clearer picture of the neighbourhoods' spatial makeup. Just like the total amounts of UGS, the percentages of UGS do not seem equally distributed. But the differences have scaled down after accounting for the total surface. *02 Oud-Zuid, 08 Zuidwest and, 13 Noorddijk a.s.* have disproportionately large relative amounts of UGS while *03 Oud West,* and *09 Hoogkerk a.s.* seem to have relatively fewer UGS.

Graph 1. Percentages of different UGS in the neighbourhoods (Source: OpenData CBS (1+2), edited by author).

Finally, we take a look at the amount of UGS per inhabitant. As I explained in the literature review, this second indicator will give us a better insight into the accessibility of UGS in the neighbourhoods. We assume that when a lot of people share the same UGS, the accessibility becomes smaller. Graph 2 shows the per capita values of UGS.

16

Graph 2. Amounts of UGS per inhabitant in the neighbourhoods (Source: OpenData CBS (1+2), edited by author).

We can clearly see some inequality existing in the amount of UGS per person. *06 Zuidoost*, *08 Zuidwest* and *13 Noorddijk e.o.* have a clear advantage over the rest. In the case of *06 Zuidoost*, this results can mostly be based on the earlier mentioned fact that the neighbourhood is largely made up of industrial area, thus housing very little inhabitants as can be seen in table 3. This means that the amount of UGS gets divided by a very little number of inhabitants resulting in the high number. The neighbourhoods *01 Centrum, 03 Oud West, 04 Oud Noord* and *05 Oosterparkwijk* are clearly showing below average amounts of UGS per person. As said, I am using the percentage UGS of the total surface and the amount of UGS per person as main indicators for UGS distribution in Groningen. In order to establish a single number, I will convert the previous variables into one new indicator. I call this indicator the UGS distribution level. This will be done by taking the deviations from the mean for every value and adding those up for each neighbourhood. The new variable is nothing other than an indicator that shows the differences between the neighbourhoods.

Neighborhood	Amount of inhabitants
01 Centrum	22.550
02 Oud-Zuid	20.245
03 Oud-West	14.675
04 Oud-Noord	18.620
05 Oosterparkwijk a.s.	12.120
06 Zuidoost	2.375
07 Helpman a.s.	19.190
08 Zuidwest	10.940
09 Hoogkerk a.s.	12.150
10 Nieuw-West	16.620
11 Noordwest	18.320
12 Noordoost	16.325
13 Noorddijk a.s.	16.445

Table 3. Amounts of inhabitants per neighbourhood (Source: OpenData CBS (1+2), edited by author).

Neighbourhood	% UGS of total surface	Amount of UGS per person [x1000]		UGS distribution level
01 Centrum	7,9%	0,84		-136,8
02 Oud-Zuid	31,3%	5,93		98,9
03 Oud-West	1,7%	0,14		-187,1
04 Oud-Noord	9,7%	0,97		-123,5
05 Oosterparkwijk a.s.	11,3%	1,73		-99,7
06 Zuidoost	15,5%	16		190,5
07 Helpman a.s.	14,8%	3,29		-49,7
08 Zuidwest	26,3%	9,87		141,8
09 Hoogkerk a.s.	6,9%	4,69		-71,3
10 Nieuw-West	19,0%	4,87		5
11 Noordwest	20,0%	5,02		13,8
12 Noordoost	20,4%	5,15		18,6
13 Noorddijk a.s.	30,7%	11,55		199,6
Average	16,60%	5,4		

Table 4. UGS variables per neighbourhood (Source: Open Data CBS (1+2), edited by author).

The maps in figure 8, are a visual representation of the UGS data shown in this chapter. For each variable, the data is clustered using Jenks Natural Breaks. This is a data clustering method designed to determine the best arrangement of values into different classes (Jenks, 1967). With these maps, I can make a global examination of the distribution of UGS over the full city.
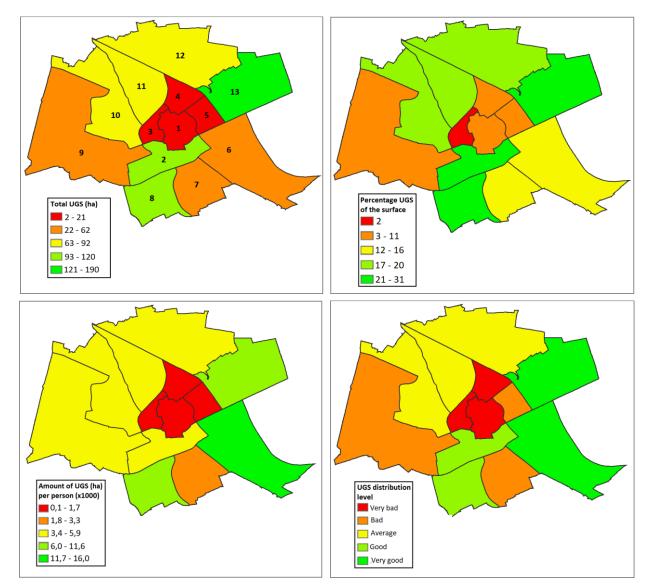
18

Figure 8. Maps displaying UGS variables. . Created by author, based on ''CBS Wijk- en Buurtkaart 2019'' (Esri Nederland, 2019).

The trends in UGS distribution can be seen are the following:

- The inner-city neighbourhoods have the lowest values.
- The west, north-western neighbourhoods come second.
- The east, south-eastern parts have the highest values.
- The only exception to these rules seem to be neighbourhood *07 Helpman e.o.*, this neighbourhood has an orange/yellow colour in every map, which doesn't follow the trend of the surrounding neighbourhoods.

7.2 Social-economic status

In the previous section, I have taken a look into the distribution of UGS to see if this spatial inequality could be found. In the following section, I will look into the SES of the different neighbourhoods. This research will be using *percentage of low education inhabitants*, *average household income* and *percentage of work seeking inhabitants* as indicators for the SES of the neighbourhoods. With three indicators *education, income* and, *occupation,* that cover the aspects in the earlier mentioned definition

of Chu Lim and Omar Thanoon (p. 8), the span of variables is broad enough to approximate the actual SES of the neighbourhoods.

I expect to see the different factors of SES to be dependent on each other. That is, if the neighbourhood has a low SES, the percentage of low educated inhabitants will be high, the household average income will be low and the percentage work seeking will be high. For high SES neighbourhoods, this pattern is expected to be the other way around. The different SES factors are shown in table 5. Again, I will combine these three variables into one, namely SES, by taking the deviation from the mean for every variable and adding those up. Likewise, the new variable is nothing other than an indicator that shows the differences between the neighbourhoods.

Neighbourhood	% low educated inhabitants [2018]*	Average household income [1000 euro][2017]**	% work seeking [2020]***		SES
01 Centrum	8	23,9	6,9		55,3
02 Oud-Zuid	9	31,9	6,6		76,3
03 Oud-West	9	34,9	6,8		83,0
04 Oud-Noord	15	27,1	13,8		-44,2
05 Oosterparkwijk a.s.	23	27,8	14,5		-92,3
06 Zuidoost	9	45,2	5,1		130,5
07 Helpman a.s.	15	40,2	9,2		41,4
08 Zuidwest	19	38,7	8,7		20,7
09 Hoogkerk a.s.	28	41,6	7,7		-8,9
10 Nieuw-West	29	35,3	9,6		-52,2
11 Noordwest	29	27,6	13,8		-117,9
12 Noordoost	22	35,6	12,8		46,7
13 Noorddijk a.s.	27	37,2	10,5		-45,2
Average	18,62	34,38	9,69		

*   Percentage low educated inhabitants of 18 years and older. Low is: untill vmboTL/mavo.
**   Average gross income.
*** Percentage registered job seeking with the UWV (dutch employee insurance agency).

Table 5. SES values per neighbourhood (Source: OpenData CBS (1+2), edited by author).

As can be seen in table 5, the earlier described SES pattern is often visible. In the table, you can clearly see that the colour grading for every variable is often more or less the same in one area, which tells us that the variables are likely to be dependent and therefore a good indication of the actual SES. However, the first three neighbourhoods seem to be a big exception to this rule. I theorize that this anomaly is due to the high number of students that live in these neighbourhoods. Students are often not work seeking, at least not registered at the UWV; they do not have a high income, but they are often highly educated. This does not follow our regular assumptions of socioeconomic status. Table 6 shows the percentage 15-25-year-old in each neighbourhood, underpinning my theory that a high number of students is the reason for this result. These atypical data could be seen as outliers. Outliers can significantly affect the process of estimating statistics (Kwak & Kim, 2017) resulting in a blurring of the results. Removing the outliers will prevent this from happening. They point out that in order to specify data as an outlier, the data either needs to be over 3 standard deviations (SD) from the mean or over 1.5 times the quartile distance from either the first or the third quartile. As you can see in table 6 and figure 9 neither of these standards for outliers has been met. Therefore, I will not be discarding any of the neighbourhoods.

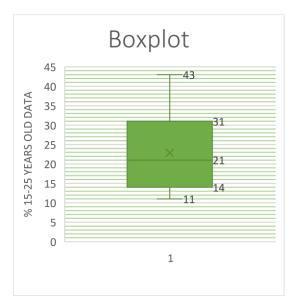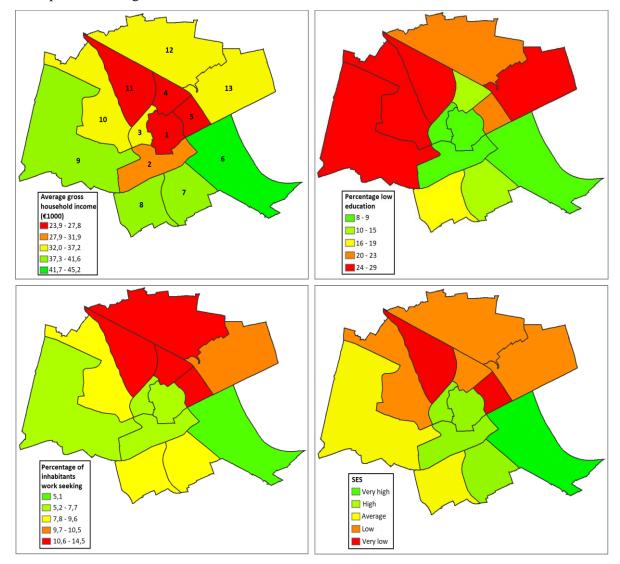| Neighborhood	% 15-25 years old	#SD from the mean
01 Centrum	43	2,2
02 Oud-Zuid	33	1,09
03 Oud-West	33	1,09
04 Oud-Noord	29	0,66
05 Oosterparkwijk a.s.	21	0,2
06 Zuidoost	14	0,95
07 Helpman a.s.	14	0,95
08 Zuidwest	14	0,95
09 Hoogkerk a.s.	15	0,84
10 Nieuw-West	19	0,41
11 Noordwest	24	0,12
12 Noordoost	27	0,45
13 Noorddijk a.s.	11	1,27

Table 6. Percentages 15-25-year-old inhabitants and their SD from the mean (Source: OpenData CBS (1+2), edited by author).

Figure 9. Boxplot percentages 15-25-year-old inhabitants per neighbourhood.

21

The maps shown in figure 10 visualise the data on SES.

Figure 10.Maps showing the different SES indicators for the neighbourhoods in Groningen. Created by author, based on ''CBS Wijk- en Buurtkaart 2019'' (Esri Nederland, 2019).

We can see some general patterns when it comes to the SES of neighbourhoods in Groningen:

- The inner-city neighbourhoods, *01 Centrum*, *02 Oud-Zuid* and, *03 Oud-West*, are a clear exception to the rule.
- The northern parts of Groningen have a disadvantage when it comes to SES. We also see that neighbourhood *13 Noorddijk e.o.* is now part of this cluster.
- The southern neighbourhoods have a higher SES than the northern neighbourhoods.

In the next section I will determine whether these differences in SES are spatially related to the distribution of UGS.
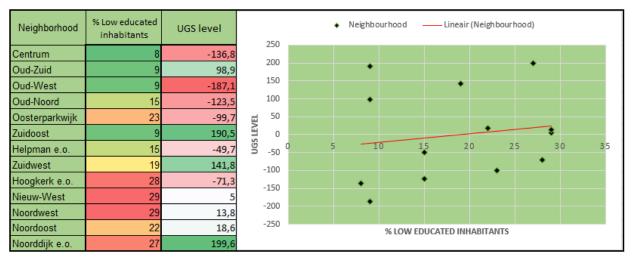
7.3 Spatial justice

In the previous sections, I have explained and visualised how UGS are spatially distributed in Groningen. Then I analysed what the SES of the different neighbourhoods is and showed how this is spatially distributed. In this section, I explain if we can speak of spatial injustice by seeing if the UGS

distribution is spatially related to the SES of the neighbourhoods. The data that is gathered in this research is not applicable for quantitative data analysis. First of all, because this study contains 13 – the number of neighbourhoods – cases, while qualitative research often needs 30 or more cases. And second of all because the data is not independent. Simply put, what happens in one neighbourhood affects what happens in the next neighbourhood. Whereas with qualitative data analysis, the data is presumed to be independent. Therefore, the following analysis will be an analysis without any real statistical significance. The results, of course, can still show general patterns and indicators of spatial injustice.
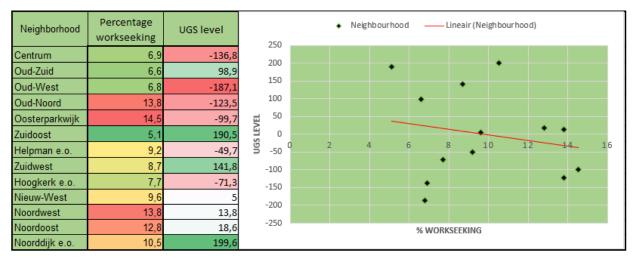
In order to see if there is spatial injustice in the city of Groningen I will see if the following pattern can be established:

1. In neighbourhoods with relatively low SES is relatively low UGS distribution.
2. In neighbourhoods with relatively high SES there is relatively high UGS distribution.
3. This pattern can be seen across multiple neighbourhoods in the same area.

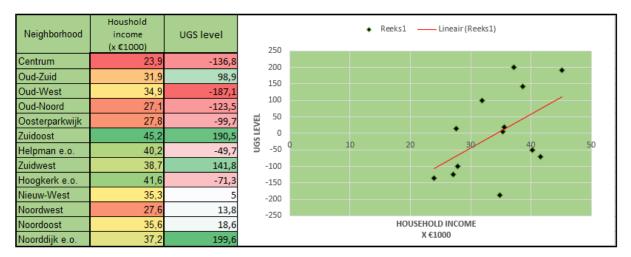To check the first to presumptions I will display the different SES statistics compared to the UGS level in

Neighborhood	% Low educated inhabitants	UGS level
Centrum	8	-136,8
Oud-Zuid	9	98,9
Oud-West	9	-187,1
Oud-Noord	15	-123,5
Oosterparkwijk	23	-99,7
Zuidoost	9	190,5
Helpman e.o.	15	-49,7
Zuidwest	19	141,8
Hoogkerk e.o.	28	-71,3
Nieuw-West	29	5
Noordwest	29	13,8
Noordoost	22	18,6
Noorddijk e.o.	27	199,6

Infographic 1. Visualization of the UGS level against the percentage low educated inhabitants per neighbourhood.

Neighborhood	Percentage workseeking	UGS level
Centrum	6,9	-136,8
Oud-Zuid	6,6	98,9
Oud-West	6,8	-187,1
Oud-Noord	13,8	-123,5
Oosterparkwijk	14,5	-99,7
Zuidoost	5,1	190,5
Helpman e.o.	9,2	-49,7
Zuidwest	8,7	141,8
Hoogkerk e.o.	7,7	-71,3
Nieuw-West	9,6	5
Noordwest	13,8	13,8
Noordoost	12,8	18,6
Noorddijk e.o.	10,5	199,6

Infographic 2. Visualization of the UGS level against the percentage work seeking inhabitants per neighbourhood.

Neighborhood	Houshold income (x €1000)	UGS level
Centrum	23,9	-136,8
Oud-Zuid	31,9	98,9
Oud-West	34,9	-187,1
Oud-Noord	27,1	-123,5
Oosterparkwijk	27,8	-99,7
Zuidoost	45,2	190,5
Helpman e.o.	40,2	-49,7
Zuidwest	38,7	141,8
Hoogkerk e.o.	41,6	-71,3
Nieuw-West	35,3	5
Noordwest	27,6	13,8
Noordoost	35,6	18,6
Noorddijk e.o.	37,2	199,6

Infographic 3. Visualization of the UGS level against the average household income per neighbourhood.

Neighborhood	SES	UGS level
Centrum	55,3	-136,8
Oud-Zuid	76,3	98,9
Oud-West	83,0	-187,1
Oud-Noord	-44,2	-123,5
Oosterparkwijk	-92,3	-99,7
Zuidoost	130,5	190,5
Helpman e.o.	41,4	-49,7
Zuidwest	20,7	141,8
Hoogkerk e.o.	-8,9	-71,3
Nieuw-West	-52,2	5
Noordwest	-117,9	13,8
Noordoost	46,7	18,6
Noorddijk e.o.	-45,2	199,6

Infographic 1. Visualization of the UGS level against the SES per neighbourhood.

In two of the three cases, we can see a trend that we expect to see, following my presumptions. Only in infographic 1, we can see a pattern in which there is more UGS for neighbourhoods that have a higher percentage of low educated inhabitants. In infographic 2, we do see the trend, neighbourhoods with more people that are work seeking, are likely to have less UGS. And likewise, in infographic 3, we see a pattern that follows our presumption, the higher the amount of household income, the higher the amount of UGS in the neighbourhood. Also in infographic 4, that shows the SES variable I computed against the UGS level, there is a small trend to be seen that goes along with the presumptions. I cannot, because of earlier discussed limitations to the data, put any significance to these trends. But the spread of the points in the graphs does suggest that if there are any real relations, they are most likely very weak.

The infographics do not suggest a clear pattern but do suggest some weak form of injustice. To see if this trend can be found across multiple neighbourhoods in the same area, I have done a hot-spot analysis. The output of this analysis is shown in figure 11. The map is created out of different layers of the hot-spot analysis for every variable. The analysis tells us where high and low values cluster spatially. In other words, it tells us where 'bad' and 'good', SES and UGS results, spatially cluster. The tool does so by looking at the neighbourhoods within the context of the surrounding neighbourhoods. So, if a neighbourhood with low UGS is situated in an area where other neighbourhoods also have low UGS, it is more likely to turn up blue. This also goes the other way around. But if a neighbourhood has low UGS in an area where other neighbourhoods do not have low UGS, it will likely not turn up blue. This creates

a analysis that goes beyond the neighbourhood border. Normally the hot-spot analysis required 30 cases. Therefore, again, I cannot presume the outcome to have a true statistical meaning. The colour-trend that is shown, however, is still of value.
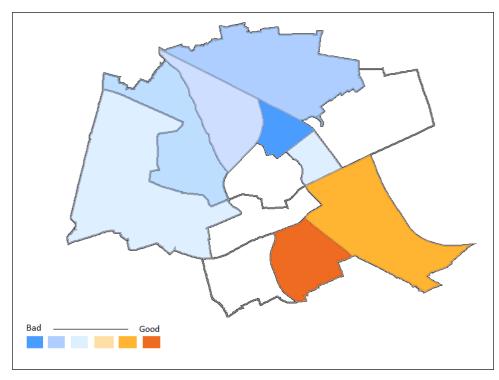

Figure 11. Map showing the hotspot analysis. . Created by author, based on ''CBS Wijk- en Buurtkaart 2019'' (Esri Nederland, 2019).

The hot-spot analysis shows that the northern neighbourhoods seem to be worse off when it comes to the combination of SES and UGS: they have a lower SES and lower amounts of UGS. This also points toward a trend of spatial injustice.

8. Conclusion

The main research question for this research asked how UGS are distributed in Groningen, in relation to the spatial layout of SES. The answer to this question also confirms my thesis. It seems that the higher lying areas, build on the 'Hondsrug' in the south, have a higher SES than the northern areas. And generally, these higher lying areas also have more UGS to their disposal. The research was also able to fulfill some of its broader aims, stated in the introduction. Firstly, it has provided insight into the spatial distribution of UGS in the city of Groningen. However, it cannot come to an unambiguous answer to the question on spatial justice concerning UGS distribution, but does reveal some general trend. In my opinion it has also contributed to the bigger societal debate on spatial justice concerning UGS.

As said this research was not able to indicate exact statistical values due to the form of data that was gathered. Another limitation of the study is the fact that it did not account for the perceived accessibility of the UGS. Moreover, I feel that the study is very reliant on the way the neighborhoods are drawn up.

This research has found indicators of spatial injustice. It seems that the northern neighbourhoods have lower average SES and lower average amounts of UGS than the southern neighbourhoods. There are multiple other possible explanations for these indicators. Preventing green gentrification, explained on page nine, for example, could be a reasoning behind the decision making on UGS distribution. This is

also one of the weaker aspects of this study, it does not account for different explanations of unequal UGS distribution. But as it is a study into the global trends, it does not limit its findings.

Also, the spatial injustice indicator do not seem to have a strong enough relation to be able to speak about real spatial injustice in Groningen. This study tried to overcome this limitation by doing a hot-spot analysis, but I would still recommend future studies to look at different spatial appropriations than just neighbourhoods. Another recommendation for future studies to do a broader study that includes multiple cities in the Netherlands to be able to get at least 30 cases. This could also be done by doing research on another spatial scale.

8.1 Conflict of interest or biases

There are no indications of any conflicts of interests in this research. I am aware of some biases that might be included in this research because of the fact that I was an inhabitant of the city of Groningen for many years. These biases might have steered me into a direction that wanted to confirm my presumptions of some neighbourhoods. For example, it is common fact in Groningen that the neighbourhoods in the south are 'richer' than those in the north. These kinds of pre-existing knowledge might have steered the research in a certain direction.

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