

Reclaiming nature in cities: An economic valuation approach across the socio-economic gradient in Potchefstroom

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PREFACE

“There is no logic that can be superimposed by the city; people make it, and it is to them, and not to buildings, that we must fit our plans.” – Jane Jacobs

Nature has always been something I appreciated, astonished by its beauty, wonders and resources. Unfortunately, our cities and the technological development of the modern-day are jeopardising environmental quality and separating people from nature. Studying Urban and Regional Planning at the North-West University, Potchefstroom campus, I was blessed to have incredible professors and lecturers that taught me that Urban Planners have the ability to encourage a shift in planning practice while prioritising the environment in planning projects. They emphasised the importance of engaging with the people on the ground, collaborating with stakeholders and to plan in context. Thus, they inspired me to encourage the latter in planning practice. Choosing a theme for my mini-dissertation during my fourth year of studies, there was no doubt in my mind that I would focus on the environmental component of cities. I had the opportunity to refine a study conducted by my supervisor aiming to confirm the economic value of urban green spaces, a crucial and challenging goal to achieve if urban green spaces were to be prioritised in South African planning approaches in the future. This year I had the privilege to use the results obtained from my mini-dissertation and write my first academic article as co-author which was published in an accredited journal in July of 2020. This year I further refined my study by investigating how urban green spaces between different socio-economic groups influence property value. Ultimately, this research delivered meaningful and useful results, contributing to South African urban planning research.

Many have contributed to the success of this research. I wish to express my sincere appreciation to the following people:

- The National Research Foundation (NRF) as this research (or parts thereof) was made possible by the financial contribution of the NRF, South Africa (Grant Number 116243). Any opinion and conclusions or recommendations expressed in this study are those of the author and therefore the NRF does not accept any accountability in regards thereto.
- My supervisor, Professor E.J. Cilliers, for her guidance, support, inputs, motivation and passion for her work and research which inspired me to engage in my Masters studies.
- My co-supervisors, Doctor L.G. Lategan and Professor S.S. Cilliers for their guidance and inputs throughout the year.

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ABSTRACT

Nature is essential to urban quality of life, yet urban green spaces (UGSs) are continuously competing with other land-uses with explicit monetary contributions to the city economy. Indeed, the economic benefits delivered by UGSs are often underestimated. In an attempt to strengthen the case for urban greening and to reclaim nature in cities, this research considered urban green spaces from an economic spatial perspective. It reflected on planning-related challenges including urban expansion that will continue to threaten UGSs in future decades as urban areas will need to absorb most of the population due to the rapid rates of urbanisation on a global and regional scale, causing detrimental environmental effects. This research considered the proximity principle, an indicator of the economic benefits of urban green spaces, as part of a hedonic price analysis method to determine the impact of urban green spaces on property value across the socio-economic gradient in Potchefstroom, South Africa. This local case study was selected based on the assumption that context-specific conditions between different socio-economic groups would deliver contrasting results in terms of how UGSs influence property value. The primary data was gathered through statistical analyses that determined the applicability of the proximity principle across the socio-economic gradient in Potchefstroom. Supporting quantitative data was gathered through structured questionnaires and electronic interviews to gather local and professional perceptions of urban green space (UGS) benefits and UGS planning, as well as the process of compiling a municipal valuation roll. Results indicated distinct differences in proximity principle applicability between different socio-economic groups and planning contexts. Context-specific conditions and the socio-economic status of an area determine UGS characteristics and community needs, influencing willingness-to-pay and how UGSs influence property value. The research results contributed to the discourse on the economic benefits of UGSs and presented the trends of such benefits within the local case study of 2020, in comparison with the results of similar studies conducted in 2015 and 2019 respectively. The results emphasised the need to rethink the planning and design of UGSs while considering context-specific conditions and active community involvement. This research calls for greater acknowledgement towards UGS contributions to the city economy, urban environmental quality and human well-being by local municipalities, communities and private investors. Ultimately this research calls for UGS planning to be prioritised in mainstream planning approaches in an attempt to encourage sustainable urban development.

Key terms: urban green spaces; ecosystem services; ecosystem disservices; proximity principle; economic benefits; socio-economic gradient; context planning.

OPSOMMING

Die natuur is van kardinale belang vir stedelike kwaliteit van lewe, tog kompeteer stedelike groen ruimtes voortdurend met alternatiewe grondgebruike wat duidelike bydraes lewer tot 'n stad se ekonomie en daarom word die ekonomiese voordele van stedelike groen ruimtes onderskat. In 'n poing om die saak vir stedelike vergroening te versterk en die natuur terug te bring in stede het hierdie navorsing stedelike groen ruimtes vanaf 'n ekonomiese ruimtelike perspektief oorweeg. Hierdie navorsing het reflekteer op beplanning-verwante uitdagings soortgelyk aan stedelike uitbreiding wat stedelike groen ruimtes bedreig om toekomstige populasiegroei te absorbeer op globale- en streekskale, en gevolglik lei tot nadelige omgewingseffekte. Hierdie navorsing het die nabyheidsbeginsel oorweeg, 'n aanduider van die ekonomiese voordele van stedelike groen ruimtes, as deel van 'n hedoniese prysanalise metode om die impak van stedelike groen ruimtes op eiendoms waarde oor die sosio-ekonomiese gradiënt in Potchefstroom, Suid-Afrika, te bepaal. Die plaaslike gevallestudie van hierdie navorsing was gebaseer op die aanname dat konteks-spesifieke omstandighede tussen verskeie sosio-ekonomiese groepe kontrasterende resultate sal oplewer in terme van hoe stedelike groen ruimtes eiendoms waarde beïnvloed. Die primêre data is ingesamel deur statistiese analises wat die toepaslikheid van die nabyheidsbeginsel oor die sosio-ekonomiese gradiënt in Potchefstroom bepaal het. Ondersteunende kwantitatiewe data was ingesamel deur gestruktureerde vraelyste en elektroniese onderhoude om inligting in te samel rakende plaaslike perspektiewe oor die voordele van stedelike groen ruimtes, groen ruimte beplanning en die opstel van 'n munisipale waardasierol. Die navorsingsresultate het duidelike verskille getoon in die toepaslikheid van die nabyheidsbeginsel tussen verskeie sosio-ekonomiese groepe en beplanningskontekste. Konteksspesifieke omstandighede en die sosio-ekonomiese status van 'n area bepaal die karaktereenskappe van stedelike groen ruimtes, asook die behoeftes van gemeenskappe wat gevolglik bepaal tot watter mate die stedelike groen ruimtes eiendoms waarde beïnvloed. Die navorsingsresultate het tot die bewyse van die voordele van stedelike groen ruimtes bygedra en hierdie bewyse voorgestel in die Potchefstroom gevallestudie van 2020 in vergelyking met die resulte van soortgelyke studies wat in 2015 en 2019, onderskeidelik, uitgevoer is. Die resulte het die erns beklemtoon om die beplanning en ontwerp van stedelike groen ruimtes te herdink, asook om konteks-spesifieke omstandighede en aktiewe gemeenskapsbetrokkenheid te oorweeg. Hierdie navorsing vra vir meer erkenning deur plaaslike munisipaliteite, gemeenskappe en private investeerders in verband met die voordele wat stedelike groen ruimtes bied tot 'n stad se ekonomie, die bydraes tot omgewingskwaliteit en die belangrikheid hiervan vir menslike welstand. Uiteindelik vra hierdie navorsing dat die beplanning van stedelike groen ruimtes prioritiseer sal word in hoof beplanningsbenaderings in 'n poging om volhoubare stedelike ontwikkeling aan te moedig.

Sleuteltermen: stedelijke groen ruimtes; ekosysteemdienste; nabijheidsbeginsel; economische voordelen; socio-economische gradient; konteksbeplanning.

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LIST OF ABBREVIATIONS

ES: ecosystem services

GIS: geographical information system

LUS: land use scheme

MCA: multi-criteria analysis

SDF: spatial development framework

SES: socio-economic status

UGS: urban green space

UGSs: urban green spaces

WTP: willingness-to-pay

CHAPTER 1: INTRODUCTION

1.1 Problem statement

Urban expansion will continue in future decades as urban areas will absorb most of the population due to the rapid rates of urbanisation and population growth on a global and regional scale (Nor *et al.*, 2017:274; Chen *et al.*, 2017:957). This leads to urban green spaces (UGSs) continuously competing with other land-uses like residential, business and commercial development that provide explicit economic benefits to urbanities and local authorities, whereas the economic benefits of UGSs are difficult to measure. As a result, other land-uses linked to urban development are prioritised the planners. The economic benefits of UGSs are underestimated in South Africa where a pro-development rather than a pro-environmental approach to spatial planning is followed (Cilliers, 2009:182; Cilliers, 2013:347; Cilliers & Cilliers, 2015:1). Poor planning, management and decision-making also negatively influence environmental quality in South Africa (Kessides, 2006:xxii). Continuous urban development has a negative impact on the carrying capacity of the land and urban ecosystems (Funmilayo *et al.*, 2011:57). Carrying capacity can be defined as the number of people the earth may sustain without compromising the ability of the earth to sustain the needs of the future population (Funmilayo *et al.*, 2011:58). While the carrying capacity of land has already been exceeded in some urban centers, people continue to produce more goods, leading to damaged natural ecosystems and diminished biological diversity which in turn further jeopardises the sustainability of the city (Funmilayo *et al.*, 2011:57). Indeed only 10% of land in cities and towns within South Africa is occupied by UGS referring to publically accessible parks and natural areas (Girma *et al.*, 2019:138). The depletion of UGSs in the context of South Africa is not merely the result of urbanisation and rapid population growth, but also the expansion of informal settlements (Cilliers, 2013:1). The availability of UGSs between areas of different socio-economic status (SES) varies substantially, as seen in Figure 1-1. The map on the left represents low-income groups in purple and high-income groups in yellow in Pretoria, South Africa, (25.7479° S, 28.2293° E), whereas the map of the same area on the right represents UGS availability across the socio-economic gradient. The difference is undeniable, the purple areas on the right present signs of limited to no UGS availability on the left.

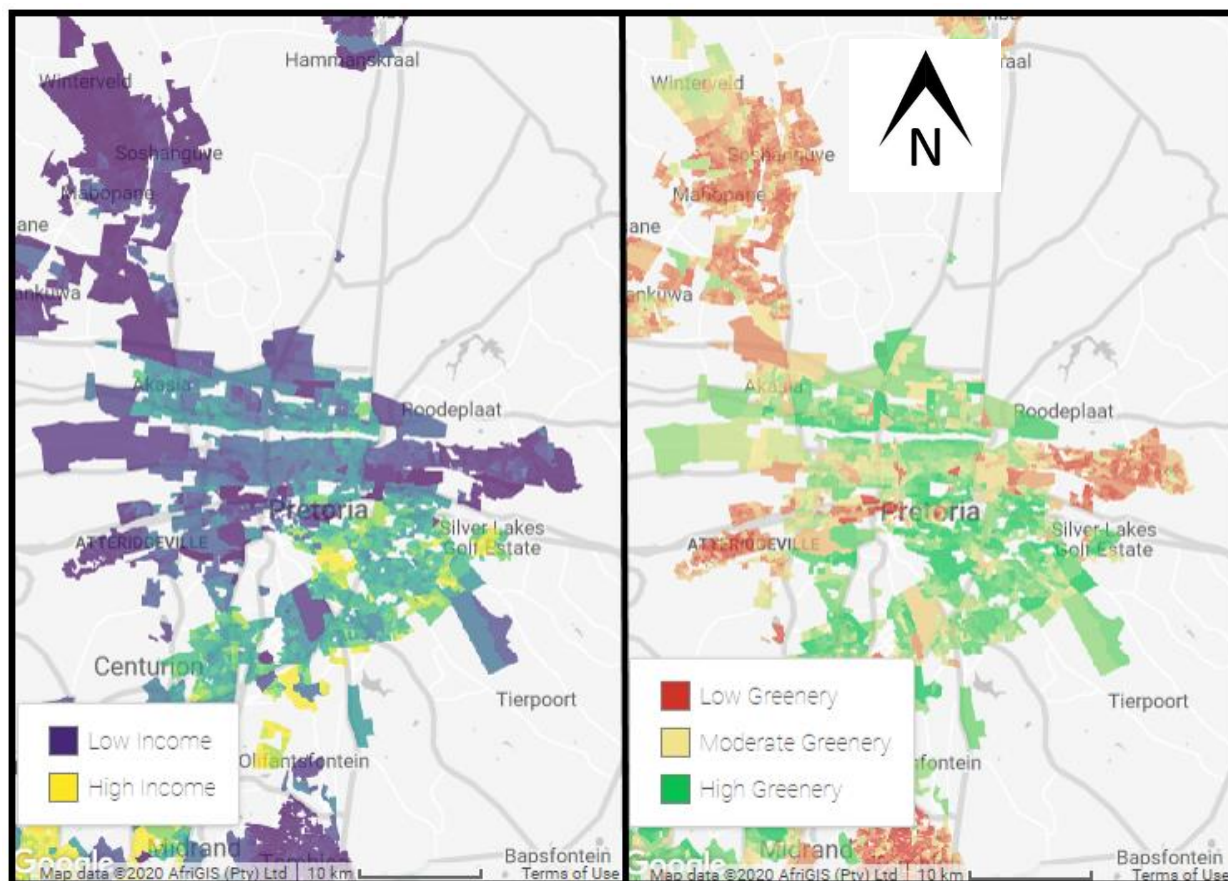


Figure 1-1: Urban green space contrast between areas of different socio-economic status
Source: Venter (2020)

Yet, irrespective of the negative impacts on the environment that are caused by urban development or mismanagement, economic growth and financial stability opens up a world full of potential for efficient infrastructure that promotes sustainability and leads to a cleaner environment (Panayotou, 2000:1). As economic growth is so important for environmental quality it motivates the need to confirm the economic benefits of UGSs in this research and the vital contribution these spaces could bring to the city economy. This research included a case study in Chapter 6 that was conducted in Potchefstroom, South Africa, investigating the impact of UGSs on property value across the socio-economic gradient by testing the proximity principle, an indicator of the economic benefits of UGSs. This case study was divided into three categories, testing the proximity principle in low-income residential areas bordering an UGS (Category A), middle-income residential areas also bordering an UGS (Category B) and a high-income residential estate with an internal green space network (Category C). Category B of the case study was a refinement of a previous study conducted by Cilliers & Cilliers in 2015 and once again in 2019 by Combrinck *et al.*, 2020. As similar results were recorded in both the 2015 and 2019 studies, the 2020 case study expanded the study area to include low-income and high-income areas to consider different planning contexts, thus, the socio-economic gradient in Potchefstroom.

The evidence of the economic benefits of UGSs, as well as the essential ecosystem services (ES) they provide, could strengthen the case for urban greening and, as a result, help to reclaim nature in cities.

1.2 Research aim and objectives

The main aim of this research is to determine the influence of urban green spaces (UGSs) on property value across the socio-economic gradient in Potchefstroom and, more specifically, to confirm that UGSs provide crucial economic benefits to urbanities and local authorities. The objectives of this research included:

- To reflect on the social, environmental and economic benefits (ecosystem services) that UGSs provide.
- To reflect on the hedonic price analysis method as an economic valuation method for UGSs.
- To investigate the applicability of the proximity principle in the local context of Potchefstroom by comparing the 2020 trends with the 2015 and 2019 trends.
- To determine what characteristics of UGSs and different socio-economic status groups have a positive or negative impact on property value that may be considered in UGS planning.
- To formulate recommendations that could address environmental issues in South Africa regarding the planning and management of UGSs to ultimately enhance UGS planning as part of a broader spatial planning approach.

1.3 Document structure

This research will commence with one chapter discussing the research methodology employed (Chapter 2). An in-depth literature study will follow focusing on the main aim and research objectives mentioned in section 1.2 above. The literature study includes one chapter on urban ecosystems and urban green spaces (Chapter 3), one chapter on the economic valuation of urban green spaces (Chapter 4) and one chapter providing contextual background for the empirical investigation (Chapter 5). Thereafter, the empirical investigation is discussed comprehensively in three chapters. Chapter 6 will focus on the 2020 Potchefstroom case study as part of the quantitative research investigation. The following chapter (Chapter 7) will provide further explanations for the results obtained in the 2020 case study (Chapter 6) through a multi-criteria analysis (MCA). Chapter 8 will present a quantitative and qualitative research investigation consisting of surveys. The final conclusions of this research and the ultimate planning recommendations will be discussed in Chapter 9 and Chapter 10 respectively. Thereafter the

bibliography and annexures will follow. Figure 1-2 illustrates the dissertation outline as explained above.

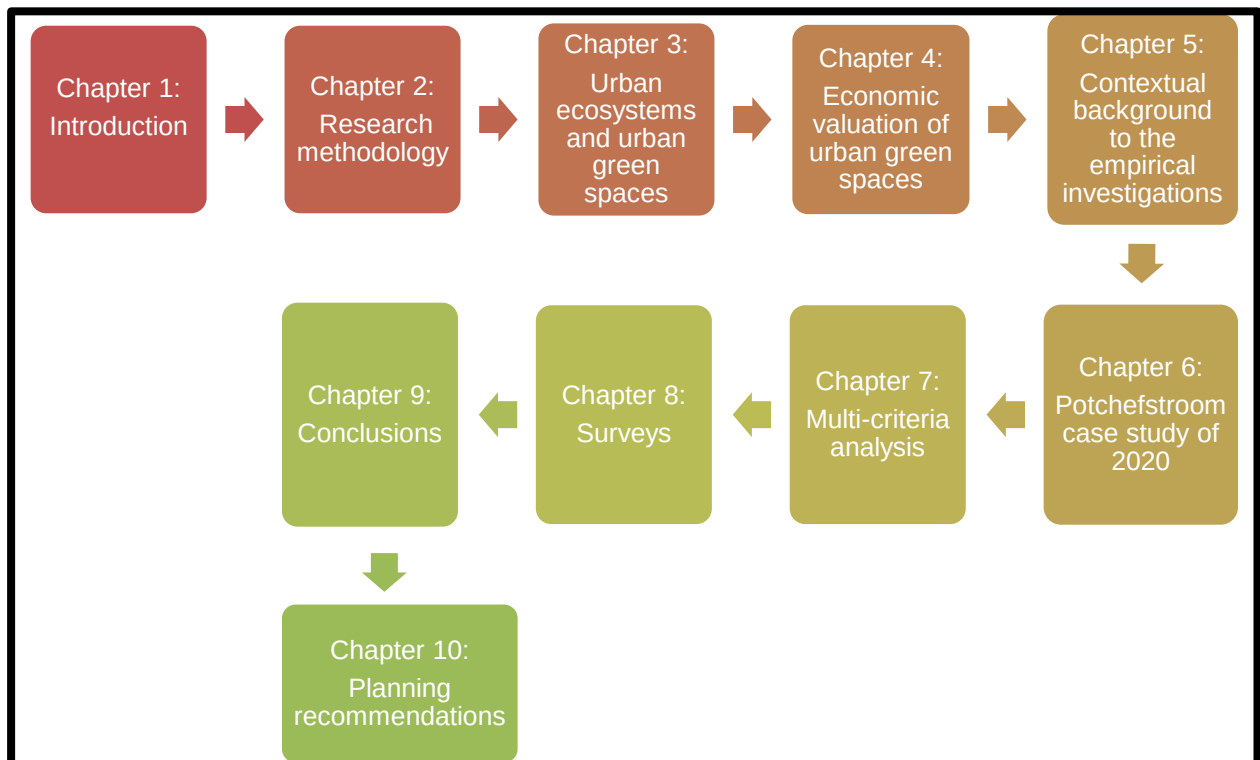


Figure 1-2: Dissertation outline
Source: Own composition (2020)

1.4 Methodology

This section will provide an overview of the research methodology that was employed through this research. The detailed discussion will follow in Chapter 2, as mentioned in section 1.3 above. This research followed the mixed-method research approach accounting for both quantitative and qualitative research approaches. The research commenced with a comprehensive literature study, where after the empirical investigations were completed. The quantitative data methods included a Potchefstroom case study and two structured questionnaires. A MCA was completed using the quantitative data results obtained from the Potchefstroom case study and a qualitative research method. Thus, the MCA was a combination of quantitative and qualitative research approaches. The qualitative data included electronic interviews. Chapter two will provide a comprehensive discussion on the research methodology of this research and will include definitions, methods and how the data was gathered in the literature study, the quantitative empirical investigations and the qualitative empirical investigations.

1.5 Study area

The study area of this research was Potchefstroom, located in the North-West Province of South Africa at 26.7145° S and 27.0970° E. Potchefstroom is situated approximately 120 kilometres South-West of Johannesburg and 180 kilometres South-West of Pretoria. Potchefstroom is also situated approximately 50 kilometres North-East of Klerksdorp. Figure 1-3 and Figure 1-4 illustrate the location of the North-West province in South Africa and the location of Potchefstroom in the North-West province of South Africa, respectively.

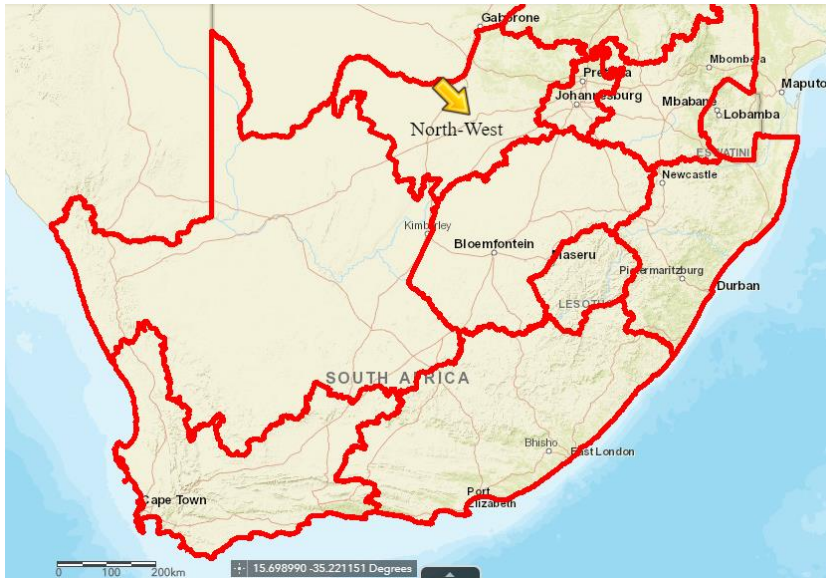


Figure 1-3: The location of the North-West Province in South Africa
Source: Google Earth (2020)

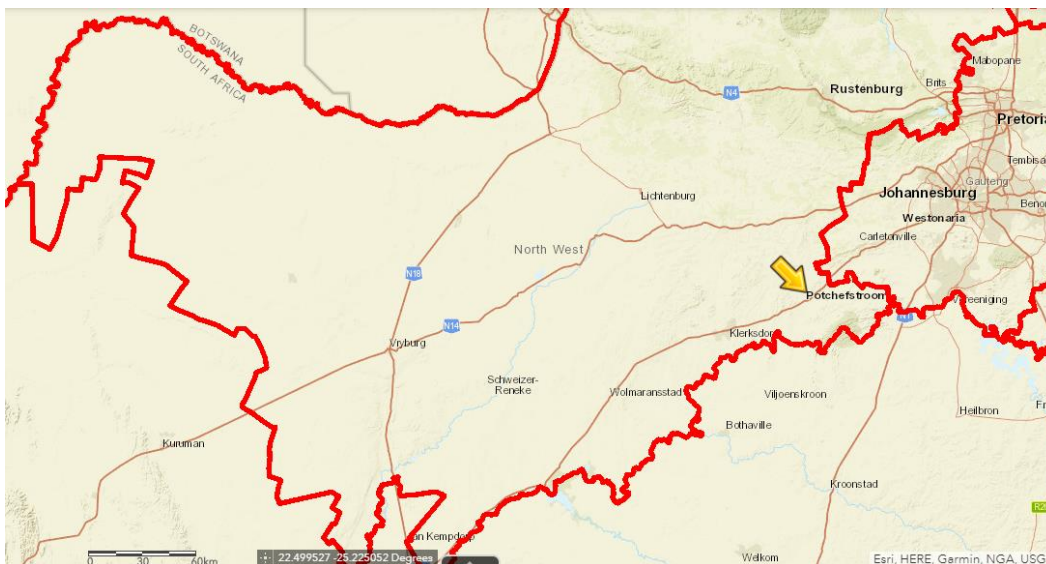


Figure 1-4: The location of Potchefstroom in the North-West Province of South Africa
Source: Google Earth (2020)

Potchefstroom was originally chosen by Cilliers & Cilliers (2015) to determine the impact of urban green spaces (UGSs) on property value in five residential areas in Potchefstroom to compare local case study findings with findings captured in international literature. The study by Cilliers & Cilliers (2015) was refined in 2019 by Combrinck *et al.* (2020). The current research is a further refinement of the study by Cilliers & Cilliers (2015) and Combrinck *et al.* (2020) to determine the impact of UGSs on property value in areas of different socio-economic status (SES) in Potchefstroom, thus, the same study area used in the previous case studies. Potchefstroom has a unique planning context. The Western part of Potchefstroom is predominantly comprised of low-income residential areas characterised by informal settlements. The Northern and Eastern parts of Potchefstroom consist of middle to high-income residential areas surrounding the Central Business District (CBD), as well as the North-West University and Mooirivier Mall. Potchefstroom is highly segregated in areas of different socio-economic status (SES) making this study area the ideal study area to investigate how UGSs across the socio-economic gradient influence property value. The Potchefstroom planning context as well as the background to the 2015 Potchefstroom case study by Cilliers & Cilliers (2015) will be discussed comprehensively in section 5.3 and section 5.4. The following chapter will discuss the research methodology of this research.

1.6 Ethics: Questionnaires

Questionnaires were sent to Potchefstroom residents and Professional Planners (structured questionnaires), as well as Municipal Valuers (electronic interviews). The structured questionnaires were sent to Potchefstroom residents and Professional Planners which was part of a mini-dissertation study in 2019. The findings that were relevant to this research and that could contribute to the objective of this research were included. The questionnaires that were sent to Municipal Valuers, as electronic interviews, commenced with a paragraph which guaranteed confidentiality and anonymity of each respondent. This paragraph also explained the research objective and why the questionnaire was compiled, as well as what was expected from each respondent. It was made clear that the respondent will be completing the questionnaire voluntarily and that the respondent may withdraw at any time. The paragraph explained that the research received ethical clearance from the North-West University's Faculty of Natural and Agricultural Sciences (Ethics number of NWU-01473-20-A9).

CHAPTER 2: RESEARCH METHODOLOGY

2.1 Introduction

The research methodology will explain the mixed-method research approach that was followed to complete the literature study and the empirical investigations. Thereafter, the discussion continues with definitions and methods, as well as the advantages of the mixed-method research approach that was employed to complete the empirical investigations from Chapter 6 until Chapter 8 including the quantitative investigation and the qualitative investigation (Potchefstroom case study, MCA and surveys), as seen in Figure 2-1.

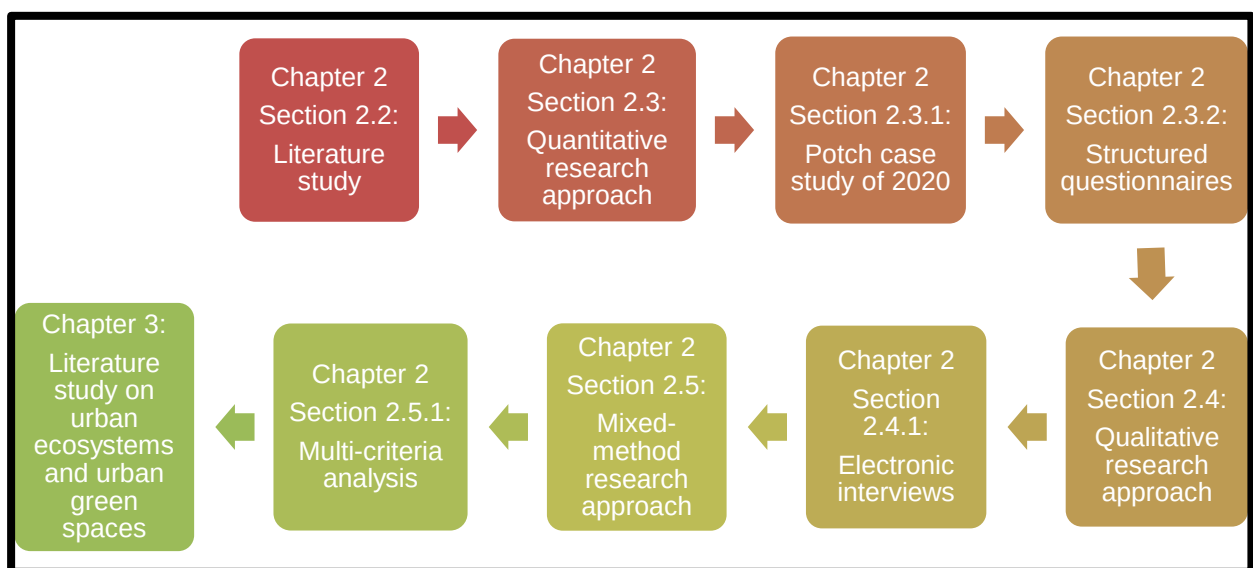


Figure 2-1: Contents and structure of Chapter 2
Source: Own composition (2020)

2.2 Literature study

Before commencing with the literature study, the key concepts relating to the main objective of this research were identified. The main objective of this research is to determine the impact of urban green spaces on property value across the socio-economic gradient in Potchefstroom. The key concepts that were selected included the following: (1) urban ecosystems, (2) urban green spaces, (3) ecosystem services and disservices, (4) economic valuation methods, (5) the proximity principle, (6) municipal property valuation, (7) the South African planning context, (8) the Potchefstroom planning context and (9) the socio-economic gradient. The key concepts also aligned with the aims of this research as set out in section 1.2. After the key concepts were selected, the concepts were categorised in three literature study chapters based on similar overall themes namely (1) urban ecosystems and urban green spaces, (2) economic valuation of urban

green spaces and (3) South African and Potchefstroom planning contexts. The literature investigation was conducted by studying several international academic articles available online (Google Scholar) in environmental, urban planning, economic and ecology journals.

The literature investigation resulted in a snowball effect as the references in some articles were used to further the literature investigation. The information gathered was then summarised to create the individual literature section in each literature chapter. The literature findings were used to compare the quantitative and qualitative research findings. The comparison between the data determined whether this research delivered consistent results starting with the literature investigation, all the way through to the empirical investigation chapters. Importantly, it also determined the validity and accuracy of the results. The following section will discuss the quantitative research approach that was used as part of the empirical investigation.

2.3 The quantitative research approach

A quantitative research approach uses variables, numbers and statistical analyses to explain the phenomena being investigated (de Vos *et al.*, 2003:63; Kiessling & Harvey, 2005:29). With quantitative research, the methods and variables are predetermined and remain the same throughout the research process (de Vos *et al.*, 2003:64). The Potchefstroom Case Study of 2020 and the two structured questionnaires were used to collect the quantitative data. The Potchefstroom case study of 2020 used pre-determined methods to collect and analyse the data. The following sections will define the methods that were used to gather the quantitative data.

2.3.1 Potchefstroom case study of 2020

The first step in the data collection process of the 2020 Potchefstroom case study was to identify and select areas that border urban green space (UGS) in low-income, middle-income and high-income residential areas, thus, areas of different socio-economic status (SES). Category A, SES level 1 to 3, included four selected areas in Ikageng and one in Mohadin, low-income residential areas with property value mostly ranging from R50 000 to R500 000. More detail regarding the background of these areas will be provided in section 5.3 of the literature investigation. Category B, SES level 4, included five selected areas located in middle-income residential areas in Potchefstroom where property value mostly ranges from R1.2 million to R2.5 million. Category C, SES level 5, focused predominately on Tuscany Ridge Estate in Potchefstroom where most of the properties exceeded R3 million in value while some properties reach the R6 million mark. Category A, B and C included rare cases where some properties either had a lower value than the minimum or exceeded the maximum value mentioned above. Figure 2-2 illustrates the differences between the different socio-economic status (SES) levels of Category A, B and C with

regards to green space accessibility and availability, as well as property sizes. The properties in Category A are small with limited to no tree cover across the area, whereas the properties in Category B are larger with higher UGS coverage (private green space) and tree cover. In Category C, the properties are slightly smaller than the properties in Category B, however, a large green space network exists within walking distance from each property and limited private green space availability are present on each property.



Figure 2-2: Aerial view of Category A, B and C
Source: Own composition from Google Earth (2020)

The approach that was used to identify the residential areas in Category A, B and C, as well as the properties in each residential area will be discussed below.

2.3.1.1 Category A: Low-income residential areas (SES level 1 to 3)

The results obtained from the study by Cilliers & Cilliers (2015) indicated that the proximity principle was rejected in middle-income residential areas in Potchefstroom. Potchefstroom, similar to most other cities and towns in South Africa, is still demonstrably segregated according to racial and income groups due to the legacy of the apartheid era (Lubbe, 2011:24). This motivated the need to consider residential areas of a unique planning context in Category A by expanding the study area to include five low-income residential areas bordering an urban green space (UGS) in Potchefstroom. The five low-income residential areas included four areas in Ikageng and one area in Mohadin with property sizes ranging from 200 square meters to 500 square meters. The property sizes in Mohadin are slightly bigger than in the other areas of Ikageng, reaching 1000 square meters in some cases. Geographical Information Systems (GIS)

was used to identify the UGSs in Ikageng which included vacant land, urban parks and sport grounds. The following five UGSs were selected, as seen in Figure 2-3:

- Ikageng Extension 7, bordering vacant land that is connected to Poortjies Dam.
- Mohadin, bordering a communal urban park
- Ikageng Extension 4, bordering vacant land with informal squatters
- Ikageng Area 2, located across from a sport ground
- Ikageng Area 3, bordering vacant land

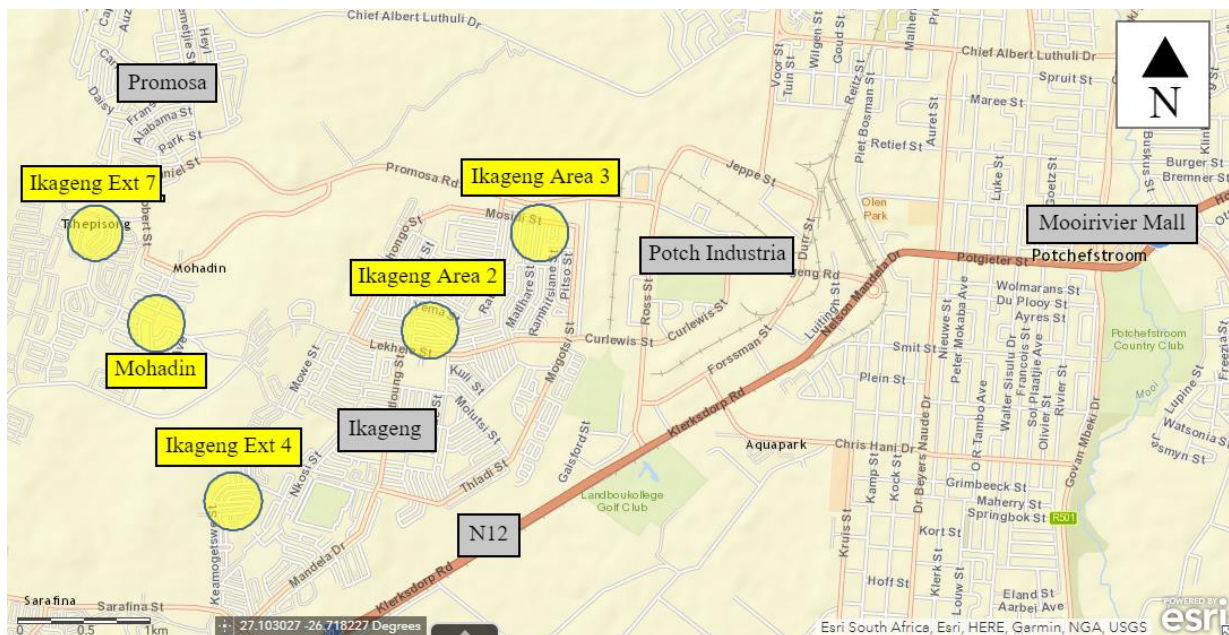


Figure 2-3: The five selected residential areas of Category A
Source: Own composition (2020)

After the residential areas were selected, each area was divided into three zones to test the proximity principle. Each zone was located further away from the green space with zone 1 bordering the green space, zone 2 located further away from the green space and zone 3 located furthest away from the green space. Each zone comprised of selected properties in a convenience sample. The following criteria were considered to select the zones and properties:

Proximity to the green space: As mentioned above, each zone was located further away from the green space. For each residential area, this distance varied according to property size and street widths.

Consistent proximity in-between zones: When the properties were selected for each of the respective zones, it was crucial to maintain a consistent distance in between zone 1 and zone 2, as well as in-between zone 2 and zone 3. This was to ensure that distinctive differences between the property values of each respective zone could be surveyed as this could influence the data

analysis and results. The distance in between zones varies from one residential area to another, however, but remained consistent within each respective residential area. Distances in between zones from one residential area to another varied due to variations in street layouts and property sizes. The following distance between zones were maintained:

- Mohadin: 50m in-between zones
- Ikageng Extention 7: 13m in-between zones.
- Ikageng Extention 4: 10 – 17m in-between zones
- Ikageng Area 2: 32m in-between zones
- Ikageng Area 3: 30m in-between zones

Quantity: The same number of properties for all three zones within each respective area was selected. In some residential areas, more properties were selected in comparison to other areas depending on the sizes of the green spaces, the sizes of the properties and the number of green spaces in one area. In the case of Ikageng Extention 7, the green space bordering the area, as well as the green space located in the center of the area were considered, thus, more properties had to be selected. The reason for considering both green spaces was to consider both green spaces' characteristics to determine whether one green space's characteristics were more dominant in influencing property value than the other green space's characteristics. This consideration is discussed in section 4.2, focusing on how UGSs influence proximate property value.

Data availability: In some rare cases, the property data (property number, street name, property size and property value) were not recorded in the municipal valuation roll of June 2019. In this case, another property was selected that also complied with the criteria (proximity, consistency, quantity, data availability and land-use).

Land-use: Geographical Information Systems (GIS) was used to study the residential areas in Ikageng from an aerial point of view. By doing so, the vacant properties were identified where no dwelling unit was present on the property and were, therefore, not selected in the property sample. Only residential (single-dwelling) properties were included in the property sample.

Figure 2-4 to Figure 2-8 illustrate the 3 zones within each respective residential area of Category A, as well as the selected properties of each zone.

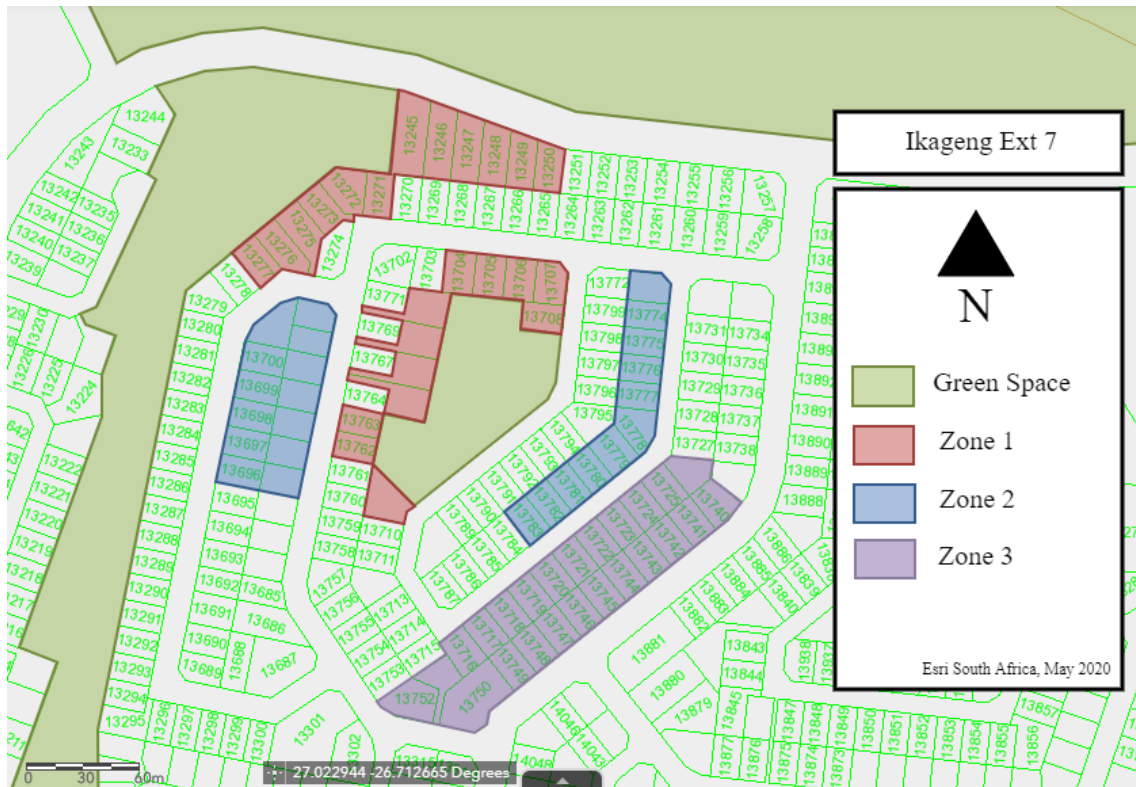


Figure 2-4: Zone 1 to 3 in Ikageng Extension 7
Source: Own composition (2020)

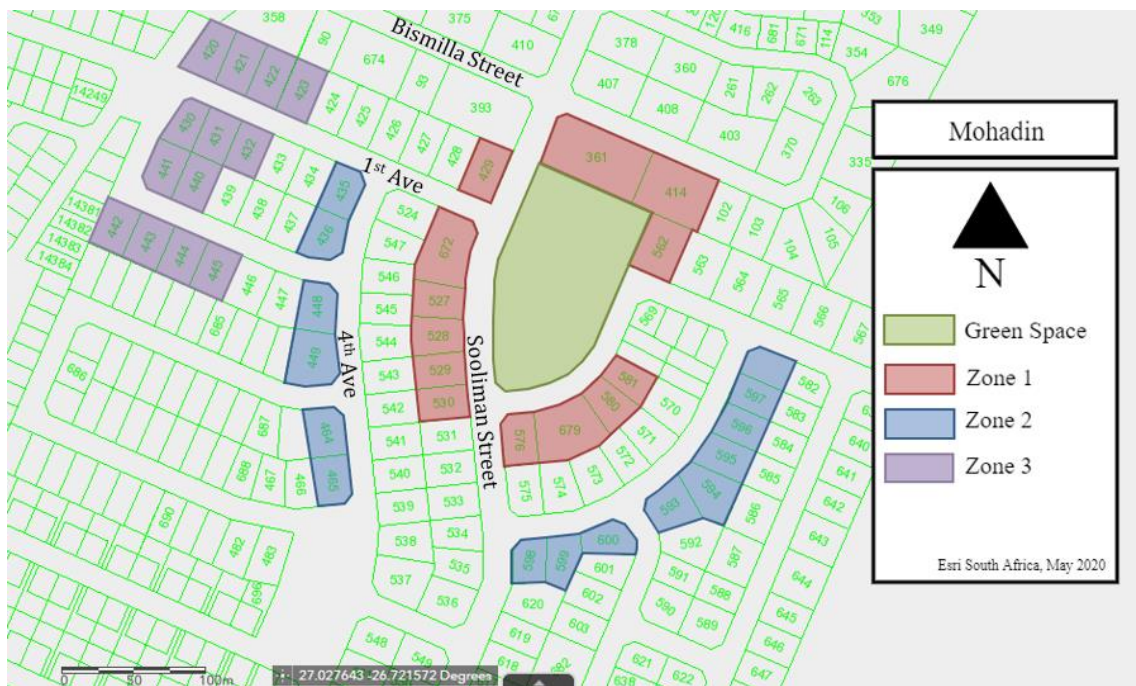


Figure 2-5: Zone 1 to 3 in Mohadin
Source: Own composition (2020)

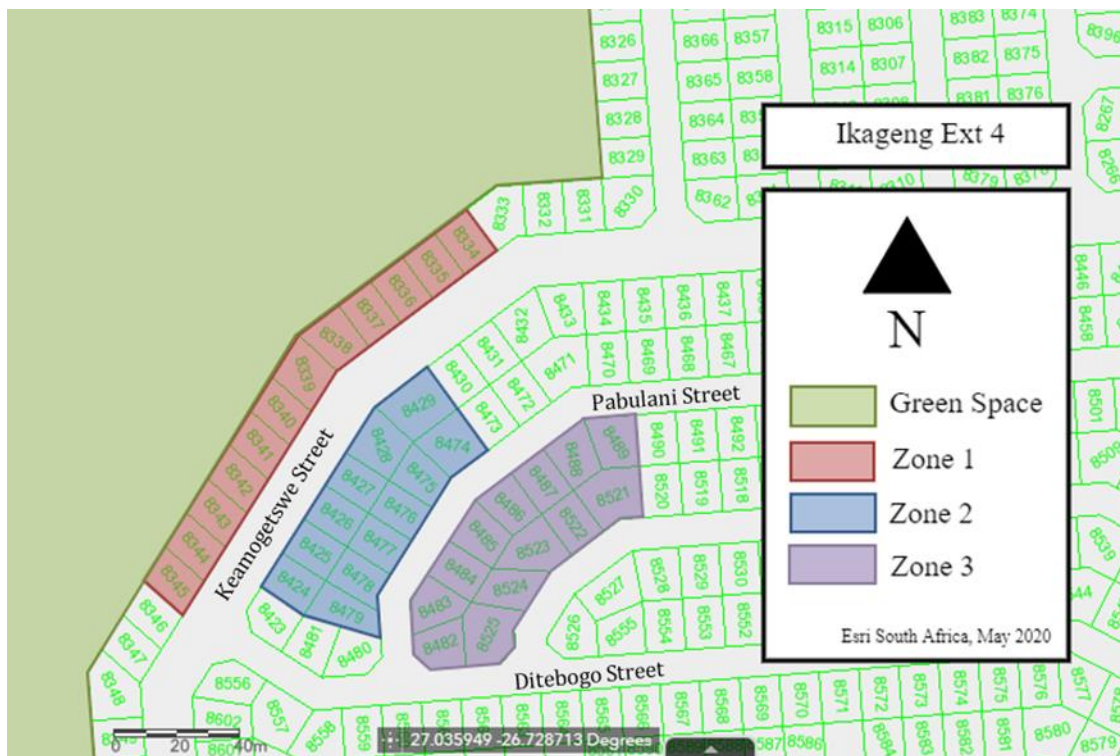


Figure 2-6: Zone 1 to 3 in Ikageng Extension 4
Source: Own composition (2020)



Figure 2-7: Zone 1 to 3 in Ikageng Area 2
Source: Own composition (2020)

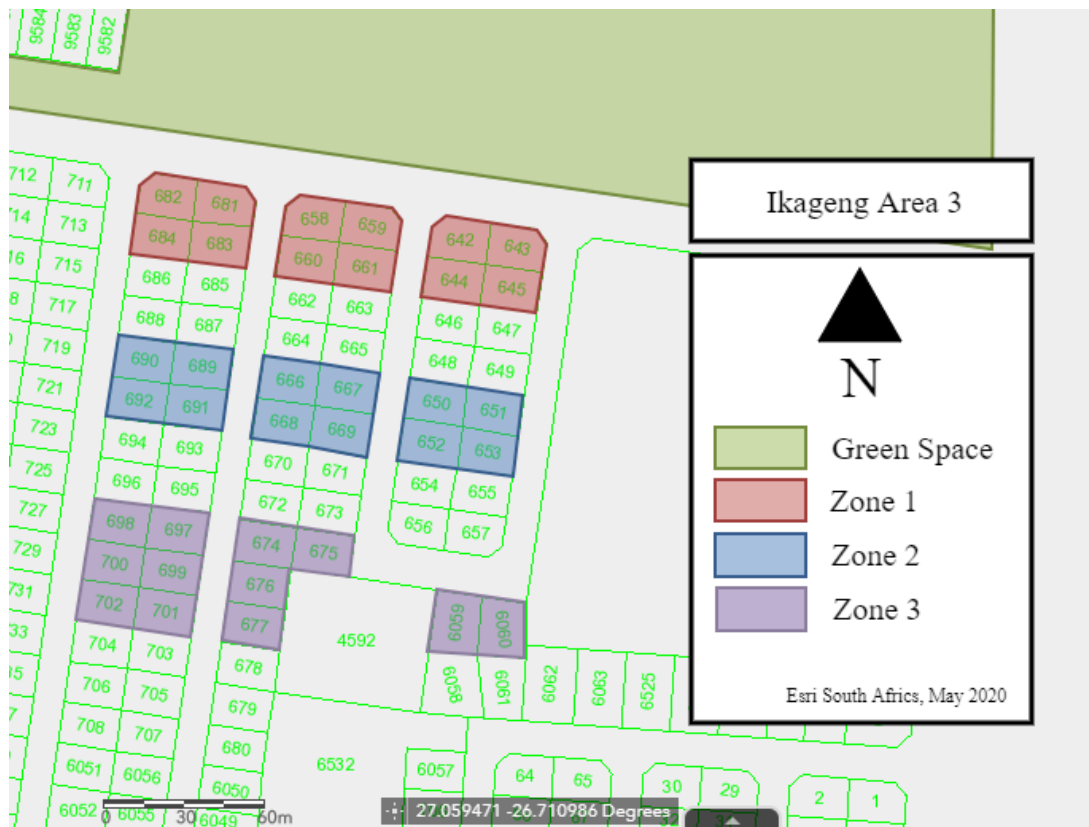


Figure 2-8: Zone 1 to 3 in Ikageng Area 3
Source: Own composition (2020)

2.3.1.2 Category B: Middle-income residential areas (SES level 4)

Category B included specifically selected properties in five middle-income residential areas in Potchefstroom bordering an urban green space (UGS). Category B properties were based on the samples used by Cilliers & Cilliers in 2015 and Combrinck *et al.* in 2020 to facilitate longitudinal comparison of findings. These residential areas were initially selected based on their proximity and accessibility to an UGS. The size of the green spaces was not considered, neither if the green spaces supported a specific function as the selected UGSs ranged from being utilised for recreational activities and valued for aesthetics, as natural systems or as equestrian open spaces (Cilliers & Cilliers, 2015:5). The size of the properties ranged from 1000 square meters to 2000 square meters with a limited number of properties either exceeding 2000 square meters or having a property size below 1000 square meters. The properties are large and well-maintained. The residential areas that were reselected included the following, as seen in Figure 2-9:

- Grimbeek Park, bordering a golf course (Potchefstroom Country Club).
- Van der Hoff Park, situated next to an equestrian open space and wetland (Mooi River).
- Potchefstroom Dam Area, situated next to Potchefstroom Dam and the surrounding open space.

- Heilige Akker, situated adjacent to the Fanie du Toit sports grounds of the North-West University.
- Oewersig, situated adjacent to the Mooi River and surrounding open space.

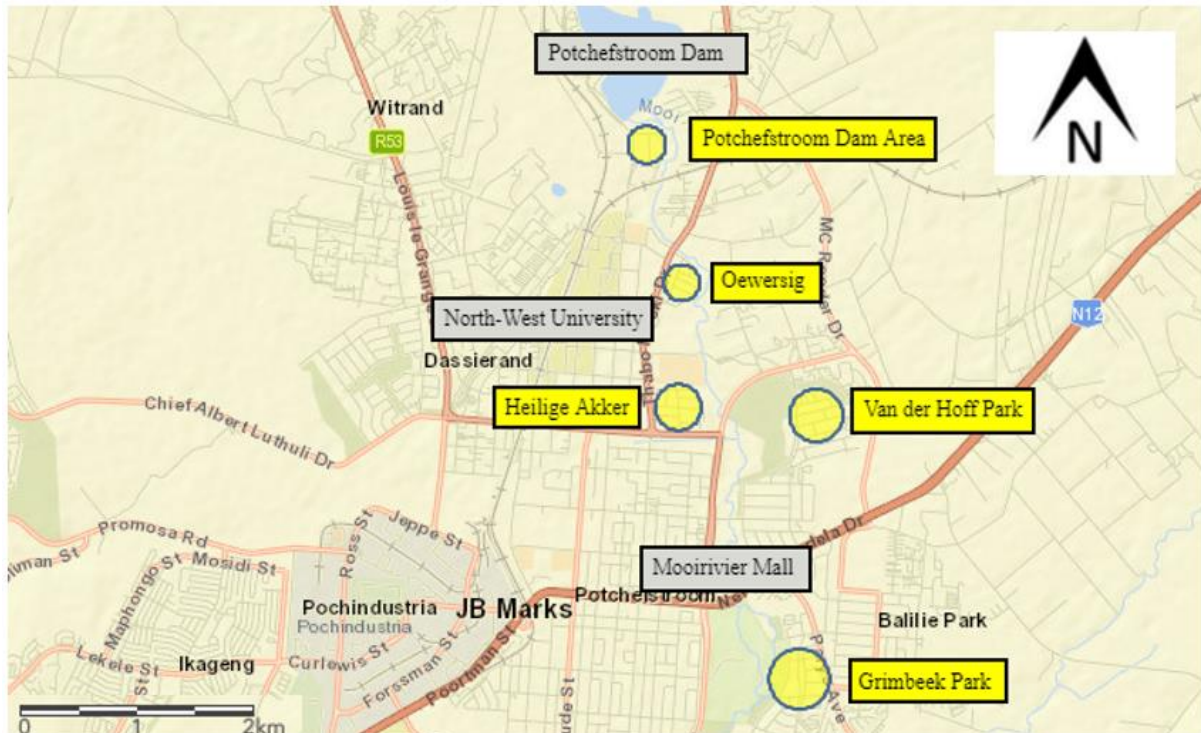


Figure 2-9: The five selected residential areas of Category B
Source: Own composition (2020)

The same five residential areas were selected, thus, the same properties were also used to divide each area into zone 1, zone 2 and zone 3. Each zone was located further away from the green space with zone 1 bordering the green space, zone 2 located further away from the green space and zone 3 located furthest away from the green space as explained in Category A. Figure 2-10 to Figure 2-14 illustrates the three zones within each residential area of Category B.

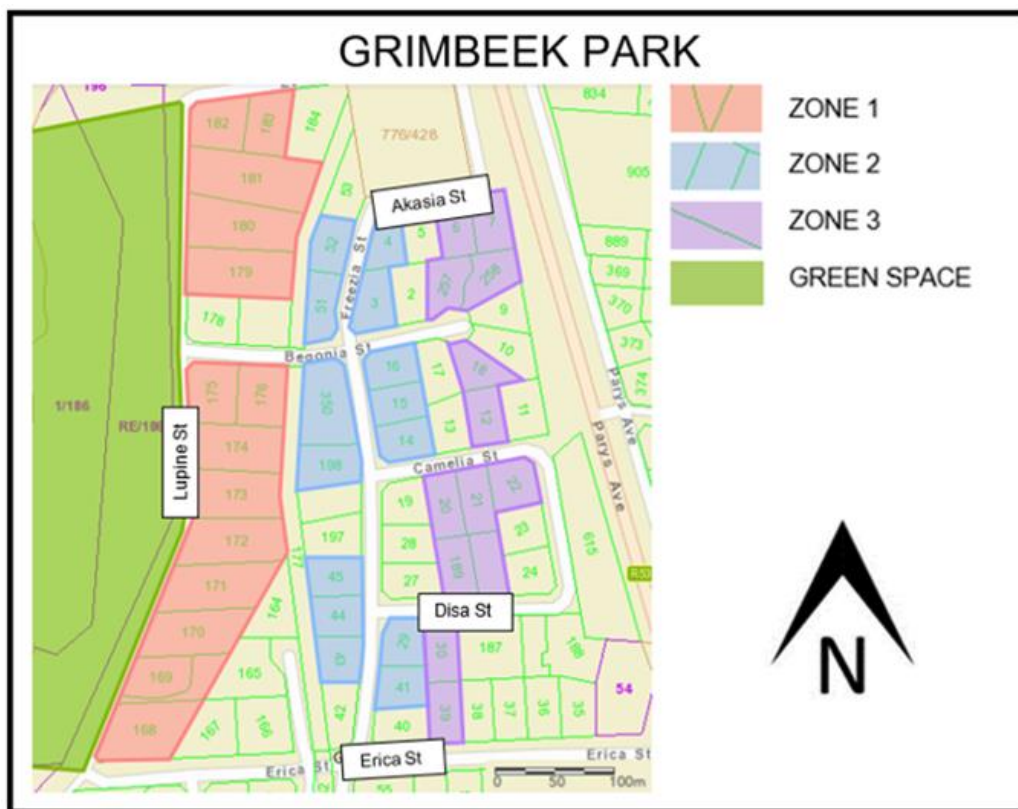


Figure 2-10: Zone 1 to 3 in Grimbeek Park
Source: Own composition (2020)

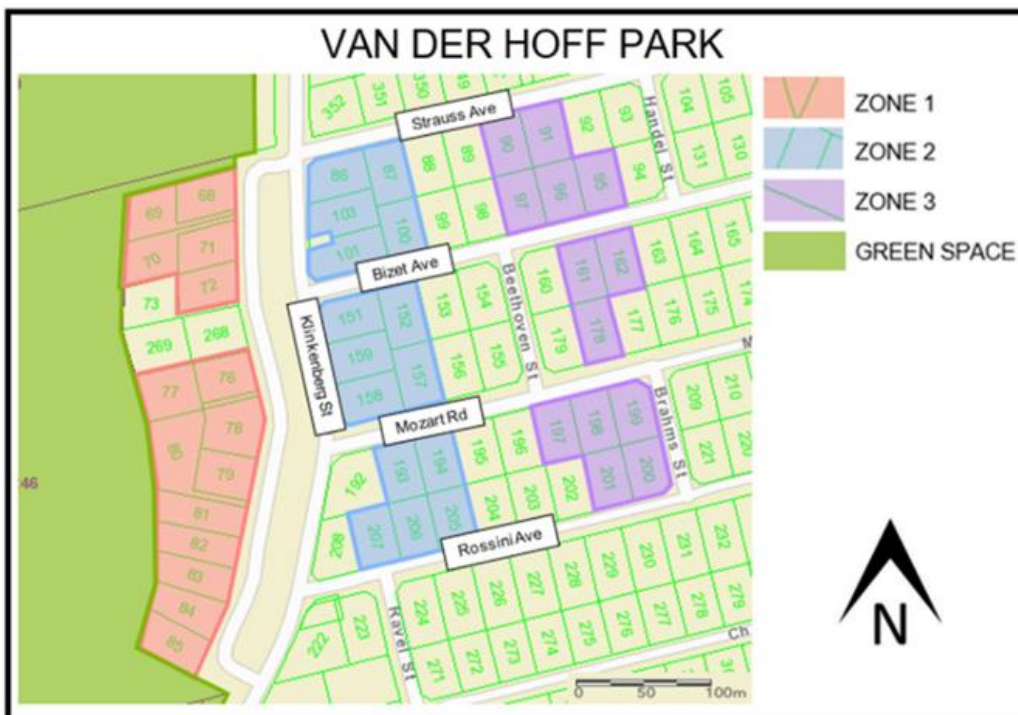


Figure 2-11: Zone 1 to 3 in Van der Hoff Park
Source: Own composition (2020)

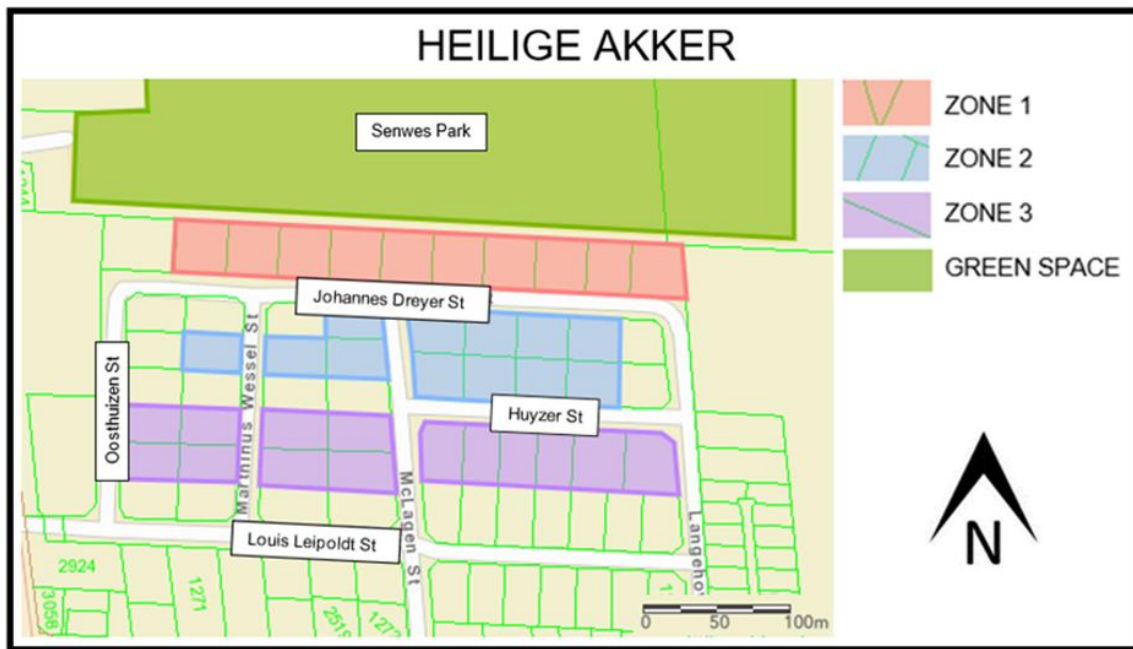


Figure 2-12: Zone 1 to 3 in Potchefstroom Dam Area
Source: Own composition (2020)

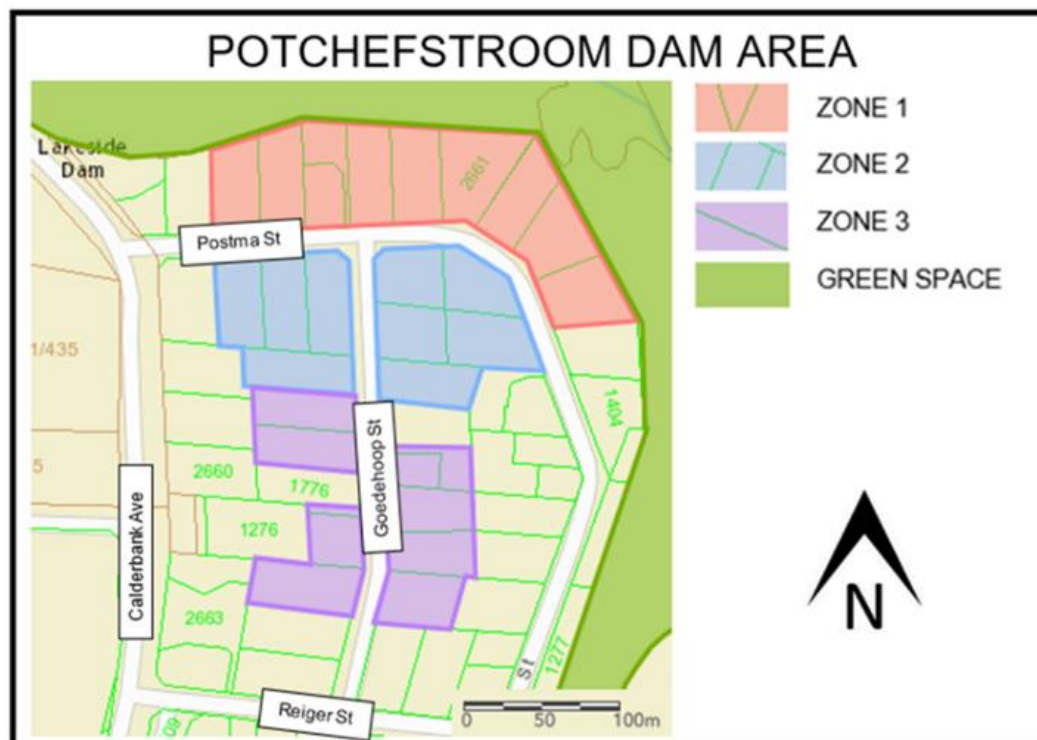


Figure 2-13: Zone 1 to 3 in Heilige Akker
Source: Own composition (2020)

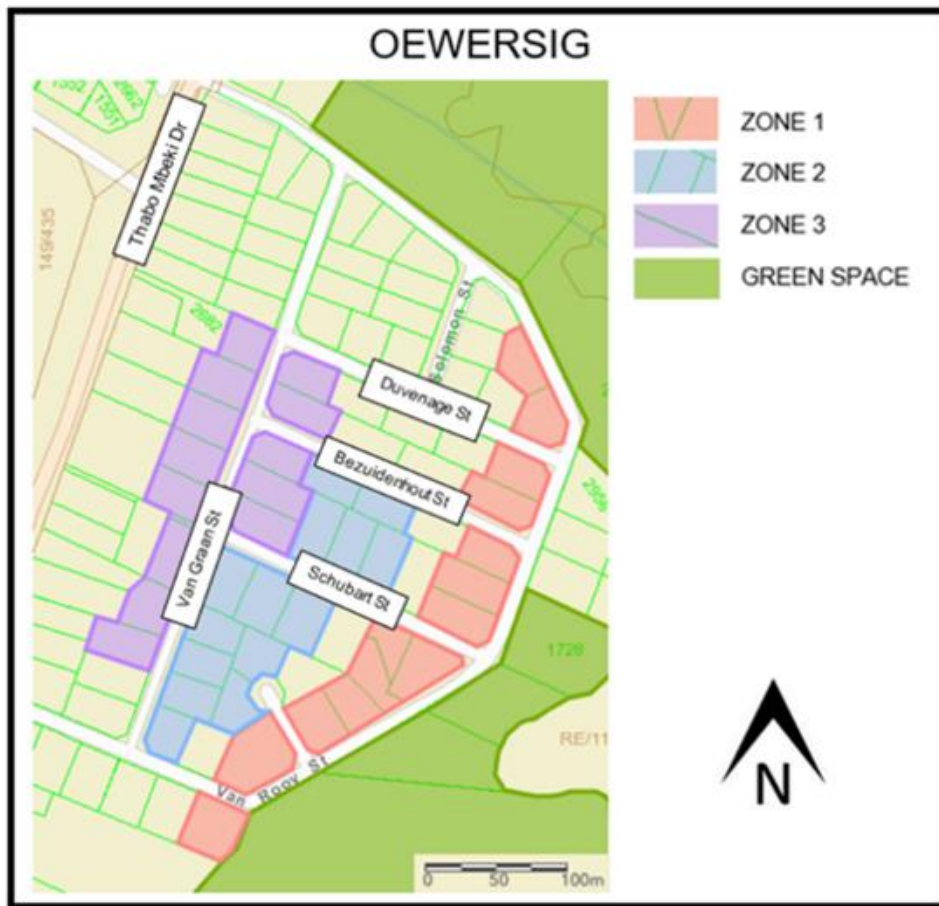


Figure 2-14: Zone 1 to 3 in Oewersig
Source: Own composition (2020)

2.3.1.3 Category C: High-income residential areas (SES level 5)

Category C included Tuscany Ridge Estate as the high-income residential sample to test the proximity principle. The estate is located in Van der Hoff Park in Potchefstroom. An internal green space network exists, as well as access control into the estate and security services. In contrast with Category A and B, the green spaces in Tuscany Ridge Estate are well-maintained, child-friendly, safe and aesthetically pleasing. The property sizes range from 700 to 2000 square meters. Figure 2-15 indicates the location of Tuscany Ridge Estate in Potchefstroom.



Figure 2-15: The location of Tuscany Ridge Estate
Source: Own composition (2020)

Once Tuscany Ridge Estate was selected, the estate was also divided into three zones with Zone 1 bordering the green space and Zone 3 being located furthest away from the green space, as seen in Figure 2-16, below. Geographical Information Systems (GIS) was also used to identify appropriate sample properties for each of the 3 zones. The same criteria that used to select the properties in Category A and B were also used in Category C namely proximity, quantity, data availability and land-use. However, it is important to bear in mind that the layout of Tuscany Ridge Estate made the selection of properties more complex as properties are located around centrally located green spaces, thus, the distance between zones and to green space may be more inconsistent in comparison to Category A and B.

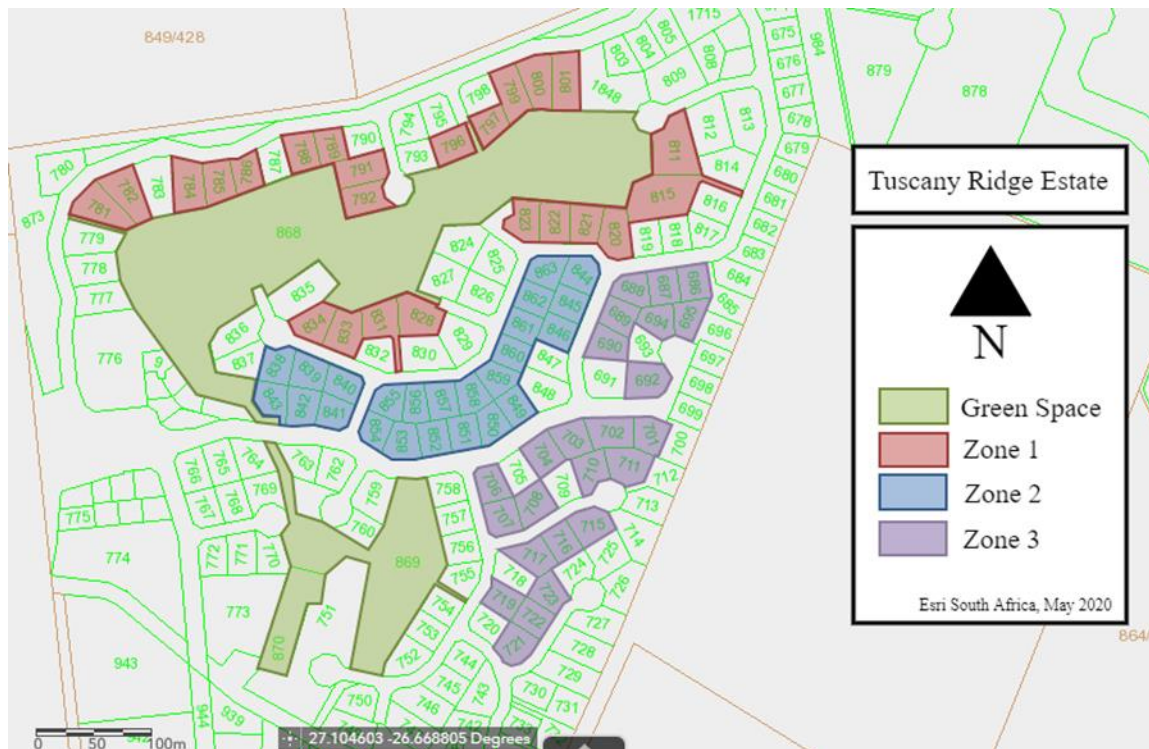


Figure 2-16: Zone 1 to 3 in Tuscany Ridge Estate
Source: Own composition (2020)

As part of the quantitative research investigation, structured questionnaires were completed by Potchefstroom residents and Professional Planners.

2.3.2 Structured questionnaires

The data were collected using two structured questionnaires (refer to Annexure A). The first questionnaire (Potchefstroom resident survey) was compiled to gather information on how residents perceive urban green spaces in Potchefstroom. The questions focused on social, environmental and economic benefits. The questionnaire also aimed to determine the level of knowledge residents have regarding the influence of UGSs on property value. The Potchefstroom resident survey was sent to mainly students studying at the North-West University, either residing in on-campus hostels or apartment buildings located near campus.

The second questionnaire (Professional Planner survey) aimed to gather information on the professional opinions of Urban Planners regarding UGS planning in the context of South Africa. The questionnaire gathered information regarding Urban Planning practice and was used to consider professional opinions when the data was analysed and interpreted. The questionnaire focused on urban green space aspects including the capacity of local authorities (local-budgeting) in UGS management, community engagement in UGS planning, environmental considerations in practice and UGS typologies.

The questionnaires were sent to a random sample of Potchefstroom residents and Urban Planners whose contact details were publically available or already on the researcher's contact list. It is important to bear in mind that these two questionnaires formed part of a previous study by Combrinck *et al.* (2020), the first refinement of the study by Cilliers & Cilliers (2015). Thus, the sample of Potchefstroom residents and Urban Planners did not consider the socio-economic gradient as the previous studies solely focused on middle-income residential areas (Category B). It was only from the current research (Potchefstroom case study of 2020) that the socio-economic gradient was considered. Furthermore, the information provided by these questionnaires serves as additional information to this research and is included as a preliminary approach that could be elaborated upon in future research. The questionnaires were distributed using electronic communication networks including email and WhatsApp. Questionnaires could be answered according to a Likert scale with 5 potential answers. The answers included the following: 1= Fully agree, 2= Agree, 3= Not sure, 4= Disagree and 5= Fully disagree. The questionnaires could be viewed in Annexure A, and more details regarding the questionnaires will be reported in section 8.2 and section 8.3.

2.4 The qualitative research approach

A qualitative investigation involves semi-structured interviews with participants and observations of human behaviour to fully comprehend the scope, source and impacts of the phenomena (economic value of UGSs) being tested (de Vos *et al.*, 2003:64). In contrast with the quantitative research approach, the qualitative research approach is holistic and emergent as the research design and methods may change throughout the research process, thus, the process is unstructured and flexible (de Vos *et al.*, 2003:65). The qualitative data collection process is site-specific and applicable to different cultures whose goals, needs and values vary significantly (Kiessling & Harvey, 2005:30). In this research, electronic interviews with municipal or private Valuers were included to understand property valuation from their perspective and gather information on the compilation of municipal valuation rolls. The following section elaborates on the data collection process of the electronic interviews and how it was used to collect the qualitative data of this research.

2.4.1 Electronic interviews

Electronic interviews are a data collection method that uses electronic communication facilities similar to email to communicate with a sample of participants (Cassell & Symon, 2004:23). This method may also be called computer-mediated communication (CMC) and has the potential to overcome some of the barriers that are imposed by other more conventional research methods (McCoyd & Kerson, 2006:391). When compared to face-to-face interviews, favourable results

were obtained which indicated that data captured by CMC are credible and trustworthy (McCoyd & Kerson, 2006:403). An advantage of using CMC above face-to-face interviews is that participants can complete the questions promptly and feel more comfortable to answer honestly (Cassell & Symon, 2004:30). Other advantages include that this method is both convenient for the interviewer and participants and that this method is also less time consuming (Qu & Dumay, 2011:244). Though this method does have some disadvantages including misunderstanding of the research questions, the success of this method could be promoted by focusing on asking the right questions and maintaining the participants' interest (Cassell & Symon, 2004:30). The electronic interviews used similar guidelines as that of structured interviews to gather the data electronically. The questionnaire consisted of predetermined questions that were the same for each participant to respond to (Qu & Dumay, 2011:244).

The data was collected by distributing the e-questionnaire to a random sample of Professional municipal or private Valuers (refer to Annexure A). The contact information of these Valuers is available on the South African Council for the Property Valuers Profession (SACPVP) website. The e-questionnaire was sent via email to 35 Valuers, either working in the private or public sector and only four responses were captured. Initially the goal was to complete face-to-face surveys, however, the lockdown regulations that were implemented during the state of disaster (COVID-19) during a large part of 2020 prohibited these surveys, thus, the surveys was done electronically with unfortunate low responses. The electronic interviews included multiple-choice, checkbox, short answer and long answer questions and can be viewed in Annexure A.

The e-questionnaire commenced with five questions aiming to retrieve personal information of the respondent including (1) at what municipality the respondent works, (2) in what province the respondent is located in, (3) what the respondent's job-description is, (4) how long the respondent had been in his/her current position and (5) the respondent's qualification is. These questions are important to ask as the respondent's working environment and experience in the field could have a significant impact on the validity of the results. Question 6 to Question 11 focused on the process of compiling a municipal valuation roll including questions that investigated who is responsible for the task and what the law requires in terms of property valuation in South Africa. Question 12 to Question 16 then focused on the proximity principle and the impact of UGS on proximate property value, as well as the different criteria that are considered when determining the value of a residential property. The last two questions, Question 17 and Question 18 aimed to gather information on the respondent's opinion regarding ecosystem disservices (EDS) and how these disservices influence property value.

2.5 The mixed-method research approach

The mixed-method research approach emerged in the early 19th century, however, it was not until the 1950's that it gained attention (Creswell, 1999:458). A discussion continued in the following years on combining multiple **quantitative** and **qualitative** methods in research and how this “new style of research” introduced opportunities and advantages (Creswell, 1999:458). These opportunities and advantages of research by uncovering unique variance in data and strengthening research findings are called “triangulation” (Creswell, 1999:458; Kiessling & Harvey, 2005:30). The mixed-method research approach is used to define a problem or investigate a specific phenomenon by focusing on external reality and considering situational specific and cultural specific environments where the phenomenon is present (Kiessling & Harvey, 2005:32). Thus, this research approach ensures that a researcher understands the phenomena and can explain how and why it exists by using numbers and statistical analyses (Creswell, 1999:455).

The mixed-method research approach was employed in this research as both quantitative and qualitative data were required to, firstly, understand how UGSs influence property value across the socio-economic gradient and, secondly, explain why it is important to confirm the economic benefits of UGSs. Both the quantitative and qualitative data were collected in areas that are site-specific and culturally specific. According to Creswell (1999:463), a researcher uses the mixed-method approach for one of the following three reasons: (1) to collect both the qualitative and quantitative data and examine the research findings collectively by using a *convergence model*, (2) using a *sequential model* including two phases in data collection, either starting with the quantitative research and expanding the data with qualitative research or vice versa and (3) following the *instrument-building model* where explanatory qualitative data is collected to be analysed, whereafter the data will be converted into questions and scales. This research used the *sequential model* by commencing with a quantitative empirical investigation using statistical analyses and structured questionnaires, thereafter expanding the data with qualitative data that included a multi-criteria analysis (MCA) based on observations and electronic interviews. When using the mixed-method research approach, it is crucial to be objective and willing to consider the opinions offered by participants (Kiessling & Harvey, 2005:32). Thus, this research included structured questionnaires and interviews to ensure that the opinions of the participants are reflected in the research findings and considered in the conclusions and recommendations. As part of the quantitative data, the data results obtained from the 2020 Potchefstroom case study were further interpreted to provide a comprehensive explanation for the quantitative results. The in-depth interpretations were done through MCA that used qualitative techniques to analyse the quantitative data findings. The MCA was based on observations and judgment and focused on

the ecosystem services, service provision and physical characteristics of the respective residential areas. The analysis was based on the following three categories of the 2020 Potchefstroom case study: (Category A) low-income residential areas, (Category B) middle-income residential areas and (Category C) high-income residential areas. This was done to create a link between the quantitative research Chapter (Chapter 6) and the surveys in Chapter 8.

2.5.1 Multi-criteria analysis (MCA)

Multi-criteria analysis (MCA) is a technique where a decision-making body uses a set of measurable criteria to determine, based on the decision-makers' judgments, whether an objective has been achieved (Dodgson *et al.*, 2009:20). The criteria are inserted into a 'performance matrix' or 'performance table' combined with a preference scale to measure the level of performance or weight of the criteria where after the decision-makers should decide whether the objective/s have been met based on the "performance" of the criteria (Dodgson *et al.*, 2009:21). Multi-criteria analysis (MCA) has many advantages including that the process analysis is open and explicit, that the objectives and criteria could be changed throughout to ensure appropriateness, that the technique could be cross-referenced with other sources of information and that the results could be used as an important means of communication to raise awareness of the phenomena being investigated (Dodgson *et al.*, 2009:21).

Many studies have employed MCA to value environmental attributes and factors. This method is one of the most frequently employed methods in studies involving ecological economics (Fontana *et al.*, 2013:128). Vollmer *et al.* (2015) used MCA, coupled with Geographical Information Systems (GIS) to quantify ecosystem services in rapidly urbanising river basins in Jakarta, Indonesia. Another study based in South Tyrol, Italy, used multi-criteria decision analysis to compare land-use alternatives by focusing on the ecosystem service concept (Fontana *et al.*, 2013:128). Multi-criteria analysis is a suitable technique to employ when a researcher aims to consider various environmental and administrative attributes, especially in combining the technique with geo-spatial information (Nobre *et al.*, 2009:97).

This technique could be employed site-specific and is well-suited to investigate complex environmental questions that involve economic, ecological and social criteria (Fontana *et al.*, 2013:128). The analysis and quantification of UGSs in Potchefstroom called for a transparent technique that could consider a variety of economic, environmental and social factors. This method should be applicable to unique planning contexts (site-specific) and quantify the factors to, finally, determine the scale or weight of each factor based on judgment decision in combination with the use of Geographical Informational Systems (GIS). Thus, as multi-criteria analysis (MCA) complies with all the above-mentioned requirements, this technique was chosen to value the

UGSs across the socio-economic gradient in Potchefstroom to further explain the quantitative research findings presented in Chapter 7. Table 2-1 presents the eight steps in MCA that will be followed to analyse the UGSs in Potchefstroom.

Table 2-1: The eight steps in the multi-criteria analysis process

Step	Objective
Step 1	Establish the decision context. Identify the aims of the MCA, the decision-makers and key players
Step 2	Identify the options
Step 3	Identify the objectives and criteria that will determine the ultimate value of each option
Step 4	Describe the expected performance of each option against the criteria/objectives
Step 5	'Weigh' each option against the criteria by applying a score or weight
Step 6	Combine the scores or weights of each option to determine each option's overall value
Step 7	Examine and interpret the results
Step 8	Complete a sensitivity analysis to change scores or weights where necessary

Source: Dodgson et al. (2009:31)

A direct analysis of the 'performance table' was performed that reflected on the concept of 'dominance' (Dodgson et al, 2009:24). Dominance occurs when an option, after scoring, performs similarly on all criteria but outperforms the other options with at least one criterion (Dodgson et al, 2009:24). Another concept linked to direct analysis is 'compensation' which implies that the good performance of one criterion could compensate for the weak performance of another criterion (trade-offs), for example, scoring high in the 'performance table' under poverty rates will lead to a low score under maintenance of UGSs (Dodgson et al, 2009:24). Analysing the 'performance table' will require a scoring method. The scoring technique of Fuzzy MCA methods will be used by appointing a decimal number between 0 and 1 (degree of membership) to each criterion of each option in the 'performance table' to aggregate "fuzzy" performance levels presented by "fuzzy" quantities (Dodgson et al, 2009:24).

Appointing the number 0 to a criterion, indicates no membership function value, whereas the number 1 indicates a complete or high membership function value (Dodgson et al, 2009:140). The Fuzzy MCA method has been applied in many environmental evaluation and assessment studies including the word completed by Borri et al. (1998) and Gonzalez et al. (2002). Another study by Morón et al. (2009) combined quantitative and qualitative data in a Fuzzy EIA model and Fuzzy set theory to conduct Environmental Impact Assessments. Similarly, Liu et al. (2009) also used a Fuzzy logic as a type of decision support approach in Environmental Impact Assessments.

2.6 Summary of Chapter 2

Quantitative data collection involves statistical analysis and predetermined methods to gather the data, whereas qualitative data collection involves interviews and observation with participants where the methods could change throughout the process (de Vos *et al.*, 2003:64). A mixed-method research approach combines both quantitative and qualitative data collection methods that have many advantages and opportunities to strengthen research findings (Creswell, 1999:458; Kiessling & Harvey, 2005:30). Three different methods of a mixed-method research approach exist including the convergence model, the sequential model and the instrument-building model (Creswell, 1999:463). This research employed the sequential model, starting with the quantitative research approach followed by the qualitative research approach to support and further explain the quantitative data.

The quantitative data was gathered through a local case study in Potchefstroom and structured questionnaires with pre-determined methods and questions. The qualitative data was gathered through electronic interviews, sending an e-questionnaire to Private or Municipal Valuers. A combination of quantitative and qualitative approaches are used to complete the MCA to further explain the quantitative data findings delivered through the 2020 Potchefstroom case study. The mixed-method approach ensures the use of predetermined methods and variables, as well as a context-specific technique (the multi-criteria analysis) to accurately value UGSs in Potchefstroom. The following chapter will commence with the literature investigation by focusing on urban ecosystems and UGSs.

CHAPTER 3: LITERATURE STUDY: URBAN ECOSYSTEMS AND URBAN GREEN SPACES

3.1 Introduction

Urban expansion will continue to increase on a global and regional scale with a total of 90% of the estimated population growth over the next four decades to occur in African countries (Lategan & Cilliers, 2016:2; du Toit *et al.*, 2018:250). The increase in growth rates leads to a decline in the number of urban green spaces (UGSs), a component of urban ecosystems, within the urban boundary as urban areas will continue to grow in size and density to satisfy the growing population's needs (Cilliers, 2013:1). A wide variety of UGSs exist, ranging from urban parks to sports grounds and including equestrian open spaces along rivers and lakes (refer to Table 3-1 for types of UGSs) (Panduro & Veie, 2013:123). UGSs provide essential ecosystem services to urbanities that refer to the benefits people derive from fully functioning ecosystems and in return, enhance their quality of life (Cilliers *et al.*, 2013:682). However, these benefits are mostly not recognised by local authorities and private investors due to a preference for land-uses within residential and business zonings that have an explicit monetary value (Cilliers & Cilliers, 2015:1). The same ecosystem functions that deliver crucial benefits to urbanities, could also result in a negative impact on human well-being, called ecosystem disservices (Klimas *et al.*, 2016:3). Figure 3.1, below, illustrates how the literature review of Chapter 3 will commence with a discussion on the concept of urban ecosystems in section 2.2 followed by a comprehensive discussion on ecosystem services and disservices. Thereafter a discussion on their relevance to urban planning in South Africa and a review of the different types of urban green spaces is provided in section 3.5.

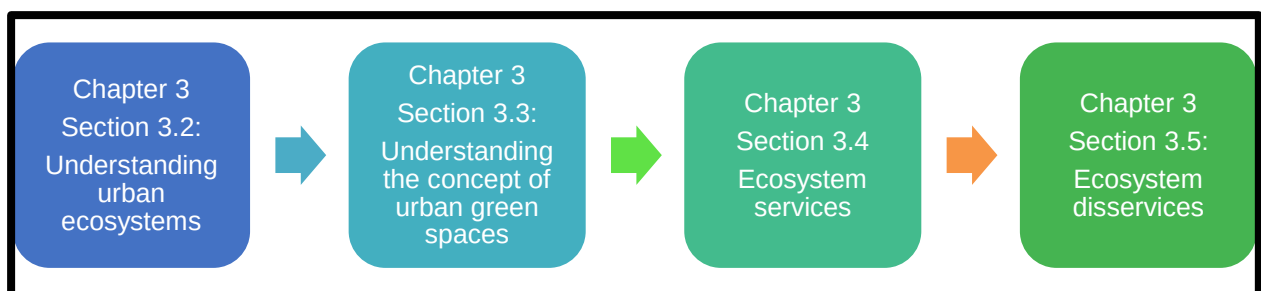


Figure 3-1: Contents and structure of Chapter 3
Source: Own composition (2020)

3.2 Understanding the concept of urban ecosystems

An ecosystem is an area, varying in size, comprising of a complex of living (biota) organisms that interact with one another, as well as with their physical environment to sustain life (Muller,

2019:12). Ecosystems are characterised by a system of functions and elements combined with a variety of structural components (Cepeliauskaite & Stasiskiene, 2020:2). Pickett *et al.* (2011:333) explain in their work that ecosystems are divided by natural boundaries similar to watersheds, airsheds, communicating radii or administrative units. Ecosystems are constantly changing due to the continuous interaction between species, as well as changes in the physical environment caused by human intervention (Rees, 2003:2). According to Bolund & Hunhammar, 1999:294, informal areas in cities similar to abandoned backyards and dumps may also be regarded as ecosystems as these areas also accommodate a variety of plant and animal species. Species and organisms (biota) in cities have adapted to the built environment of the urban structure through time, therefore, cities may be considered as ecosystems (Rees, 2003:1)

Urban ecosystems comprise of all the natural green and blue areas (biological components) in cities where grey-infrastructure development (physical components) cover most of the land surface and include socio-economic characteristics, population patterns and urban sprawl (social components), enhancing sustainability in cities, as illustrated in Figure 3-2 (Francis *et al.*, 2012:185; Nilon *et al.*, 2003:3).

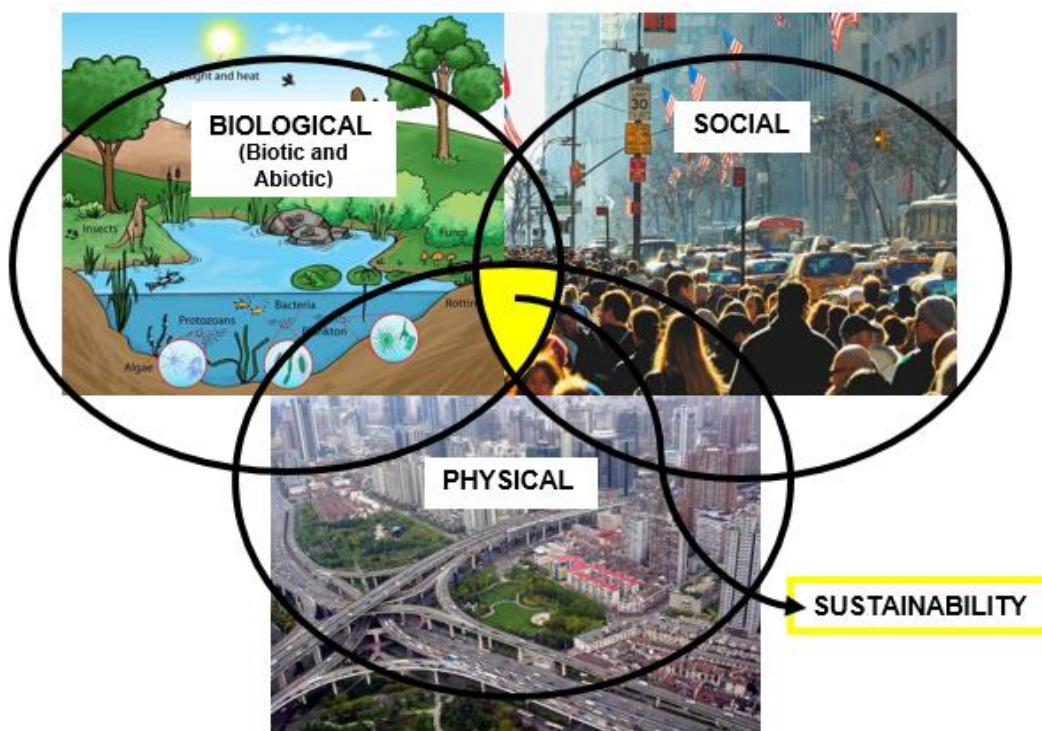


Figure 3-2: Urban ecosystem components
Source: Own composition (2020)

Humans may be accepted as the main component of urban ecosystems as they have the ability to create and modify the natural environment including plant species, natural systems, habitat quality and green space quantity in cities (Francis *et al.*, 2012:185; Muller, 2019:12). These

ecosystems are complex as a city consists of a combination of ecosystems that are modified by humankind to include all the essential components an ecosystem should provide as required by the city's inhabitants (Rees, 2003:5). Urban ecosystems, also known as man-made ecosystems, comprise of less than 1% of the ecosystem capacity needed to sustain urbanities as most of the ecosystems that provide sustaining services to urbanities are far removed from the city itself (Bolund & Hunhammar, 1999:294; Rees, 2003:73). According to Muller (2019:12), urban ecosystems may also include the urban core, suburban areas, hinterlands or villages that are connected to the dense urban core by transportation services. Urban ecosystems include the following categories: street trees, lawns or parks, lakes, urban forests, cultivated land, wetlands and natural or man-made streams. However, categorisation will be determined by site-specific conditions and uniqueness of the ecosystems.

The study of urban ecosystems applies to both science and urban planning (Pickett *et al.*, 2011:333). In scientific terms, urban ecology refers to the study of organisms in urban areas, as well as the biochemical budgets of urban areas (Pickett *et al.*, 2011:333). In urban planning, the term refers to the planning and design of environmental functions in cities to increase the quality of life of urbanities, as well as environmental management to reduce negative environmental impacts and increase environmental quality (Baycan-Levent *et al.*, 2009:193; Pickett *et al.*, 2011:333). Existing urban ecological knowledge should be considered in the planning, design and management of the urban structure to achieve sustainability (Breuste *et al.*, 2013:676). One way of prioritising the environment in urban planning is through the planning and management of green infrastructure in cities.

Green infrastructure, or ecological infrastructure, refers to the interconnected and multifunctional natural, semi-natural and artificial spaces or systems that prioritise both ecological and social activities and include street trees, parks, community gardens, riparian zones, public gardens and private gardens (Schaffler & Swilling, 2012:2; Gómez-Baggethun *et al.*, 2013:177; du Toit *et al.*, 2018:249). Green infrastructure also refers to interconnected urban green space (UGS) that conserve ecosystem functions and promote the ecosystem benefits that urbanities derive from functional ecosystems (Benedict & McMahon, 2002:12). Green infrastructure is linked to the different types of green spaces in cities (cross-reference to section 3.3), however, these spaces are sometimes only regarded as “green infrastructure” or “ecological infrastructure” when the ecological features are treated as infrastructure that are designed to provide social and environmental benefits (ecosystem services), as well as economic benefits (Schaffler & Swilling, 2013:2). Urban green spaces (UGSs), as a component of green infrastructure, are critical environmental components in urban ecosystems that are often used interchangeably with urban

green infrastructure which include natural and semi-natural UGSs (Odindi & Mhangara, 2012:653).

3.3 Understanding the concept of urban green spaces (UGSs)

The term “urban green space” is used in a substantial amount of literature, however, no universal definition exists to define these areas (Panduro & Veie, 2013:120). It is beyond the scope of this paper to revise and account for all the definitions of UGSs provided in international literature. UGSs vary in their overall extent and functionality from one city to another, and their distribution within the urban boundary is complex (Gaston *et al.*, 2013:3). Therefore, UGSs may be used as an umbrella term to describe all areas that are characterised by permeable surfaces, vegetation cover/soft surfaces (soil, grass, shrubs and trees) and refer to publicly accessible or private green spaces (Baycan-Levent *et al.*, 2009:194; du Toit *et al.*, 2018:249). Urban green spaces also include all the natural, semi-natural and man-made ecological systems in cities, around cities and the fragmented green spaces between urban areas (Cilliers *et al.*, 2013:685).

High density urban centers are often characterised by smaller and fragmented UGSs, whereas larger UGSs are found on the periphery of cities (Gaston *et al.*, 2013:3). The term was first used in the 19th century by Frederick Law Olmsted as an approach to introduce nature in the planning and layout of cities (Yilmaz & Mumcu, 2016:101). Olmsted referred to such green spaces as “the lungs of the city” (Yilmaz & Mumcu, 2016:101). Urban green spaces are viewed and classified according to their characteristics and functionality, quantity and quality, accessibility, performance levels, transformation, maintenance and how they are planned (Baycan-Levent *et al.*, 2009:194; Panduro & Veie, 2013:122). In the work of Yilmaz & Mumcu (2016:103) and Panduro & Veie (2013:123), UGSs are categorized into groups and types according to their characteristics, as summarised in Table 3-1, below.

Table 3-1: Types of urban green spaces in cities

Category	Type of urban green space	Description
Amenity	Recreational green space	Public spaces that are fully accessible by the public and characterised by vegetation, trees and flowers. The spaces include parks, playgrounds and outdoor sports grounds with a high maintenance level. May also include a common area in a housing development.
	Private green space	Mainly domestic gardens featuring a variety of flora species and maintained by the property owner.

Category	Type of urban green space	Description
Semi-natural and natural	Wetlands and lakes	Running water, diverse flora and fauna species. Includes a marsh or fen.
	Forests	Any type of woodland in or outside the city borders. Accompanies diverse fauna species.
	Other natural habitats	Grasslands and disturbed ground.
Functional	Burial grounds	Churchyards and cemeteries with footpaths. Open to the public during specific times of the day and have a high level of maintenance.
	Institutional green space	School grounds and other institutional grounds that also include private sports fields.
	Productive green space	Agricultural fields and agricultural holdings with homogeneous flora species limited access and fenced most of the time.
Linear	Linear natural features	Rivers, canal banks and cliffs.
	Green buffers	Trees and other vegetation that are connected to highways, railways, roads and industrial areas to reduce noise and air pollution. The infrastructure may be seen as borders between ecosystems.

Source: Yilmaz & Mumcu (2016:103); Panduro & Veie (2013:123)

The extent of urban green space (UGS) loss in cities is related to urban growth, urbanisation, socio-economic factors and environmental management (Odindi & Mhangara, 2012:653). Urban green spaces are crucial to maintain the environmental quality within the urban boundary and to promote the sustainability of the city as their heterogeneity ensures the provision of a range of benefits to the people and the environment (Gupta *et al.*, 2012:325; Panduro & Veie, 2013:119). It is important to consider the benefits UGSs provide in the planning and management of urban areas.

3.4 Considering ecosystem services in planning

Ecosystem goods and services refer to the benefits people derive, either directly or indirectly, from any form of ecosystem functions in cities that have a positive impact on human well-being including parks, rivers, wetlands and lakes (Bolund & Hunhammar, 1999:294; Cilliers *et al.*, 2013:682). Emphasising the positive impacts of ecosystem services on human well-being has the potential to convince politicians and decision-makers to prioritise these services as they risk making decisions and implementing policies that may undermine human well-being if they choose to ignore these crucial services in decision-making processes (Shackleton *et al.*, 2016:2).

Furthermore, it is necessary to understand the different categories of urban green space benefits (ecosystem services) to properly define and measure these benefits in urban areas and, finally, consider ecosystem services in planning (Cilliers & Timmermans, 2015:147). The benefits of green spaces are categorised in two main spheres namely direct and indirect benefits (Cilliers & Timmermans, 2015:677; Cilliers & Timmermans, 2013:147). The indirect benefits include environmental and social benefits, whereas the direct benefits of urban green spaces (UGSs) refer to the economic benefits, measured employing different methods, techniques and approaches (cross-reference to section 2.9) (Simpeh & Smallwood, 2018:1831). Furthermore, the social and environmental benefits of urban green spaces are categorised by the Millennium Ecosystem Assessment (MA, 2005) and The Economics of Ecosystem Services and Biodiversity (TEEB, 2010) in regulating, provisioning, supporting and cultural ecosystem services (Cilliers *et al.*, 2013:682; Gómez-Baggethun *et al.*, 2013:179). Table 3-2 captures the different ecosystem services that urban green spaces provide, as well as the economic benefits of UGSs.

Table 3-2: Ecosystem services and urban green space benefits

Green space benefit category	Ecosystem service	Examples of benefits and ecosystem services	Relevance to Planning
Environmental (Indirect benefits)	Regulating services	• Noise reduction by attenuating noise pollution (absorbing and reflecting sound waves). • Reducing the urban heat island effect through urban temperature regulation (absorbing heat in summer and releasing heat in winter and absorbing heat through evaporation). • Runoff mitigation by intercepting water through leaves and stems and reducing pressure on urban drainage systems. • Improving air and water quality by removing pollutants in the atmosphere [Ozone, Sulphur Dioxide, Nitrogen Dioxide, Carbon Monoxide]. • Wastewater treatment • Erosion control • Pollination, pest regulation and seed dispersal • Biological control • Moderating climate extremes through ecological infrastructure (e.g. mangroves, deltas, coral reefs, vegetation) that forms barriers and buffers to protect cities from extreme climate events and landslides.	• Noise reduction depends on the length, height, width and positioning of trees that can be altered by the planning and design of UGSs, public spaces, housing developments etc. • Moderating climate extremes calls for risk management and vulnerability reduction strategies that involve the combination of both built and ecological infrastructure • Runoff mitigation through green roofs and rain gardens requires the combination of built-infrastructure and ecological features. This is only possible through combined planning and design by ecologists, economists, planners etc.
	Provisioning services	• Water supply through storage and controlled release of water flow by urban ecosystems. Vegetation in cities also influences the availability of water. • Food supply in peri-urban farm fields, rooftop gardens, back yards, community gardens etc.	• Urbanisation and urban development threaten the quality and quantity of natural water resources in cities similar to long-term availability and watersheds. This calls for extensive environmental management strategies that need to be considered in land-use planning.

Green space benefit category	Ecosystem service	Examples of benefits and ecosystem services	Relevance to Planning
		● Protection and restoration of natural resources in cities.	
	Supporting services	● Provides habitats for biodiversity. Urban systems with plants provide refuge to species such as butterflies, bees and birds, for example, in green roofs and golf courses.	● The urban ecosystems that provide refuge to species are man-made and natural. Understanding the supporting ecosystem services in cities will ensure that planning approaches prioritise, specifically, the habitats provided by critical biodiversity areas and other green areas with high biodiversity.
Social (Indirect benefits)	Cultural services	● Promoting recreation, the highest valued ecosystem service in cities. ● Improving mental and physical health ● Improving aesthetic value ● Encouraging social cohesion, shared interests and neighbourhood participation. ● Limiting violence and reducing criminal activity. ● Cognitive development through local ecological knowledge that strengthens resilience and adaptive capacities of urban systems and green spaces can be utilised for educational purposes. ● Promoting sense of place and sense of community.	● The quality of recreation depends on infrastructure availability similar to benches, walkways, sports facilities and amenities that can be provided through planning and design. ● Recreational value decreases when green spaces are unpleasant and under-maintained (ecosystem disservices) (cross-reference to section 2.6). Disservices can be addressed through planning and design (cross-reference to section 2.5). ● Understanding how communities are formed and what their needs are enable Planners to design housing and green spaces that will be better utilised and maintained.
Economic (Direct benefits)	Economic benefits	● UGSs replace expensive conventional and technical environmental management systems (storm water management). ● Microclimate regulation by reducing expenses on cooling and heating systems in cities. ● Water regulation and retention through permeable surfaces and vegetation cover. ● Pollution reduction ● Health benefits (mentally and physically). ● Increasing property value (willingness to pay and proximity to green space). ● Increasing property tax returns of local municipalities. ● Promoting the marketability of a city.	● The efficient planning and design of urban green spaces that consider context and community interest could lead to an increase in the quality of UGSs, increasing economic benefits. ● Local municipalities should be informed of the economic benefits of UGSs and that UGSs contribute to the economic potential of the city as tax returns could be utilised for the development and maintenance of UGSs. ● Increasing UGS quantity and enhancing UGS quality require that green space planning form part of a greater spatial planning approach in local municipal areas.

Source: Own composition (2020) based on Cilliers (2010:42); Escobedo *et al.* (2011:2080); Cilliers & Timmermans (2013:147); Cilliers (2013:10; Simpeh & Smallwood (2018:1831); Gómez-Baggethun *et al.* (2013:184); Elmqvist *et al.* (2015:102) & Silvennoinen *et al.* (2017:18)

Ecosystem services are crucial for urban quality of life and to promote resilience and sustainability in cities, yet the limited amount of research conducted thus far in developing countries underscores the importance of these services (du Toit *et al.*, 2018:249). The concept of sustainability has gained attention over the last few decades aiming to promote human-

environmental systems in cities that ensure a desirable state for future generations while also providing solutions for management, planning and policy-making in terms of urban sustainability (Cilliers *et al.*, 2013:682). According to Schaffler & Swilling (2013:2), cities are not recognising the economic contribution of green infrastructure enough and planning to address issues regarding the environment are in their infancy, referring to South Africa in particular.

A case study in Johannesburg, South Africa, one of the fastest growing cities in Africa, determined that cities and towns within Sub-Saharan Africa need to consider the incorporation of green infrastructure in the city's built environment (Schaffler & Swilling, 2013:2). This will require that the contribution of ecosystem services to the city's economy are recognised and considered in city budgeting and accounting systems, as well as integrating the "ecological economy" in urban planning processes (Schaffler & Swilling, 2013:2). De Wit *et al.* (2012:43) determined the monetary value of well-maintained and healthy ecosystem services in Cape Town, South Africa, and concluded that these services contributed 10% to 25% to the annual municipal budget and should, thus, be considered in its budgeting processes. Existing studies regarding ecosystem services have focused overwhelmingly on the developed world, neglecting South Africa and other developing countries (du Toit *et al.*, 2018:250). However, the approach in urban planning that considers ecosystem services is slowly emerging in South Africa (du Toit *et al.*, 2018:250). Ecosystem functions, processes and attributes also deliver goods and services that have a negative impact on or undermine human well-being and are referred to as ecosystem disservices (Shackleton *et al.*, 2016:4; Klimas *et al.*, 2016:3).

3.5 Considering ecosystem disservices in planning

The same ecosystem functions that provide benefits to cities and positively impact human well-being can also be responsible for certain detrimental services that negatively impact human well-being (Lategan & Cilliers, 2016:4). Escobedo *et al.* (2011:2081) refer to ecosystem disservices as additional expenses that are often generated through ecosystem disservices similar to the costs related to infrastructure damages. Ecosystem disservices can also develop as disturbed or missing services due to loss of biodiversity (Lyytimäki & Faehnle, 2009:311). Ecosystem disservices are site-specific, thus, vary between communities and individual residents (Escobedo *et al.*, 2011:2081). As a result, differentiating among ecosystem disservices, services or goods will depend on humans, their preferences, and socio-political as well as biophysical contexts (Dobbs *et al.*, 2011:197).

Ecosystem disservices can be framed according to the following characteristics: Ecosystem disservices (i) occur at different spatial and temporal scales, (ii) may interact with other disservices leading to an ultimate negative impact on human well-being, (iii) may require certain threshold

conditions to occur, for example the production of allergens in urban green spaces (UGSs) produced by the correct density on allergen producing species together with appropriate weather conditions, (iv) impacts vary between socio-economic scales and are context-specific, (v) have a negative impact on human well-being (vi) have long-lasting and long-term effects, (vii) frequency of occurrence are irregular and (viii) the impacts occur suddenly (Shackleton *et al.*, 2016:6). Table 3-3 summarises the categories of ecosystem disservices according to the biological or abiotic origin and provides suitable international (general examples in Table 3-3), as well as context-specific examples (South African examples in Table 3-3). Table 3-3 aims to better explain ecosystem disservices within the South African planning context. Bear in mind that some of the ecosystem disservices may apply to more than one category and most of the general examples are also applicable in the South African context, indicated in the South African example column as “Refer to general examples”.

Table 3-3: Ecosystem disservice categories according to origin and impacts

Category	Ecosystem origin	General example	South African example (in addition to general examples)
Environmental/Ecological	Biotic	• Invasive species out-compete indigenous species • Changes in specie interactions and specie populations	Refer to general examples in the column to the right
	Abiotic	• Change in abiotic species variables	Refer to general examples in the column to the right
Economic/Financial	Biotic	• Damage to infrastructure (property, cables, sidewalks, roads) caused by vegetation and tree roots • Pest-disease control	• Damage caused to infrastructure by trees is a problem especially in South Africa as the damages are not restored due to a lack of management, maintenance and financial capacity of local municipalities.
	Abiotic	• Drought • Wildfires • Siltation • Irrigation • Leaching of nutrients • Pruning and planting (maintenance cost) • Foregone land-use opportunities	• Within the South African planning context access to UGSs, especially in low-income areas, is extremely limited due to fragmented cities developed by the apartheid era. This resulted in high transportation costs to access green space and child-friendly spaces and sensitive approaches to address green space disservices in low-income areas.
Health (Physical, Mental, Safety)	Biotic	• Human diseases • Negative health impacts due to volatile organic compounds (VOC's) and pollen • Poisonous plants and pests/animals • Safety hazard due to tree falls	• Safety hazards due to a lack of maintenance of playgrounds.

Category	Ecosystem origin	General example	South African example (in addition to general examples)
	Abiotic	• Security concerns • Floods • Storms • Landslides • Changes in air quality due to the production of VOC's.	• Unsafe environments due to frequent criminal activity (drug trade, substance abuse, gang-related violence, robberies, sexual assault and murders).
Cultural (Aesthetic and Cultural)	Biotic	• Bird excrement on stonework and sculptures • Damage to infrastructure (sidewalks/paving) • Littering and scattering of human rubbish by animals • Unpleasant odours • High noise levels	• High noise levels apply to UGSs in high-income residential estates and UGSs that accompany active uses.
	Abiotic	• Soil erosion • Landslides • Exposure to the elements (winds) makes it an unpleasant experience.	Refer to general examples

Source: Own composition based on Lategan & Cilliers (2016:4); Cilliers *et al.* (2013:683); Lyytimäki & Faehnle (2009:311) & Gómez-Baggethun *et al.* (2013:184)

Table 2-3 captures examples of ecosystem disservices in the South African context, indicating that the ecosystem disservices of UGSs could vary from one context to another. In South Africa, the ecosystem disservices often result in a decrease of green space quality (Gómez-Baggethun *et al.*, 2013:184), indirectly having a negative impact on the economic value of UGSs. Understanding ecosystem disservices in the South African context could ensure efficient planning to avoid or minimise disservices as the balance between ecosystem services and disservices are recognised and considered (Klimas *et al.*, 2016:3). Addressing the disservices could be more cost-effective and successful in improving human well-being than promoting ecosystem services (Shackleton *et al.*, 2016:2). A one-sided focus on ecosystem services or disservices is however insufficient as optimising particular ecosystem services may also lead to an increase in an associated ecosystem disservice. Therefore, the complexity of ecosystem management should be considered on multiple scales and within multiple contexts (biophysical, social, economic and political) to optimise human well-being (Shackleton *et al.*, 2016:2). The socio-economic status (SES) of urbanities influences and determines how local authorities and Planners should plan for UGSs and manage their accompanying disservices to ultimately promote human well-being in different planning contexts (Wilkerson *et al.*, 2018:107).

3.6 Conclusions of Chapter 3

Urban ecosystems include all natural green and blue areas within cities where infrastructure cover the majority of the surface area (Francis *et al.*, 2012:185). Urban ecosystems vary in size and scale from one city to another and include the social dimension, thus the city itself could be regarded as an ecosystem (Rees, 2003:1, Francis *et al.*, 2012:185). Biota adapt to the urban environment to survive and sustain life (Rees, 2003:1, Francis *et al.*, 2012:185). Interestingly, though cities are regarded as an ecosystem, this ecosystem does not comprise of enough resources to sustain urban life (Bolund & Hunhammar, 1999:294). Urban ecology is equally important in the Planning profession as the environment should be prioritised in land-use planning and management by incorporating UGSs and environmental features in the design of urban areas (Baycan-Levent *et al.*, 2009:193; Pickett *et al.*, 2011:333). Green spaces provide crucial ecosystem services to urbanities including regulating, supporting, provisioning and cultural services (environmental and social benefits) (Gómez-Baggethun *et al.*, 2013:184). In addition to these ecosystem services, UGSs also provide a range of economic benefits (Simpeh & Smallwood, 2018:1831), including an increase in the value of adjacent properties. However, it is crucial to understand that even though ecosystems provide benefits to urbanities, their trade-offs are equally important to consider as poor management or a one-sided focus on solely the benefits ecosystems provide could increase ecosystem disservices, negatively influencing the value and ultimate benefits urbanities receive in return (Shackleton *et al.*, 2016:2). These ecosystem disservices (criminal activity, littering, nuisance and noise) accompanied by UGSs in the South African context have a substantial impact on how UGSs influence property value (the economic benefits of UGSs). The influence of UGSs characteristics on property value will be discussed in section 4.3. Chapter 4 focuses on the importance of economically valuating UGSs including different methods and previous case study findings.

CHAPTER 4: LITERATURE REVIEW: ECONOMIC VALUATION OF URBAN GREEN SPACES

4.1 Introduction

There are relatively few studies measuring the economic benefits of UGSs in developing countries, failing to emphasise the importance of urban ecosystem benefits in unique planning contexts like the South African planning context (Schaffler & Swilling, 2013:2). Many approaches and methods to economically value UGSs exist, depending on the context and scale of the valuation process (Farber *et al.*, 2002:389). One approach to economically value UGSs includes testing the proximity principle that suggests that the value of a property will be higher when the property is located closer to an UGS (Cilliers & Cilliers, 2015:5). The proximity principle could be tested as a Hedonic Price analysis method, a method that quantifies the different factors that influence property value including 'proximity to urban green space' (Nicholls, 2004:25). Figure 4-1 illustrates how each section of Chapter 4 leads to the discussion in the next section, starting with different valuation methods in section 4.2, thereafter discussing the impact of UGSs on property value (the proximity principle) in section 4.3 which is linked to Hedonic Price Analysis in section 4.4 and, finally, how residential properties are valued and what South African law requires in terms of property valuation in section 4.5. The discussions of Chapter 4 will lead up to Chapter 5 that will discuss the South African and Potchefstroom planning contexts comprehensively.

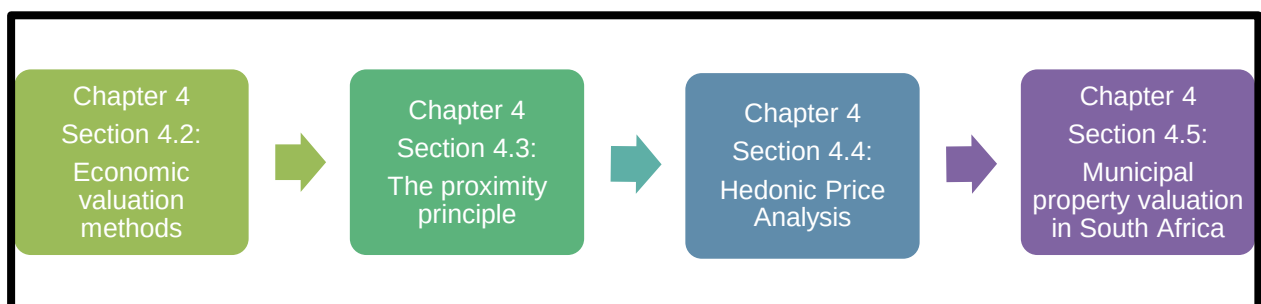


Figure 4-1: Structure and contents of Chapter 4
Source: Own composition (2020)

4.2 The economic valuation of urban green spaces (UGSs)

As the main focus of this research relates to quantifying the economic benefits provided by urban green spaces (UGSs), this section provides an overview of different approaches, methods and techniques to value UGSs in economic terms. These approaches and methods each have their own set of strengths and weaknesses and each ecosystem service should be valued or

measured by an appropriate set of techniques (Farber *et al.*, 2002:389). Though some of these methods may have shortcomings in proving the monetary value of UGSs (ecosystem services), the ultimate goal of using these methods is not to put a price tag on environmental attributes, but rather to raise awareness of ecosystem services' contribution to human well-being and the city economy (Cilliers *et al.*, 2013:684). It is crucial to economically value UGSs and their accompanying ecosystem services to strengthen the case for UGSs in the cost-benefit analyses considered by local municipalities when UGSs are planned, to improve incentives and to generate income required to cover expenditure for conservation, maintenance and sustainable environmental planning (Cilliers, 2010:51; de Groot *et al.*, 2012:51). The key challenge, however, is that the monetary value of ecosystem services is not generally prioritised in financial decision-making processes as these values are unclear and underestimated (de Wit *et al.*, 2012:39). This results in poorly informed decisions regarding budget allocations to environmental management departments (de Wit *et al.*, 2012:39).

Valuation methods aim to determine (i) the changes associated with ecosystem services in terms of the benefits people derive from the ecosystem services provided by UGSs or (ii) the cost of change of the benefits (Costanza *et al.*, 1997:5). The monetary valuation of UGSs and their related ecosystem services involve 'use' and 'non-use' values (Cilliers *et al.*, 2013:683). 'Use' values include wood provided by trees, water provided by lakes and other resources (direct consumptive), recreational activities and aesthetic appreciation (direct non-consumptive) or ecosystem services provided by UGSs (cross-reference to section 2.4) including, among others, climate regulation services and water purification (indirect use) (Cilliers *et al.*, 2013:683). 'Non-use' values refer to the existence value of attributes of the environment, irrespective of the 'use value' of the attributes (Cilliers *et al.*, 2013:683). Table 4-1 provides a summary of different methods to economically value UGSs and their accompanying ecosystem services.

Table 4-1: Economic valuation methods

Method/Approach/Technique	Application
Stated preference approach	The stated preference approach includes 'contingent valuation' referring to surveys where individuals are asked about their "willingness to pay" (WTP) for environmental attributes and their benefits such as to enhance the image of an area, attract tourism, promote investment, encourage retail sales and create favourable working environments that increase employment.

Method/Approach/Technique	Application
Revealed preference approach	According to this approach, the benefits of UGSs do not have an existing market but are directly linked to the cost of amenities that do have an existing market. Therefore, the market choices that individuals tend to make, including the estimated value of certain goods, services and benefits, are directly linked to the benefits of UGSs. This approach includes the proximity principle (cross-reference to section 4.3).
“Willingness-to-pay” (WTP) or “willingness-to-accept (WTA) the cost to replace a service.	These techniques apply to ecosystem services that do not have an existing market. Once these services become available to one person, the service becomes available to all people which makes it difficult to measure the WTP or WTA. WTP is applicable to the proximity principle.
Avoided Cost (AC)	Services that would have been replaced by conventional services in the absence of those services including to avoid property damage through efficient flood control of UGSs.
Replacement Cost (RC)	Services that would otherwise be replaced by expensive conventional systems like storm water management systems.
Factor Income (FI)	Services that increase income, for example, services that improve the quality of water that enhances commercial fisheries and as a result increases fishermen’s income.
Travel Cost (TC)	Services that require travelling to, for example, quality recreational UGSs. The implied value of the services provided by UGSs are placed on how much distant visitors are willing to pay to travel to these UGSs.
Hedonic Pricing (HP)	The service demand is reflected in prices people are willing to pay for associated goods and services, for example, higher house prices for a beach house than an inland house or a higher price for a house with a view onto an aesthetically pleasing UGS than a house located far away from the UGS. This approach includes the proximity principle.
Contingent Valuation (CV)	The service demand is elicited by valuating alternatives in hypothetical scenarios similar to expecting that people would be willing to pay a higher price for an increase in fish caught in a lake or alternative educational activities at a park.

Source: Own composition (2020) based on Farber *et al.* (2002:388); Cilliers *et al.* (2013:690); Cilliers (2010:51)

The different approaches to determine the economic benefits of UGSs link to the following six main aspects to consider when UGSs are defined in economic terms: (1) market value (real-estate), (2) enhancement value (positive effect on adjacent land), (3) production value (contribution to production), (4) natural systems value (ecosystem service value), (5) direct and indirect value and, lastly, (6) intangible value (ethics and knowledge) (Tekel & Akbarishahabi, 2013:347). A study conducted in South-Eastern Australia by Ives *et al.* (2018:2136), using a similar method to that of the stated preference approach considered the aspects 'natural systems value' and 'direct and indirect value' to value green space in Charlestown, Lake Macquarie. Participants received 2 maps (local suburban map of Charlestown and larger Local Governmental Area map including Charlestown and areas outside the urban boundary) and were asked to use the criteria in the legends of the maps (aesthetically pleasing, utilised for fitness activities, natural systems, culturally significant, promoting social integration, child-friendly, unappealing, unsafe, noisy and unpleasing) to indicate with markers what criteria they prefer to appoint to the respective parks and green spaces on the maps (Ives *et al.*, 2018:2137). The study concluded that people appointed more green space criteria to the local suburban area, thus, that residents in high-density suburbs experiencing urban development pressures recognise the benefits (ecosystem services) that green spaces provide and are also concerned about the deteriorating quality of green spaces (Ives *et al.*, 2018:2137). Urban green space quality determines the economic benefits related to green spaces, thus, it is important to consider a range of aspects in green space valuation, as proposed by Tekel & Akbarishahabi (2013:347). Most of the studies conducted thus far valuing UGSs followed either stated preference or revealed preference approaches, taking into account green space type and size (Trojanek *et al.*, 2018:359).

Not many studies have been conducted valuing UGSs in economic terms in Africa (Cilliers *et al.*, 2013:688). Studies conducted in Durban and Cape Town, South Africa present good examples of ecosystem valuation (Cilliers *et al.*, 2013:688). Through extensive consultation with various stakeholders, the economic value of urban biodiversity was determined in Durban by Roberts *et al.* (2005) through (i) determining the Replacement Cost (RC) of ecosystem services provided by urban biodiversity due to unsustainable development and (ii) meeting the needs of poorer communities by incorporating stakeholder preferences in Durban's Environmental Management System (Cilliers *et al.*, 2013:689). Another study by Davenport *et al.* (2012) using a consultation process and the Avoided Cost (AC) technique investigating the consumptive use of UGSs in three towns in the Eastern Cape determined that poorer communities mostly rely on municipal commonage with an estimated increase in future usage due to rapid rates of urbanisation (Cilliers *et al.*, 2013:689). A good example of an appropriate valuation method developed according to the specific context of the study area is the valuation method developed by the City of Cape Town (de Wit *et al.*, 2012:39). The City of Cape Town developed a conceptual

model that included a six-step valuation method considering participatory processes with stakeholders to investigate the selection and prioritisation of ecosystem services (de Wit *et al.*, 2012:39). This six-step method included various natural assets (types of UGSs). In step 1, the approach determined the importance of these assets. In step 2, the importance of these assets to users and beneficiaries was determined. In step 3, it established the link between ecosystem services and development. In step 4, the method examined how the city could manage these services. In step 5, it prioritised these services according to sustainability and risks. Lastly, the approach applied appropriate valuation techniques applicable to the case study in step 6 (de Wit *et al.*, 2012:39).

Ecosystem services are generated at different spatial and institutional scales based on different perceptions and dependency on ecosystem services to sustain stakeholder's living environments (Hein *et al.*, 2006:225). Thus, it is crucial to consider the scale of ecosystem service provision when an appropriate method is applied to value these services in economic terms (Hein *et al.*, 2006:225). Investigating the economic benefits of UGSs in the Potchefstroom case studies as discussed in Chapter 3, this study focuses on the aspect 'market value', one of the six aspects proposed by Tekel & Akbarishahabi (2013:347), as the study aimed to determine the impact of UGSs on property value in areas of different socio-economic status (cross-reference to section 4.3).

4.3 The impact of urban green spaces on property value: the proximity principle

The proximity principle, or proximate principle, focusses on the overall value of properties as their proximity to UGSs decrease or increase (Cilliers & Cilliers, 2015:5). This involves the process where the monetary value of amenities like UGS is determined by the value of surrounding residential properties (Combrinck *et al.*, 2020:4). The concept reflects the premise of willingness-to-pay (WTP) as people are often willing to pay more for properties located closer to UGS in compensation for the accompanying environmental attributes they receive, known as the capitalisation of land in higher property values (Daams *et al.*, 2016:389). The increase in property value directly increases the tax revenues for local municipalities which could be utilised for the maintenance of recreational UGSs and to address issues regarding the environment in their municipal area (Epsey & Owusu-Edusei, 2001:491; Cilliers & Cilliers, 2015:3). However, though higher tax revenues are appreciated by local authorities, property owners frequently do not perceive this as a positive outcome due to the higher tax rates they are required to pay (Crompton, 2005:217). Investigating the different factors that lead to an increase in property value of properties adjacent to UGS provides crucial monetary indicators, adding to the accountability for public expenditure on UGS planning and management (Crompton, 2005:217).

The degree of influence of UGSs on adjacent properties will depend on the distance from the urban green space (UGS) and the type of UGS (Trojanek *et al.*, 2018:259). Trojanek *et al.* (2018:359) introduces five possibilities for higher property value and includes access to recreational opportunities, sense of community and social capital (includes aesthetics), health and well-being, pollution mitigation and, lastly, reduction of the urban heat island effect. These possibilities reflect on the ecosystem services that UGSs could provide (cross-reference to section 3.4), validating that ecosystem services have the potential to enhance the economic benefits of UGSs. Internationally, several studies have investigated the impact of UGSs on property value, however, it is beyond the scope of this paper to reflect on all of these studies. Instead, a selection of prominent studies will be reported on in this section.

Biao *et al.* (2012:244) established that UGSs have an estimated 5% to 20% positive influence on property value. Another study in Bellingham, Washington, indicated that property value may increase by 26% if the property enjoys a view of a UGS (Cilliers, 2010:40). Multiple studies have shown that the positive impact of UGS on adjacent property value is greatest when (i) the properties have direct access to the green space (short walking distance), (ii) enjoy a view of the green space, (iii) have small property sizes (apartment buildings and properties in low-income areas) and (iv) when the green space accommodates passive uses (Trojanek *et al.*, 2018:367; Crompton, 2005:216, Crompton, 2001:28). Longer walks to UGS and active uses like recreational activities accommodated by UGS are likely to diminish the positive impact on property value, similar to large property sizes that are regarded as private leisure space, downplaying the need for accessible public urban green space (Trojanek *et al.*, 2018:367; Crompton, 2005:216). However, even though some parks are utilised by active users leading to noise, nuisance and congestion, properties adjacent to these spaces still tend to present higher property value than properties located further away (Crompton, 2001:28). Table 4-2 captures a selection of studies that have investigated the impact of UGS on adjacent properties supporting the proximity principle.

Table 4-2: Summary of studies investigating green space impact on property value

Author/s	Study area	Title of study	Conclusion
Bolitzer & Netusil (2000)	Oregon, Portland	"The impact of open spaces on property value in Portland, Oregon"	Properties located within 460m from green space account for 1% to 3% higher value.
Epey & Owusu-Edusei (2001)	Greenville, South Carolina, United States	"Neighborhood Parks and Residential Property Values in Greenville, South Carolina"	In general, parks had a positive impact on property value in Greenville.

Author/s	Study area	Title of study	Conclusion
Miller (2001)	Dallas, Texas	"Valuing open space: Land-economics and neighbourhood parks"	Property value 22% higher than properties 800m or more away.
Nicholls & Crompton (2005)	Austin, Texas	"The Impact of Greenways on Property Values: Evidence from Austin, Texas"	Greenways positively affect proximate properties' sales prices (approximately to the extent of one-fifth of their value), leading to a subsequent enlargement of the property tax base.
Crompton (2005)	United States	"The impact of parks on property values: empirical evidence from the past two decades in the United States"	Overall positive impact of approximately 20% on property values abutting or fronting a passive park.
Mayor <i>et al.</i> (2009)	Dublin, Ireland	"A hedonic analysis of the value of parks and green spaces in the Dublin area"	Green spaces result in higher house prices in the neighbourhood, with a 7% to 9% premium depending on the proximity buffer used. People value park amenities and aesthetics higher than proximity to green space.
Biao <i>et al.</i> (2012)	Beijing, China	"The Effects of Public Green Spaces on Residential Property Value in Beijing"	Proximity to a park indicated to have a statistically significant effect on the neighbourhood property value (price premiums vary from 0.5% to 14.1% to approximately 850–1604 m from the green space). Property tax revenue received through the enhanced value of properties around public green spaces amounted to 2.86 billion Chinese Yuan (CNY) annually (maintenance cost were only 0.7–1.6 billion).
Daams <i>et al.</i> (2016)	Netherlands	"The Effect of Natural Space on Nearby Property Prices: Accounting for Perceived Attractiveness"	Supporting evidence was provided that Dutch property buyers pay higher prices for properties located at a distance of up to 7 km from attractive natural space.
Trojanek <i>et al.</i> (2018)	Warsaw, Poland	"The effect of urban green spaces on house prices in Warsaw"	An increase of 2.8% to 3% on apartment prices within 100m from publically accessible green space.

Source: Own composition (2020)

The studies summarised in Table 4-2 support the proximity principle as all of these studies indicated a positive influence on the value of properties located in close proximity to UGS. Depending on the context, these studies indicated that property value increased (i) when the properties were located within a specific proximity buffer from the green space, (ii) when the properties had a view onto a passive and attractive green space or (iii) when the properties were within walking distance from the green space. Studies conducted in developing countries like South Africa have also indicated cases where proximity to a UGS resulted in negative impacts on property values due to low green space quality and relating ecosystem disservices like fire risk, poor management and maintenance, the occurrence of frequent criminal activity, vandalism, noise and littering (Trojanek *et al.*, 2018:361; Epsey & Owusu-Edusei, 2001:490; Crompton, 2005:216).

Case studies conducted in Potchefstroom, South Africa, investigating the impact of UGS on property value in five selected residential areas rejected the proximity principle and concluded that various ecosystem disservices contributed to the diminished value of proximate properties (Cilliers & Cilliers, 2015; Combrinck *et al.*, 2020). Figure 4-2 explains how both positive and negative factors relating to green space have an impact on property value.

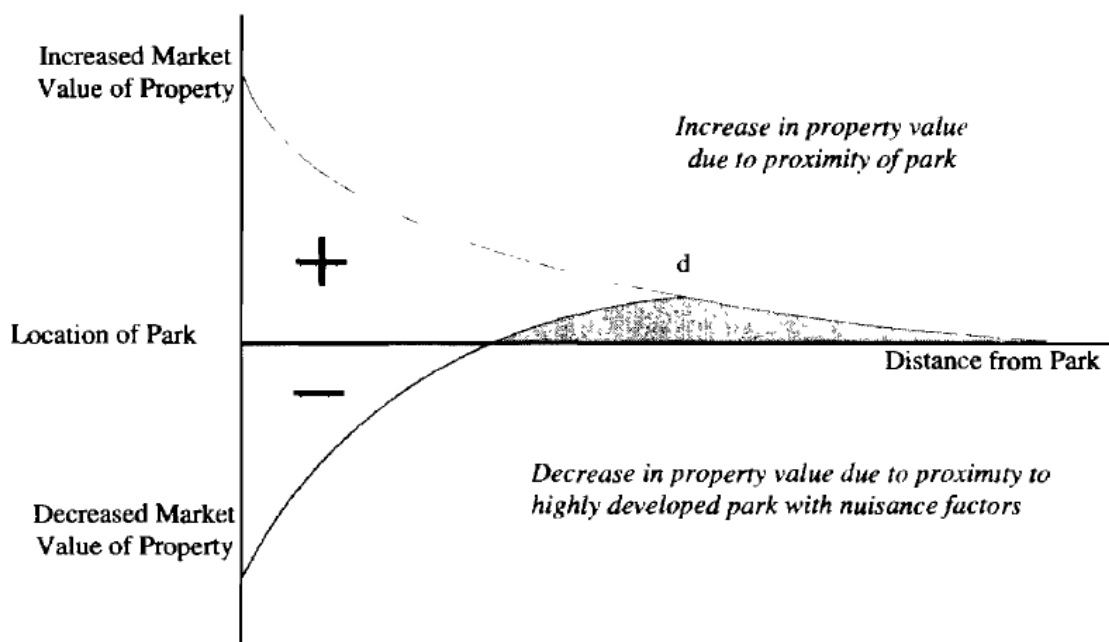


Figure 4-2: Positive and negative urban green space impacts on property value
Source: Crompton (2001:6)

The top half of Figure 4-2 indicates how property value decreases as proximity from UGS increases, while the bottom half of the graph shows how the negative impacts imposed by UGS slowly diminishes as proximity from UGS increases (Crompton, 2001:6). The negative impacts (nuisance factors) relating to urban green space decreases more rapidly than the positive impacts

(an increase in property value) as the distance from UGS increases, thus, though the positive impacts on property value start to decrease with increasing distance from UGS, properties should still experience an increase in value as the negative impacts have already diminished (Crompton, 2001:6). One limitation of the studies captured in literature thus far is that most have been confined to single-family homes and exclude the impact of UGSs, specifically parks, on adjacent commercial properties (Crompton, 2005:217). A considerable amount of research has attempted to value UGSs through analysis of property data and the Stated Preference Approach, however, Hedonic Price Analysis of property prices could also be considered to value UGSs (Troy & Grove, 2008:233).

4.4 Hedonic price analysis

Major developments have taken place during the past few decades in terms of scientific studies investigating the impact of UGS on property value (Crompton, 2005:204). Among these are the sophistication of Hedonic Price Analysis studies to consider a range of factors that influence property value (Crompton, 2005:204). The Hedonic Price Analysis method generally breaks down the price of an observed good into separate unobserved marginal implicit prices of the separate characteristics of that good while also considering consumers' choice (Troy & Grove, 2008:235; Mayor, *et al.*, 2009:6). Regarding real-estate, this method is used to identify and quantify the different factors influencing property value where these factors are studied respectively without considering the interactions between these different factors (Nicholls, 2004:25; Cilliers & Cilliers, 2015: 4; Daams *et al.*, 2016:38; Troy & Grove, 2008:235). Hedonic Price Analysis investigates residential properties as heterogeneous goods, reflecting on various factors that influence property value through objective measures, as mentioned above, including property size, external characteristics of the property, accessibility and location, as well as green space density and size (Combrinck *et al.*, 2020:4; Panduro & Veie, 2013:122).

In contrast, Gibbons *et al.* (2014:176) argue that hedonic price analysis studies are inaccurate as limited environmental factors are considered that result in failure to account for multiple additional factors, as well as housing preferences influencing each other. Biao *et al.* (2012:243) do not support the proximity principle as a hedonic price analysis method as studies testing the proximity principle occasionally deliver contrasting results since all the influencing factors are not considered. According to Biao *et al.* (2012:243-244), one factor influencing the value of a property close to a UGS may increase the value where another factor may lead to a decrease in value, therefore, all the factors must be studied respectively. Studies conducted by Cilliers & Cilliers (2015) and Combrinck *et al.* (2020) in Potchefstroom delivered results supporting the statements made by Gibbons *et al.* (2014:76) and Biao *et al.* (2012:243) as the proximity principle was rejected in middle-income residential areas of Potchefstroom but confirmed in respective areas

in Ikageng, a low-income residential area in Potchefstroom, as well as Tuscany Ridge Estate, a high-income residential estate in Potchefstroom (refer to Chapter 6 of this research). The local case study of this research (refer to Chapter 6) uses municipal property values to test the proximity principle in the local context of Potchefstroom. To strengthen the case study, other factors such as ecosystem disservices (cross-reference to section 3.5), the socio-economic status of the residential areas, location and property size were also taken into consideration. All of these factors also have an impact on how UGSs influence the value of adjacent properties. As the Potchefstroom case study discussed in Chapter 6 used the municipal property values to test the proximity principle, the following section will provide more detail regarding municipal property valuation in South Africa.

4.5 Municipal property valuation in South Africa

Property valuation involves the process of investigating land and the improvements thereupon to develop an opinion of value determined by a Professional Valuer (Nyabwengi *et al.*, 2020:1731). As previously mentioned, an increase in property prices contributes towards property taxation that is an essential government revenue source utilised for service delivery, maintenance and management of public facilities, emergency services, community centres, infrastructure and parks (Epsey & Owusu-Edusei, 2001:491; Ramakhula, 2010:36; Nyabwengi *et al.*, 2020:1731). Property tax or rates refer to the revenue Local Municipalities receive from ownership of property in their municipal area (Ramakhula, 2010:24). However, property taxation has been neglected thus far in most developing countries, including South Africa, due to a lack of adequate property tax registers and incomplete valuation rolls, a lack of revenue generation and inadequate monitoring of the performance of registers (Almy, 2014:23; Nyabwengi *et al.*, 2020:1731). Not only is poor record-keeping a major issue in South Africa, but poor financial management also contributes to the poor economic health of local municipalities, resulting in poor financial sustainability to provide infrastructure and deliver services (Channing & van der Walt, 2019:525). An effective solution to address these shortcomings is to use software tools that estimate the value of a property by comparing the property to other recently sold residential properties, called Computer-Assisted Mass Appraisal (CAMA) or mass valuation that relies on standardised procedures and statistical analysis (Almy, 2014:14; Nyabwengi, 2020:1734). Ramakhula (2010:29) summarised the three steps in a practical approach to mass valuation, as seen in Table 4-3.

Table 4-3: The three steps in die mass valuation process

Step	Description
Step 1: Basic property description	Through aerial photographs or Geographic Information Systems, the property is identified through physical characteristics including property size, physical condition, location of the property, age of the property, materials and building quality.
Step 2: Market information	This step is extremely important in the valuation process and should be carried out regularly. The Valuer should gather information regarding recent property sales and rentals, estate agent records, the registration of land and construction cost.
Step 3: Valuation	During the third and final step, the Valuer performs a market analysis where the factors (size, condition, location, age etc.) determined in Step 1 are measured according to the influence each factor has on market sales. This is completed by mathematical models and tables of values per square meter to finally determine a taxable value for the property.

Source: Ramakhula (2010:29)

Unfortunately, a lack of technological advancements limits the accuracy of mass evaluations in South Africa (Almy, 2014:23). Another model which is a relatively new concept in South Africa moving away from traditional valuation and that could be used to value any type of property is Automated Valuation Models (AVM) (Boshoff & de Kock, 2013:2). Automated Valuation Models (AVM) are models, processes and computerised analytical algorithms that have the potential to estimate the value of a property without any human interference or assistance and are specifically used to value residential properties. However, the use of Automated Valuation Models in South Africa raises causes for concern as accuracy will decrease due to slow adoption and implementation of AVM, as well as a lack of physical inspections (Boshoff & de Kock, 2013:20). Another issue is the challenge to include the substantial number of properties in the valuation roll, especially with regards to the number of rural properties now part of municipal boundaries (McCluskey & Franzsen, 2004:29). Though the last-mentioned models both speed up the valuation processes and have shortcomings in terms of accuracy, sufficient sales data and market ratings are easily accessible through the Deeds Office database by municipal Valuers to provide accurate, updated data regarding the properties and ownership (McCluskey & Franzsen, 2004:28). Table 4-4 provides more detail regarding property valuation in South Africa, applicable to residential property valuation.

Table 4-4: Important details of property valuation in South Africa

Key component	Description
Level of government responsible	Local Municipalities
Included in property taxation	Land, properties and improvements thereon
Basis of valuation	Market value
Individuals responsible	Municipal Valuers, Private Valuers
Methods	• Mostly mass valuation • Physical inspection is optional according to the Municipal Property Rates Act (Act 6 of 2004).
Monitoring and evaluation <i>(National and Provincial level)</i>	• National level: Minister should implement ratio and statistical measures that ensure valuation accuracy • Provincial level: Required to review rates policies annually
Municipal Property Rates Act (Act 6 of 2004) <i>[Summary of Chapter 4 (General valuation of rateable property) and Chapter 5 (Valuation criteria)]</i>	• <i>Section 30 (1) (a) and (b):</i> When a Local Municipality levy a rate on property, that property should be valued and included in the valuation roll. • <i>Section 32 (1) (a) and (b):</i> A municipal valuation roll is valid after inspection is completed from the start of the financial year for no more than 4 financial years. • <i>Section 33 (1):</i> Before commencement of valuation, the municipality should designate one of their officials or a Valuer from private practice as their Municipal Valuer. • <i>Section 39 (1) (a):</i> The municipal Valuer must be a registered Professional Valuer or Professional Associated Valuer

Key component	Description
	• <i>Section 45 (2) (a) and (b)</i>: Physical inspection of property is optional, Valuers may use alternative methods and techniques similar to computer-assisted Mass Appraisal Systems. • <i>Section 46 (1)</i>: The market value of a property is the amount sold to willing buyer from a willing seller on the date of valuation in the open market. • <i>Section 46 (2) (a), (b) and (c)</i>: When determining the market value of a property any licenses/permissions/privileges should be accounted for, as well as all immovable property and improvements thereof, should be accounted for. • <i>Section 46 (3) (a), (b) and (c)</i>: When determining the value of a property the following should be disregarded: any structure or minerals underground defined by the Minerals Act (Act 50 of 1991), any immovable machinery on the property excluding escalators, lifts, air-conditioning plants, pump instalments for swimming pools and irrigation.

Source: Nyabwengi (2020:1737); Municipal Property Rates Act (Act 6 of 2004)

Other valuation methods in property valuation include traditional methods like the Comparable Sales Approach, Income Capitalisation Approach, Reproduction Cost Approach, Depreciated Replacement Cost Approach and advanced technology methods similar to hedonic pricing and spatial analysis (Ramakhula, 2010:25; Boshoff & de Kock, 2013:4).

4.6 Conclusions of Chapter 4

Many methods, approaches and techniques can be applied to measure the economic benefits of UGSs. The stated preference approach and Hedonic Price Analysis are among the most commonly used approaches and methods to specifically measure the impact of UGSs on proximate property values. Though many studies have applied and confirmed the proximity principle, the majority of these studies were conducted in developed countries where the planning contexts vary greatly from the planning contexts of developing countries. The Hedonic Price Analysis method is used to quantify the factors that have an impact on property value and presents an appropriate method to economically measure green spaces in the South African planning context as urban areas are highly fragmented into areas of different socio-economic status (SES) (Lubbe, 2011:37). There exist various factors that influence the value of a property adjacent to urban green space including property size, distance to green space, green space use

(active or passive), the aesthetic value of the green space, vegetation type, vegetation density and maintenance (Trojanek *et al.*, 2018:367; Crompton, 2005:216, Crompton, 2001:28; Troy & Grove, 2008:233). Most municipalities follow the same process to value properties in South Africa by using mass valuation. The unique planning context in South Africa makes it extremely challenging for Municipal Valuers to value properties in South Africa as they are required to value a substantial amount of urban and rural properties across the socio-economic gradient, resulting in inaccurate mass valuations (McCluskey & Franzsen, 2004:29). This leads to lower values being assigned properties and decreases property tax in return which also decreases the funds available to local municipalities for maintenance, planning and management. Chapter 4 discusses the South African and Potchefstroom planning contexts, as well as the previous Potchefstroom case study that was conducted by Cilliers & Cilliers (2015).

CHAPTER 5: CONTEXTUAL BACKGROUND TO THE LOCAL CASE STUDY

5.1 Introduction

The planning context in South Africa relates to the socio-political landscape of South African towns and cities characterised by urban sprawl, fragmentation and the growth of informal settlements. Though a challenge in planning, these aspects should be seen as opportunities to investigate and address these issues related to UGS planning and management in the South African planning context (van Wilgen *et al.*, 2020:12). Moreover, a pro-development approach to spatial development, rather than a pro-environment approach is currently followed neglecting urban green spaces in spatial planning (Cilliers, 2009:182). The unique planning context of Potchefstroom, South Africa, (refer to section 5.3) has an impact on the economic benefits that UGSs provide. For example, case studies conducted by Cilliers & Cilliers *et al.* (2015) and Combrinck *et al.* (2020) investigated such trends in the local context of Potchefstroom by testing the proximity principle in five selected residential areas bordering a green space, however, the studies concluded that the proximity principle did not hold true as the value of properties adjacent to green spaces presented lower property values than properties located further away from UGS. As seen in Figure 5-1, this Chapter will comprehensively discuss both the South African and Potchefstroom planning contexts in section 5.2 and 5.3 respectively, where after a discussion of the previous Potchefstroom case study conducted by Cilliers & Cilliers (2015) will follow in section 5.4.

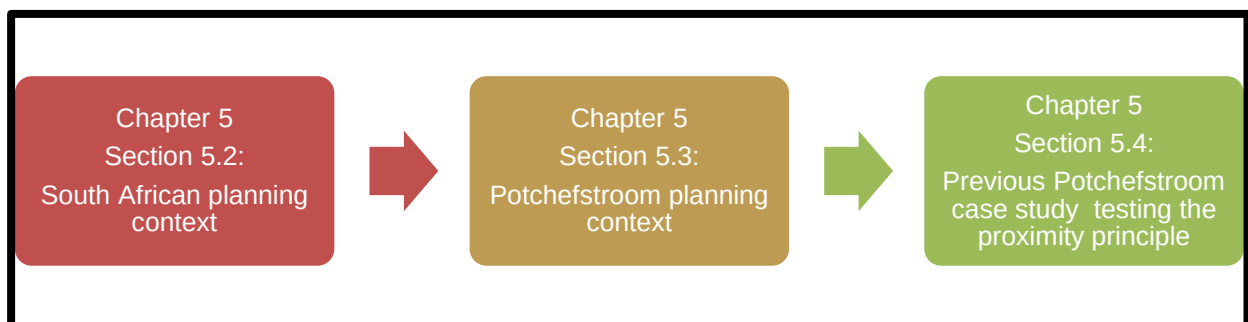


Figure 5-1: Structure and contents of Chapter 5
Source: Own composition (2020)

5.2 The South African planning context

South Africa is the most urbanised country in Africa with an estimated 73.3% of the population to be urbanised by the year 2030 (Lategan & Cilliers, 2016:2; du Toit *et al.*, 2018:250). Furthermore, three-quarters of the estimated population growth in African countries like South Africa is

expected to occur in small to medium-sized towns that accommodate one million inhabitants or less where high levels of poverty, as well as a lack of institutional, social and political capacity limit their ability to address future challenges (Shackleton *et al.*, 2016:2). Together with high rates of urbanisation, in 2019 South Africa was proclaimed as the country presenting the highest levels of inequality in the world (van Wilgen *et al.*, 2020:12). A large influencing factor is the unique socio-political landscape of South Africa formed during the apartheid era (van Wilgen *et al.*, 2020:12). Though racial segregation was enforced before the apartheid era, it was not until 1948 that The National Party implemented apartheid measures on a large scale across South Africa (Christopher, 1990:426). The Group Areas Act (41 of 1950) introduced measures that comprehensively replanned South African cities, both new and existing suburbs, into racially segregated and fragmented urban areas (Christopher, 1990:427).

Since democracy was declared in 1994, South Africa continued to deliver low-cost housing resulting in the development of informal settlements on the periphery of cities and towns contributing to urban sprawl (Lategan & Cilliers, 2014:428). The fragmentation of South African towns and cities is not solely the result of the policies and legislation enforcing racial segregation in the apartheid era (Collinson *et al.*, 2007:78). On the contrary, poor planning, bad management and governance have contributed to the discourse to a significant extent resulting in more urban populations living in informal settlements and sprawling cities below the poverty line (Collinson *et al.*, 2007:78). Kessides (2006:xxii) states that urban poverty and deprivation cannot be blamed on weak economies in countries similar to South Africa, rather the lack of institutional capacity that results in institutional failures perpetuate inequality between the groups of different socio-economic status and continues to be a driver in social exclusion. The approach to spatial planning in South Africa is also pro-development, neglecting green spaces in decision-making processes (Cilliers, 2009:182). Cilliers (2009:182) refers to the “Green-Value-Gap” to explain the conflicting factors of environmental management, that is green-driven, and spatial planning, that is development driven, in South Africa, stating that these conflicting objectives should be addressed to promote sustainable development (Cilliers, 2009:182).

In developing countries like South Africa, institutional capacity and bad management also influence urban green spaces (UGSs) and ecosystem services as the implementation of policies and legislation to plan for and manage UGSs remains a challenge (Cilliers *et al.*, 2013:696). Chishaleshale *et al.* (2015) studied strategic urban tree and green space planning in 28 local municipalities in South Africa and discovered that most municipalities do not plan for or manage urban trees and green spaces due to a lack of funding, human resources, equipment and political support. As the size of the municipalities increased, Chishaleshale *et al.* (2015:817) found that only then the planning and management for urban green spaces and tree cover also increased,

however, remained inadequate. Ecosystem services are equally important to consider as low-income areas with high levels of poverty often rely on these services and green infrastructure for water and food production (du Toit *et al.*, 2018:250).

The benefits of UGSs (and relating ecosystem services) are not recognised, calling for raised awareness among local communities, local authorities and decision-makers, as well as the inclusion of socio-economic groups in decision-making processes (Ward & Winter, 2016:575). There are various ecosystem disservices related to UGSs in South Africa which decrease the quality of these spaces (cross-reference to section 2.4). A study by Lategan & Cilliers (2014:431) in Oudtshoorn, South Africa confirmed that residents prefer functional green spaces similar to sports facilities and would rather avoid green areas that are densely vegetated as they regard these spaces as unsafe (Lategan & Cilliers, 2014:431). The informal backyard rental sector, a component of the post-apartheid housing landscape, is another driving force in the decrease of private green space availability in South Africa (Lategan & Cilliers, 2016:2). High urbanisation rates and population growth rates, together with the high demand for housing, make UGSs targets for urban development and land invasions (Lategan & Cilliers, 2014:431).

Urban green space availability is different across the socio-economic gradient. The more affluent neighbourhoods are characterised by more quality private green spaces than quality public green space availability (McConnachie & Shackleton, 2010:244; Lategan & Cilliers, 2014:430; Lategan & Cilliers, 2016:5). However, the high density of dwellings and structures in lower-income neighbourhoods and informal settlements (post-apartheid) have limited or restricted access to UGSs and relating amenities (McConnachie & Shackleton, 2010:244; Lategan & Cilliers, 2014:430; Lategan & Cilliers, 2016:5). Thus, UGS availability differs substantially between cities and town, as well as within cities and towns depending on the socio-economic status (SES) (du Toit *et al.*, 2018:252). Figure 5-2 clearly illustrates the unequal distribution of urban greening (trees and green space) between an informal settlement on the left in contrast to a middle to high-income residential neighbourhood on the right in Boubosrand, Johannesburg.



Figure 5-2: Green space availability in Boubosrand, Johannesburg
Source: National Geographic (2019)

Similarly, the socio-economic gradient in Potchefstroom also has a major impact on how UGSs influence the value of adjacent properties. The following section will discuss the background to the socio-economic gradient in Potchefstroom and how the socio-economic characteristics between different residential areas vary and influence property value in return.

5.3 The Socio-economic gradient in Potchefstroom

Potchefstroom, similar to other towns and cities in South Africa, is characterised by fragmented urban areas with a steep socio-economic gradient due to the socio-political legacy of South Africa (Cilliers *et al.*, 2013:686). Ikageng, the former Makweteng area (native location) in Potchefstroom, developed in the 1870s due to the racial segregation of subordinate racial classes from the main residential area in Potchefstroom (Jansen van Rensburg, 2006:133). Table 5-1 briefly summarises a timeline of the socio-political history of Potchefstroom, the ultimate driving force in the town's socio-economic gradient and the existence of Ikageng, Promosa and Mohadin.

Table 5-1: Socio-political history of Potchefstroom

Date / Year / Time	Historical events
1858	The Constitution of the Republic of South Africa emphasised that there was no equality between "black" and "white" citizens.

Date / Year / Time	Historical events
1877	The Republic of South Africa decided that the subordinate classes should be segregated from the main residential areas. The whites' servants lived with them on their "civil rights stands", whereas other racial groups lived in segregated residential areas called "the native location"/"coloured location"/"Makweteng".
Post South African war	Approaches and policies made "coloured" and "black" residents in "white" towns precarious as policies emphasised that towns were built by and for only "white" people.
1896 - 1940	Residents in "the native location" received limited rights to access surplus water, own businesses and access sports facilities.
1945	The National Party implemented the Native Urban Areas Act (25 of 1945) to create separate residential areas for "black" people. The presence of "black" people in "white" towns where referred to as "threatening"
1958 - 1963	"Black" people in "Makweteng" were relocated to Ikageng, eight kilometres West of Potchefstroom.
1962	The Group Areas Act (Act 41 of 1950) led to the establishment of separate residential areas for "coloureds" in Promosa and Asians in Mohadin, located West of Ikageng.

Source: Jansen van Rensburg (2006:132-136)

The racial segregation in Potchefstroom and the fragmentation of residential areas placed people with limited power in worse circumstances than they were before with unacceptably low-quality and small-sized housing, limited access to services and amenities and racial discrimination (Jansen van Rensburg, 2006:136). Potchefstroom is predominantly segregated into residential areas of different racial and income groups (Lubbe, 2011:24). A study by Lubbe (2011:36) investigating the distribution of domestic garden flora across the socio-economic gradient in Potchefstroom discussed the five levels of socio-economic status (SES) in the former Tlokwe Local Municipal area (JB Marks Local Municipal area) based on employment, household size, access to basic services, number of rooms in houses and schooling which were determined by the 2001 Census Survey.

Ikageng, Mohadin and Promosa fall within level 1, level 2 and level 3 of socio-economic status (characterised as the lower-income residential areas) accommodating informal settlements, as

well as formally built single-dwelling units. The remaining areas of Potchefstroom including Van der Hoff Park, Grimbeek Park, Heilige Akker, Oewersig and the Potchefstroom Dam Area fall within level 4 and level 5 categories of socio-economic status (characterised by higher-income residential and commercial areas). Figure 5-3 illustrates a map of Potchefstroom categorised in the five levels of socio-economic status (SES), as discussed above.

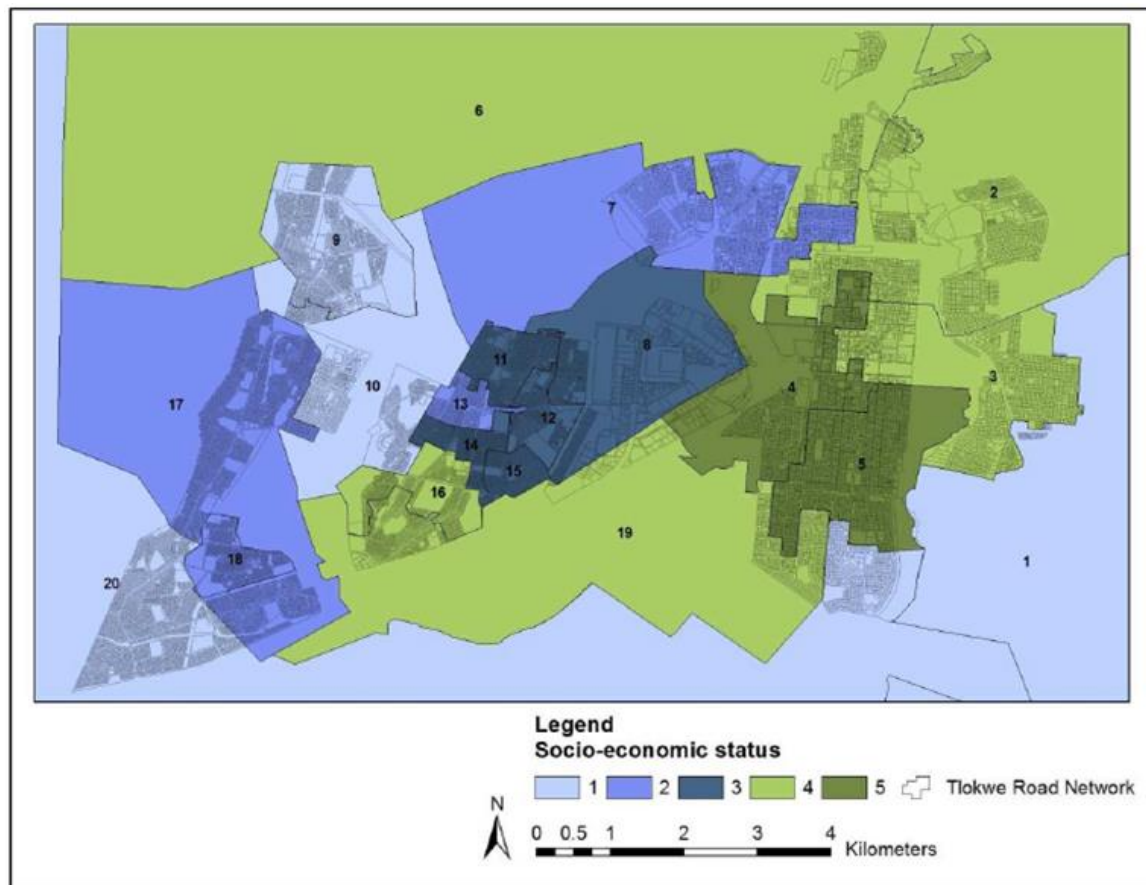


Figure 5-3: Socio-economic status levels in Potchefstroom
Source: Lubbe (2011:37)

The socio-economic status (SES) of a group or community has an impact on green spaces as it influences the ability to manage and plan for green spaces, altering green spaces according to human needs and providing green spaces for human well-being (Wilkerson *et al.*, 2018:107). Urban green spaces in communities with low socio-economic status, like Ikageng, tend to be characterised by fruit trees and personal vegetable gardens to provide in their own needs (Lubbe *et al.*, 2011:73). However, communities in urban areas of higher socio-economic status reside in areas with higher species richness, public green spaces and private green spaces (Lubbe *et al.*, 2011:73). Lubbe (2011:25) uses the term “luxury concept” to describe how the species richness and plant diversity between areas of different socio-economic status (SES) vary substantially as a group’s SES determines their resources and ability to change their environment. Thus, green spaces in areas of different SES also vary substantially in terms of the planning and management

of these spaces. Furthermore, top-down planning approaches are followed in poorer neighbourhoods in contrast with bottom-up influences that are present in more affluent neighbourhoods (Lubbe, 2011:25). Figure 5-4 illustrates the different housing types across the socio-economic gradient in Potchefstroom referring to the low-income (pictures A, B, C and D) and middle to high-income (picture E and F) residential areas. Picture D illustrates a house in a low-income residential area with its private vegetable garden.



Figure 5-4: Housing types across the socio-economic gradient in Potchefstroom
Source: Lubbe (2011:71)

5.4 Background to the Potchefstroom case study of 2015

During the past two decades, a substantial number of studies have been conducted that focused on valuing ecosystem services in urban areas, however, most of these studies were conducted in first world countries (Cilliers & Cilliers, 2015:4). One example of a study in South Africa was conducted in Durban by Roberts *et al.* (2005) to value ecosystem services using a resource economics approach (Cilliers & Cilliers, 2015: 4). Another study in Cape Town, South Africa, valuing ecosystem services using four different valuation techniques concluded that the free ecosystem services contributed to 25% of the city's total budget at the time of the study, a substantial amount to replace when these services are neglected (Cilliers & Cilliers, 2015:4). In addition, studies have also been conducted in Potchefstroom that focussed on urban biodiversity, vegetation types around cities and in fragmented areas within cities, as well as ecosystem services using biotope mapping approaches (Cilliers & Siebert, 2012:3). These studies included study areas along the urbanisation gradient, the socio-economic gradient, wetlands, urban open spaces and railway lines and included, to name a few: Cilliers & Bredenkamp, 1998; Cilliers & Bredenkamp, 1999; Cilliers & Bredenkamp, 2000; Cilliers *et al.*, 1998; Cilliers *et al.*, 1999; Jonas, 2007 and Lubbe, 2011.

The study by Cilliers & Cilliers (2015) aimed to value green spaces in economic terms by employing a hedonic price analysis method that focussed on the proximity principle to determine the impact of green spaces on property value in Potchefstroom (cross-reference to section 1.5) (Cilliers, 2010a; Cilliers, 2013). The 2015 case study used 2013 property values identified in the municipal valuation roll of the JB Marks Local Municipality to test the proximity principle. Proximity to UGS have been proven to have a positive influence on property value in international case studies (Biao *et al.*, 2012:244). The study by Cilliers & Cilliers (2015) compared local case study findings in Potchefstroom with results from international case studies in literature. The 2015 Case Study indicated that the proximity principle was rejected in the local context of Potchefstroom, thus in the local planning context (cross-reference to section 5.3) proximity to green space has a negative impact on property value (cross-reference to section 1.5). In 2019 the first refinement of the study was conducted by Combrinck *et al.* which delivered similar results (cross-reference to section 1.5). The results from the 2015 and 2019 case studies indicated that different contexts need to be considered in spatial planning at local municipal level in South Africa. The 2020 Potchefstroom case study considered different contexts to determine the impact of green spaces on property value in areas of different socio-economic status. The 2020 Potchefstroom case study is discussed comprehensively in Chapter 6.

5.5 Conclusions of Chapter 5

The unique socio-political landscape of the South African planning context includes high poverty rates, high inequality rates and expanding informal settlements. These aspects certainly call upon unique planning approaches to address issues related to UGSs in different areas of socio-economic status (SES). Areas of different SES accommodate different community needs which have a substantial impact on how UGS influence proximate property value. Though the planning context may increase the complexity of planning in urban areas with these unique trends, it provides an opportunity to investigate and deliver planning solutions and improve the planning and management of UGSs. Though many studies have applied and confirmed the proximity principle, the majority of these studies were conducted in developed countries where the planning contexts differ greatly from the planning context of developing countries. In contrast to these studies, case studies by Cilliers & Cilliers (2015) and Combrinck *et al.* (2020) applied the proximity principle in five middle-income residential areas bordering a green space in Potchefstroom, however, rejected the principle in the selected residential areas.

CHAPTER 6: EMPIRICAL INVESTIGATION BASED ON QUANTITATIVE DATA OF THE LOCAL CASE STUDY

6.1 Introduction

The Potchefstroom case study was a further refinement of the previous Potchefstroom case studies conducted by Cilliers & Cilliers (2015) using the 2013 municipal property values of the JB Marks Local Municipality, as well as the first refinement conducted in 2019 by Combrinck *et al.* (2020) using the 2019 municipal property values. The data of the Potchefstroom case study of 2020 was collected by also using the 2019 municipal property values to test the proximity principle in the local context of Potchefstroom. This case study refined the results from the previous studies while also considering the socio-economic gradient in Potchefstroom (cross-reference to section 5.3), accounting for residential areas of different socio-economic status (SES). This was to determine the impact of UGSs on proximate property value in low-income, middle-income and high-income residential areas. By considering the socio-economic gradient, the results obtained will improve our understanding regarding to what extent the socio-economic status (SES) of an area influences the impact of UGSs on property value. This study tested the proximity principle as part of a Hedonic Price Analysis method (cross-reference to section 3.4). By employing a Hedonic Price Analysis method, the context, scale and proximity to UGSs were investigated. Measuring the impact of UGSs on property value in selected residential areas with unique socio-economic and cultural characteristics are required to, finally, obtain successful and accurate results (Biao *et al.*, 2012:243). The information provided by the 2020 case study will ensure that Planners and decision-makers are equipped with useful information to plan and manage UGSs according to the socio-economic status (SES) of urban areas (Lubbe, 2011:25). Chapter 6 will commence with a detailed discussion on how the data was analysed and, thereafter, the data results that were recorded. Further interpretations of the data results through a multi-criteria analysis (MCA) will be discussed in Chapter 7, as seen in Figure 6-1, below.

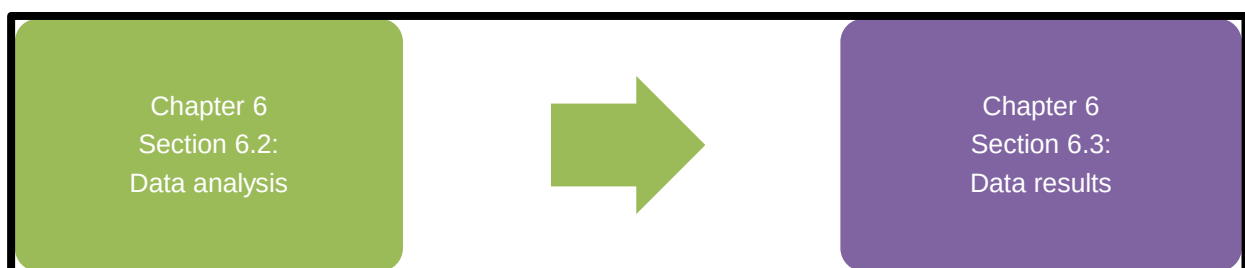


Figure 6-1: Contents and structure of Chapter 6
Source: Own composition (2020)

6.2 Data analysis

After the residential areas were selected and divided into 3 zones (cross-reference to section 2.2.1), the property price/value of each property was determined in the municipal valuation roll of June 2019, representing the most recent property values recorded for the municipal area. Thereafter, the mean *Rand per square meter* values for each respective zone within each respective residential area were calculated and used to complete the statistical analyses. The quantitative data were analysed to determine whether the proximity principle holds true in Potchefstroom. The proximity principle were tested as an indicator of the economic benefits of urban green spaces (UGSs) (e.g. cost saving through storm water management, increased property value, marketability of Potchefstroom, tourism).

The data obtained were analysed using three analytical methods including the Analysis of Variance (ANOVA), the Kruskal-Wallis analysis and the Dependent T-test. After the mean *Rand per square meter* values of each zone within each selected residential area were calculated, these values were used to complete the ANOVA and Kruskal-Wallis analyses. The effect sizes obtained from these analyses determined whether a practically significant difference was present between zone 1 and zone 2, as well as between zone 1 and zone 3 within each respective residential area. The effect sizes obtained from both the ANOVA and Kruskal-Wallis analyses were considered and interpreted as presented in Table 6-1.

Table 6-1: ANOVA and Kruskal-Wallis Effect sizes interpretation

ANOVA Effect size	Kruskal-Wallis Effect size	Interpretation
0.2	0.1	<i>No practically significant difference</i> , indicating that a distinctive difference between the values of zone 1 and zone 2, as well as between the values of zone 1 and zone 3 does not exist .
0.5	0.3	<i>Practically visible difference</i>
0.8	0.5	<i>Practically significant difference</i> , indicating that a distinctive difference between the values of zone 1 and zone 2, as well as between the values of zone 1 and zone 3 does exist

Source: Own composition (2020)

The p-values obtained from the ANOVA and Kruskal-Wallis analyses were included for the sake of completeness, but not interpreted. A convenience sample of personally selected properties was included, thus, it is better to consider the effect sizes that are directly applicable to the sample size. It is important to bear in mind that the proximity principle could have been confirmed or rejected by observing solely the mean *Rand per square meter* values of the 3 zones within each residential area, however, the statistical evidence provides credence. The *Rand per square meter* values and the effect sizes were analysed and interpreted to determine whether the proximity principle is confirmed or rejected. The *Rand per square meter* values were most important to consider, whereas the effect sizes were only interpreted to support the results provided by the *Rand per square meter* values of each zone within each residential area. Thus, the ANOVA analysis and the Kruskal-Wallis analysis effect sizes were crucial in verifying the significance of the results.

The data obtained from the previous study conducted by Cilliers & Cilliers (2015) were statistically compared to the data obtained from Category B as the same residential areas, properties, data collection and data analyses methods were used. The effect sizes obtained from the Dependent T-test indicated whether a *practically significant difference* existed between the data. The Dependent T-test p-values were also only included for the sake of completeness.

6.3 Data results

The results of Category A, B and C focused on the ANOVA and Kruskal-Wallis effect sizes, as well as the *Rand per square meter* values to determine whether the proximity principle is confirmed or rejected in each residential area.

6.3.1 Category A: Low-income residential areas

The following results were delivered:

6.3.1.1 Rand per square meter values

The mean Rand per square meter values in three of the five residential areas (Mohadin, Ikageng Ext 4 and Ikageng Area 2) indicated that zone 1 presented the highest value in Rand per square meter compared to zone 2 and zone 3, the zones further away from the urban green space, highlighted with green in Table 6-2, below. Mohadin presented a value of 969,21 R/m² in zone 1 compared to 815,99 R/m² in zone 2 and 765,87 R/m² in zone 3. Similarly, Ikageng Extension 4 presented a value of 1099,52 R/m² in zone 1 compared 824,62 R/m² in zone 2 and a value of 599,57 R/m² in zone 3. Ikageng Area 2 presented the same trends with a value of 973,41 R/m² in zone 1, a value of 833,98 R/m² in zone 2 and 758,63 R/m² in zone 3. Thus, zone 1 located

closest to the urban green space presented the highest value in three of the five areas (Mohadin, Ikageng Extension 4 and Ikageng Area 2), confirming the proximity principle. Zone 1 presented the lowest Rand per square meter values in two of the five residential areas (Ikageng Ext 7 and Ikageng Area 3), rather than the highest values as the proximity principle suggests. The collective result of the Rand per square meter values confirmed the proximity principle.

6.3.1.2 Interpretation of ANOVA effect sizes

As seen in Table 6-2, below, the effect sizes that compared zone 1 and zone 2 indicated an overall *medium* effect size ($\approx 0,5$) with 3 areas that presented small effect sizes ($\approx 0,2$) (Ikageng Ext 7, Mohadin and Ikageng Area 2) and two areas that presented medium effect sizes ($\approx 0,5$) (Ikageng Ext 4 and Ikageng Area 3). The effect sizes that compared zone 1 and zone 3 indicated an overall *medium* effect size ($\approx 0,5$) with two areas that presented small effect sizes ($\approx 0,2$) (Ikageng Ext 7 and Ikageng Area 2), two areas that presented medium effect sizes ($\approx 0,5$) (Mohadin and Ikageng Area 3) and one area that presented a large effect size ($\approx 0,8$) (Ikageng Ext 4). The collective result of the ANOVA effect sizes indicated a *practically visible difference* (overall medium effect size) between the mean Rand per square meter values of zone 1, zone 2 and zone 3 in all 5 the residential areas. Thus, distinct differences between the values of zone 1, zone 2 and zone 3 in Category A were presented which is in line with the collective result obtained from the Rand per square meter values.

6.3.1.3 Interpretation of Kruskal-Wallis effect sizes

The Kruskal-Wallis effect sizes that compared zone 1 and zone 2 in the respective residential areas indicated an overall *medium* effect size ($\approx 0,3$) with two areas that presented small effect sizes ($\approx 0,1$) (Mohadin and Ikageng Area 2) and three areas that presented medium effect sizes ($\approx 0,3$) (Ikageng Ext 7, Ikageng Ext 4 and Ikageng Area 3), as seen in Table 6-2, below. The effect sizes that compared zone 1 and zone 3 indicated an overall *medium* effect size ($\approx 0,3$) with one area that presented a small effect size ($\approx 0,1$) (Ikageng Area 2), two areas that presented medium effect sizes ($\approx 0,3$) (Ikageng Ext 7 and Ikageng Area 3) and 2 areas that presented large effect sizes ($\approx 0,5$) (Mohadin and Ikageng Ext 4). The collective result of the Kruskal-Wallis effect sizes indicated a *practically visible difference* (overall medium effect size) between the Rand per square meter values of zone 1, zone 2 and zone 3 in all five the residential areas. Thus, distinct differences between the Rand per square meter values were presented, supporting the collective result discussed in section 6.3.1.1.

Table 6-2: Results of statistical analysis for Category A

Area	Zone	N (210)	R/m ²	ANOVA effect sizes		Kruskal-Wallis effect sizes		ANOVA p-values	Kruskal-Wallis p-values
				a ≈ 0.2 small (no practically sig. diff.) b ≈ 0.5 medium (practically visible diff.) c ≈ 0.8 large (practically sig. diff.)		a ≈ 0.1 small (no practically sig. diff.) b ≈ 0.3 medium (practically visible diff.) c ≈ large (practically sig. diff.)		Statistically significant difference between the means (p<0.05)	Statistically significant difference between the groups (p<0.05)
				1 with...	2 with...	1 with...	2 with...		
Ikageng Extension 7	1	24	526,52					0,501332	0,0454
	2	24	635,96	0,33 a		0,307 b			
	3	24	588,89	0,19 a	0,14 a	0,240 b	0,220 b		
Mohadin	1	13	969,21					0,349896	0,1847
	2	15	815,99	0,31 a		0,200 b			
	3	13	765,87	0,56 b	0,10 a	0,408 c	0,030 a		
Ikageng Extension 4	1	12	1099,52					0,061053	0,0226
	2	12	824,62	0,52 b		0,255 b			
	3	13	599,57	0,94 c	0,45 b	0,55 c	0,283 b		
Ikageng Area 2	1	12	973,41					0,633078	0,7519
	2	12	833,98	0,17 a		0,059 a			
	3	12	758,63	0,26 a	0,21 a	0,071 a	0,195 a		
Ikageng Area 3	1	12	898,65					0,317137	0,2199
	2	12	1083,3	0,53 b		0,318 b			
	3	12	1080,96	0,50 b	0,01 a	0,289 b	0,047 a		

Source: Own composition (2020)

6.3.1.4 Conclusions of Category A data results

To conclude on the results obtained from the Rand per square meter values, as well as the ANOVA and Kruskal-Wallis effect sizes, the proximity principle was confirmed in Ikageng and Mohadin, the low-income residential areas of this case study. The effect sizes indicated an overall medium effect, thus, presenting a *practically visible difference* between the mean Rand per square meter values of zone 1, zone 2 and zone 3. Ikageng Extension 7 borders a piece of vacant land accommodating no land use with dense vegetation cover which is linked to high criminal activity (cross-reference to section 5.2). This led to zone 1 bordering the UGS presenting the lowest property value, rejecting the proximity principle. The properties in Mohadin are located around a central UGS with no vegetation cover and no active uses or playgrounds for children, however, due to a need for accessible UGS zone 1 presented the highest value and zone 3 the lowest value, confirming the proximity principle. Ikageng Extension 4 borders a vacant piece of land where informal structures are present. Zone 1 also presented the highest property value, zone 2 a lower value and zone 3 the lowest value, confirming the proximity principle. Ikageng Area 2 is located across from a sports ground with limited maintenance and controlled access. The proximity principle was also confirmed in Ikageng Area 2 as property value presented a downward trend from zone 1 to zone 3. The proximity principle was rejected in Ikageng Area 3 which is located across from a small vacant piece of land with limited vegetation cover, no active uses and that borders a busy road. Thus, zone 1 presented the highest property value in 3 of the

5 residential areas compared to zone 2 and zone 3, proving the proximity principle in 3 of the 5 residential areas (Mohadin, Ikageng Extension 4 and Ikageng Area 2).

6.3.2 Category B: Middle-income residential areas

The following results were delivered:

6.3.2.1 Rand per square meter values

The mean Rand per square meter values in four of the five residential areas (Grimbeek Park, Van der Hoff Park, Potchefstroom Dam Area and Heilige Akker) indicated that zone 1 presented the lowest value in Rand per square meter compared to Zone 2 and Zone 3. As seen in Tabel 6-3, zone 1 in Grimbeek Park presented a value of 1260.70 R/m² compared to a higher value of 1611.67 R/m² in zone 2 and the highest value of 1699.25 R/m² in zone 3. In Van der Hoff Park the same trends were presented with 1290.59 R/m² in zone 1, a value of 1472.43 R/m² in zone 2 and also the highest value of 1624.30 R/m² in zone 3. Similarly, in the Potchefstroom Dam Area zone 1 presented a value of 1116.44 R/m² compared to 1303.45 R/m² in zone 2 and 1448.64 R/m² in zone 3, the zone furthest away from the UGS. In Heilige Akker zone 1 also presented the lowest value of 1751.96 R/m², however, zone 2 presented the highest value of 1904.15 R/m² and the second-highest value of 1850.28 R/m² in zone 3. Thus, zone 1, located closest to the UGS had the lowest mean Rand per square meter value instead of the highest value as suggested by the proximity principle. Zone 3 presented the highest mean Rand per square meter value in three of the five residential areas (Grimbeek Park, Van der Hoff Park and Potchefstroom Dam area), being the zone furthest away from the UGS.

6.3.2.2 Interpretation of ANOVA effect sizes:

The effect sizes that compared zone 1 and zone 2 in the respective residential areas indicated an overall *medium* effect size (≈ 0.5), thus, a *practically visible difference* between the Rand per square meter values. As seen in Table 6-3, four of the five residential areas indicated a medium effect size (≈ 0.5) (Van der Hoff Park, Potchefstroom Dam Area, Heilige Akker and Oewersig), while only one residential area indicated a large effect size (≈ 0.8) (Grimbeek Park). The effect sizes that compared zone 1 and zone 3 in the respective residential areas indicated an overall large effect size (≈ 0.8), thus, a *significant difference* between the Rand per square meter values. Two residential areas indicated a large effect size (≈ 0.8) (Grimbeek Park and Van der Hoff Park) and another two residential areas indicated a medium effect size (≈ 0.5) (Potchefstroom Dam Area and Oewersig). Only one residential area indicated a small effect size (≈ 0.2) between zone 1 and zone 3 (Heilige Akker). The collective result of the ANOVA effect sizes indicated an overall *medium to large* effect size ($\approx 0.5 / 0.8$) between zone 1 and the zones further away from the

urban green space, indicating a *practically visible difference* between the Rand per square meter values.

6.3.2.3 Interpretation of Kruskal-Wallis effect sizes:

The effect sizes that compared zone 1 and zone 2 in the respective residential areas indicated an overall medium effect size (≈ 0.3), thus, a *significant difference* between the Rand per square meter values. Two residential areas indicated a large effect size (≈ 0.5) (Grimbeek Park and Potchefstroom Dam Area) and another two residential areas indicated a medium effect size (≈ 0.3) (Van der Hoff Park and Oewersig), as seen in Table 6-3. Only one residential area indicated a small effect size (≈ 0.1) between zone 1 and zone 3 (Heilige Akker). The effect sizes that compared zone 1 and zone 3 in the respective residential areas indicated an overall medium effect size (≈ 0.3), thus, a *significant difference* between the Rand per square meter values. Two residential areas indicated a large effect size (≈ 0.5) (Grimbeek Park and Van der Hoff Park) and another two residential areas indicated a medium effect size (≈ 0.3) (Potchefstroom Dam Area and Oewersig). Only one residential area indicated a small effect size (≈ 0.1) between zone 1 and zone 3 (Heilige Akker). The collective result of the Kruskal-Wallis effect sizes indicated an overall *medium* effect size (≈ 0.3) between Zone 1 and the zones further away from the urban green space, indicating a *practically visible difference* between the Rand per square meter values.

Table 6-3: Statistical analysis results of Category B

Area	Zone	N (188)	R/m ²	ANOVA effect sizes		Kruskal-Wallis effect sizes		ANOVA p-values	Kruskal-Wallis p-values
				a ≈ 0.2 small (No practically sig. diff.) b ≈ 0.5 medium (Practically visible diff.) c ≈ 0.8 large (Practically sig. diff.)		a ≈ 0.1 small (No practically sig. diff.) b ≈ 0.3 medium (Practically visible diff.) c ≈ 0.5 large (Practically sig. diff.)		Statistically significant difference between the means (p<0.05)	Statistically significant difference between the groups (p<0.05)
				1 with...	2 with...	1 with...	2 with...		
Grimbeek Park	1	14	1260.70					0.0002	0.0006
	2	14	1611.67	1.19 c		0.54 c			
	3	13	1699.25	1.63 c	0.30 a	0.68 c	0.23 b		
Van der Hoff Park	1	15	1290.59					0.015	0.005
	2	15	1472.43	0.53 b		0.38 b			
	3	13	1624.30	0.98 c	0.54 b	0.58 c	0.27 b		
Potchefstroom Dam Area	1	9	1116.44					0.396	0.237
	2	9	1303.45	0.53 b		0.43 c			
	3	9	1448.64	0.44 b	0.19 a	0.26 b	0.09 a		
Heilige Akker	1	10	1751.96					0.641	0.640
	2	12	1904.15	0.42 b		0.17 a			
	3	14	1850.28	0.24 a	0.13 a	0.07 a	0.15 a		
Oewersig	1	14	1668.44					0.105	0.052
	2	14	1852.15	0.44 b		0.26 b			
	3	13	1549.20	0.36 b	0.72 c	0.23 b	0.45 c		

Source: Own composition (2020)

Table 6-4, below, presents a comparison between the Rand per square meter values obtained from the study conducted by Cilliers & Cilliers (2015) and the results obtained in Category B of

this case study. The effect sizes obtained from the comparison indicated a *practically significant difference* between the mean Rand per square meter values (effect size of $\approx 0.8 / 0.5$). The latter was clear by observing the old and new mean Rand per square meter values in Table 6-4. The property values increased from 2013 to 2019 with 68% in Grimbeek Park, 35% in Van der Hoff Park, a total of 55% in the Potchefstroom Dam area, 46% in Heilige Akker and 45% in Oewersig. Various potential factors could have led to the increase in property values from 2013 to 2019. Inflation was a potential factor as the Consumer Price Index (CPI) increased from 5,78% in 2013 to 6,59% in 2016 and decreased, thereafter, to 4,25% in 2019 (inflation.eu, 2019). Other factors influencing property value in South Africa, according to the Absa residential property market database, include migration trends, security issues, income levels, employment, monetary and fiscal policies, investment returns, condition of the property and foreign property buying of South African properties (Vogel, 2003:1). The p-values were only included for the sake of completeness, thus, not interpreted.

Table 6-4: Dependent T-test results

Area	Zone	N (188)	R/m ² Old	R/m ² New	% Increase between Old and New	Effect sizes	Dependent T-Test
						a ≈ 0.2 small b ≈ 0.5 medium c ≈ 0.8 large	Statistically significant difference between Old and New (p<0.05)
Area A: Grimbeek Park	1	14	798.20	1260.70	68%	1.13	0.006
	2	14	953.12	1611.67		1.64	0.001
	3	13	974.76	1699.25		0.69	0.011
Area B: Van der Hoff Park	1	15	938.29	1290.59	35%	1.95	0.0001
	2	15	1105.07	1472.43		2.23	0.0001
	3	13	1202.56	1624.30		2.69	0.0001
Area C: Potchefstroom Dam Area	1	9	718.97	1116.44	55%	1.88	0.0001
	2	9	843.41	1303.45		1.36	0.0001
	3	9	925.29	1448.64		1.47	0.0001
Area D: Heilige Akker	1	10	1114.23	1751.96	46%	1.75	0.0001
	2	12	1413.52	1904.15		1.33	0.0001
	3	14	1238.36	1850.28		1.39	0.0001
Area E: Oewersig	1	14	1079.50	1668.44	45%	1.03	0.0001
	2	14	1292.09	1852.15		1.54	0.0001
	3	13	1120.30	1549.20		1.51	0.0001

Source: Own composition (2019)

6.3.2.4 Conclusions of Category B data results

To conclude, the effect sizes indicated an overall *medium* effect size (practically visible difference) between the mean Rand per square meter values of zone 1 and the zones further away from the urban green space. Zone 1 also presented values lower than the zones further away from the urban green space in all 5 of the areas, the opposite of case study findings in international literature (cross-reference to section 4.3). The proximity principle was rejected as the Rand per

square meter values revealed that the closer a property was to an UGS the value did not present an increase in property value. The properties in Category B are large, well-maintained and some have private swimming pools, which are frequently regarded as a replacement of public leisure space (cross-reference to section 4.3), eliminating the need to be located in walking distance from public UGS. In comparison to Category A, tree cover in Category B residential areas are also much denser when investigating the areas from an aerial point of view. Comparing the results obtained in Category B of this case study with the results of the first Potchefstroom case study by Cilliers & Cilliers (2015), the data indicated that an overall increase in property value captured in the 2013 and 2019 did occur most likely due to inflation and other external factors of the property sector.

6.3.3 Category C: High-income residential area

The following results were delivered:

6.3.3.1 Rand per square meter values

As seen in Table 6-5, the mean Rand per square meter values in Tuscany Ridge Estate indicated that zone 1 represented the highest value in Rand per square meter compared to zone 2 and zone 3. Zone 1 that borders the UGS had the highest value of 3915,46 R/m², zone 2 had the second-highest value of 3612,63 R/m² and zone 3 had the lowest value of 3058,63 R/m². Tuscany Ridge Estate, thus, presented trends confirming the proximity principle.

6.3.3.2 Interpretation of ANOVA effect sizes

As seen in Table 6-5, the effect sizes that compared zone 1 and zone 2 in Tuscany Ridge Estate indicated a *small* effect size (≈ 0.3), thus, *no practically significant difference* between the mean Rand per square meter values. The effect sizes that compared Zone 1 and Zone 3 in Tuscany Ridge Estate indicated a *large* effect size (≈ 0.8), thus, a *practically significant difference* between the mean Rand per square meter values. The collective result, considering both of the effect sizes mentioned above, indicated a *medium* effect size (≈ 0.5), thus, a *practically visible difference* between the mean Rand per square meter values.

6.3.3.3 Interpretation of Kruskal-Wallis effect sizes

As seen in Table 6-5, the effect sizes that compared zone 1 and zone 2 in Tuscany Ridge Estate indicated a *small* effect size (≈ 0.1), thus, *no practically significant difference* between the mean Rand per square meter values. The effect sizes that compared zone 1 and zone 3 in Tuscany Ridge Estate indicated a *large* effect size (≈ 0.5), thus, a *practically significant difference* between the mean Rand per square meter values. The collective result, considering both of the effect sizes

mentioned above, indicated a *medium* effect size (≈ 0.3), thus, a *practically visible difference* between the mean Rand per square meter values.

Table 6-5 captures the results obtained from the Rand per square meter values, the ANOVA analysis and the Kruska-Wallis analysis.

Table 6-5: Rand per square meter, ANOVA and Kruskal-Wallis results

Area	Zone	N (188)	R/m ²	ANOVA effect sizes		Kruskal-Wallis effect sizes		ANOVA p-values	Kruskal-Wallis p-values
				a ≈ 0.2 small (no practically sig. diff.) b ≈ 0.5 medium (practically visible diff.) c ≈ 0.8 large (practically sig. diff.)		a ≈ 0.1 small (no practically sig. diff.) b ≈ 0.3 medium (practically visible diff.) c $\approx$ large (practically sig. diff.)		Statistically significant difference between the means ($p < 0.05$)	Statistically significant difference between the groups ($p < 0.05$)
				1 with...	2 with...	1 with...	2 with...		
Tuscany Ridge Estate	1	24	3915,46					0,000517	0,0019
	2	24	3612,63	0,30 a		0,119 a			
	3	24	3058,63	0,84 c	0,91 c	0,408 c	0,467 c		

Source: Own composition (2020)

The urban green spaces in Tuscany Ridge Estate are well-maintained, child-friendly, safe and aesthetically pleasing. Furthermore, the properties have large houses with limited garden space increasing the need for accessible UGS for exercise and play areas which are available to residents in Tuscany Ridge Estate. High property values are presented in zone 1 (closest to the UGS), followed by a lower value in zone 2 and the lowest in zone 3.

6.4 Comparative Rand per square meter results

Figure 6-2 captures the comparative mean Rand per square meter results of Category A, B and C with zone 1 presented in pink, zone 2 in blue and zone 3 in purple. Category A indicates a slight downward trend in value from zone 1 to zone 3 with zone 1. Category B clearly indicates that the value of Zone 1 located closest to the urban green space presented a lower value than zone 1 and zone 2. Category C indicated a clear and consistent downward trend of value from zone 1 to zone 3 with zone 1 bordering the urban green space presenting the highest value, a lower value in zone 2 and the lowest value in zone 3 which is located furthest away from the urban green space. Furthermore, the socio-economic status levels of each Category is also clearly presented in Figure 6-2 as the mean Rand per square meter values are low in Category A, higher in Category B and the highest in Category C presenting an upward trend in value from Category A to Category C.

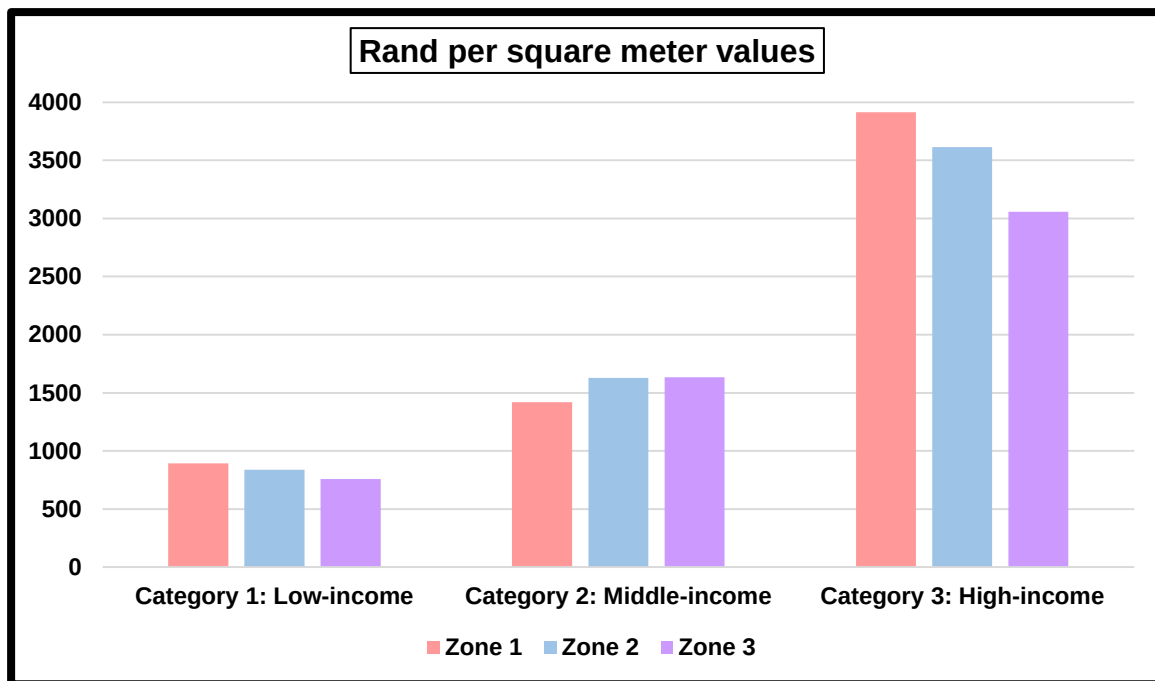


Figure 6-2: Rand per square meter values of Category A, B and C
Source: Own composition (2020)

6.5 Conclusions of Chapter 6

This case study tested the proximity principle in the local context of Potchefstroom using the June 2019 municipal property values. The case study was divided into three categories. Category A tested the proximity principle in 5 low-income residential areas in Ikageng and Mohadin. Category B tested the proximity principle in 5 middle-income residential areas which was also a refinement of previous studies conducted by Cilliers & Cilliers (2015) and Combrinck *et al.* (2020) testing the proximity principle in the same five residential areas and properties. Category C focused on a high-income residential estate in Potchefstroom. Categories A and C expanded the study area of the studies by Cilliers & Cilliers (2015) and Combrinck *et al.* (2020) by including both low-income and high-income residential areas to, finally, consider the impact of the socio-economic gradient on the impact of UGS on proximate property value.

The statistical analyses indicated an overall medium effect size (practically visible difference) between zone 1 and the zones further away from the green space (zone 2 and zone 3) in all of the residential areas of Category A, Category B and Category C. The results obtained from the mean Rand per square meter values indicated that the proximity principle was rejected in Category B, however, confirmed in Category A and Category C. This is a clear indication of the importance to consider contexts in planning. Each category (planning context) presented unique physical characteristics, functions, community needs and maintenance characteristics of the UGSs. In Category A, small property sizes, nearly no access to and availability of well-maintained

UGSs, a lack of maintenance and high criminal activity had a substantial impact on how the UGSs influenced proximate property values. Dense vegetation cover and a high risk of criminal activity, as well as vacant land with no active uses near a busy road led to a rejection of the proximity principle in Ikageng Extension 7 and Ikageng Area 3, respectively. A centrally located UGS with good accessibility in Mohadin, vacant land in Ikageng Extension 4 that can be utilised according to residents' needs and a maintained sports ground in Ikageng Area 2 led to the confirmation of the proximity principle. Vegetation cover and density of UGSs are associated with perceptions of unsafe environments as criminals have a place to hide (Troy & Grove, 2008:234). In addition, the properties in Category A are small and the needs of low-income communities to access food sources and space for community gardens could explain why residents would be willing to pay more for properties located closer to UGS as in the case of Ikageng Extension 4. Another reason for the results are due to differences in property size. Gardens of bigger properties similar to the properties in Category B (Grimbeek Park, Van der Hoff Park, Potchefstroom Dam Area, Heilige Akker and Oewersig) are frequently regarded as a replacement for public leisure space eliminating the need for publically accessible UGS (Trojanek *et al.*, 2018:367; Crompton, 2005:216). Smaller properties within walking distance from well-maintained, child-friendly and aesthetic urban green space have higher property value, as reflected in the results of Category C (Trojanek *et al.*, 2018:367; Crompton, 2005:216). Maintenance of green spaces in high-income residential estates are a priority and levies paid by residents are allocated to cover maintenance expenditure, resulting in higher property values close to urban green space, confirming the proximity principle.

The data obtained from the study conducted by Cilliers & Cilliers (2015) was compared to the data obtained in Category B of this case study. The effect sizes indicated a large effect size (practically significant difference) between the 2015 and 2019 data results, thus, the property values, shown as mean Rand per square meter, increased from 2013 to 2019 between 35% and 68%. This increase in value from 2015 to 2019 is mainly due to inflation and a change in physical property characteristics that influenced the value of the properties.

CHAPTER 7: APPLICABILITY OF THE PROXIMITY PRINCIPLE IN THE LOCAL CONTEXT OF POTCHEFSTROOM

7.1 Introduction

A multi-criteria analysis (MCA) method was employed to complete a comparative analysis investigating the urban green spaces in Category A (low-income residential areas), Category B (middle-income residential areas) and Category C (high-income residential areas) of the Potchefstroom Case study discussed in Chapter 6. Before commencing with the analysis, the following sections will discuss how the MCA was employed step-by-step and the results that were delivered. The MCA was used to evaluate the respective UGSs of Category A, Category B and Category C according to ecosystem services, management and physical characteristic criteria.

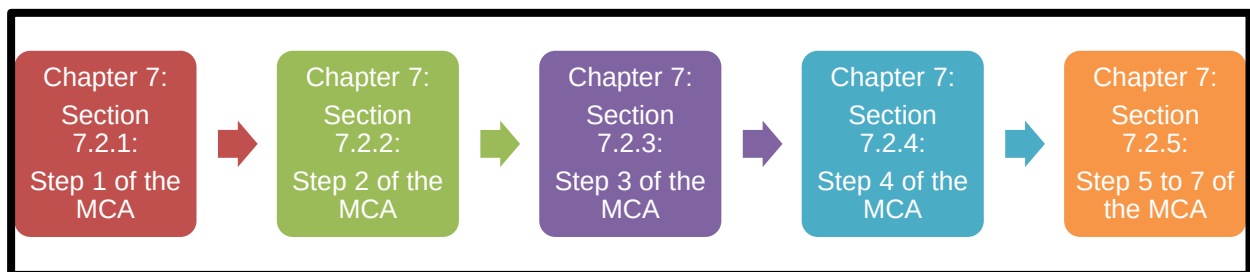


Figure 7-1: Structure and contents of Chapter 7
Source: Own composition (2020)

7.2 Multi-criteria analysis (MCA) process and results

The Multi-criteria analysis was discussed and explained in Chapter 2 regarding the research methodology that was employed throughout this research (cross-reference to section 2.5.1). The following sections will discuss the results that were obtained for each step of the MCA process.

7.2.1 Step 1: MCA objective, aims and decision-makers

The main objective of the MCA is to investigate the relationship between various environmental factors (ecosystem services), physical property characteristics (property condition and size), socio-economic characteristics (socio-economic levels) and green space management characteristics (maintenance and service delivery) and the impacts these factors have on the value of properties in close proximity to UGSs. Conclusions have been made in section 6.5 following the quantitative investigation of the 2020 Potchefstroom case study. The results of the MCA will support and further explain the results obtained from the 2020 Potchefstroom case study

as the same factors shown to have an impact on how UGSs influence proximate property value in the literature study (cross-reference to section 4.3) and the 2020 Potchefstroom case study was analysed through the MCA. The MCA aims to value ecosystem services, physical characteristics and socio-economic characteristics by applying a “scoring” model, based on guidelines of the Fuzzy MCA model, to determine the level of performance of each of these factors.

7.2.2 Step 2: Identify the options

The “scoring” model will be applied to the five residential areas in Category A (Ikageng Extension 7, Mohadin, Ikageng Extension 4, Ikageng Area 2 and Ikageng Area 3), the five residential areas in Category B (Grimbeek Park, Van der Hoff Park, Potchefstroom Dam Area, Heilige Akker and Oewersig) and Category C (Tuscany Ridge Estate). These residential areas serve as the “options” in the MCA and will be analysed through three separate ‘performance tables’, focusing on Category A, B and C respectively. Each option will be subjectively “scored” according to the selected criteria.

7.2.3 Step 3: Select the criteria

The criteria of the ‘performance table’ were selected based on the literature gathered in Chapter 3 and 4. The criteria included the following:

- Environmental benefits of UGSs (regulating, provisioning and supporting ecosystem services)
 - Climate and air quality regulation through tree cover
 - Provisioning of food, water and medicine through natural resources
 - Protection of natural systems through high biodiversity
- Social benefits of UGSs (cultural ecosystem services)
 - Aesthetic value
 - Social cohesion
 - Health and recreation
 - Quiet environment
 - Attraction for living
 - Enhance the identity of the area
- Economic benefits of UGSs
 - Cost saving through storm water management
 - Marketability
 - Tourism

- Water regulation and retention
 - Higher property value of zone 1 (2020 Potchefstroom case study)
- Service provision in the residential area
 - Waste removal
 - Water provision
 - Sanitation
 - Electricity provision
 - Clean-up
 - Infrastructure maintenance
- Environmental community needs
 - Access to parks and child-friendly spaces
- Social community needs
 - Access to UGS for recreation, health benefits and social gatherings
- Economic community needs
 - Storm water management to prevent flooding and prevent unforeseen expenses (damage)
- Property size
 - Small
 - Large
- Socio-economic levels
 - SES level 1 to 3 (low-income)
 - SES level 4 (middle income)
 - SES level (high-income)
- Physical condition of properties
 - Good maintenance
 - Aesthetic value

7.2.4 Step 4: Expected performance of options

The options are expected to deliver similar results as presented in international literature (cross-reference to section 4.3) and the results obtained from the 2020 Potchefstroom case study (cross-reference to Chapter 6). The results indicated that ecosystem disservices, specifically criminal activity, and densely vegetated UGSs negatively affect proximate property value (Ikageng Extension 7), whereas small property sizes, UGSs with limited vegetation cover where people could utilise the space according to their needs (Ikageng Extension 4) and Functional UGSs that are maintained and aesthetically pleasing (Ikageng Area 2) adds to the value of properties located in close proximity to UGSs. In addition, properties with large backyards that are maintained and

in good condition (Category B areas) tend to replace the need for publically accessible UGSs as their own backyards serve as safe and private leisure spaces. Furthermore, high-income residential estates with high-quality security, smaller backyards, maintained green spaces (child-friendly, aesthetically pleasing and within walking distance from properties) tend to increase the value of properties bordering the green spaces. Thus, the proximity principle holds true in Category A and C residential areas, however, is rejected in Category B residential areas in Potchefstroom. A clear indication of how planning contexts could influence the applicability of planning principles (the proximity principle) was reflected by these trends. These trends are expected to be reflected in the MCA results of section 7.2.5, below.

7.2.5 Step 5 to Step 7: Scoring and examination of MCA performance tables

The scoring method that will be used to determine the performance of each option against the criteria mentioned in step 3 of the MCA process is similar to that of the Fuzzy MCA method. This method uses a scale of 0 to 1 where 0 indicates no membership to the set and no performance and 1 indicates full membership of the set and excellent performance (cross-reference to section 8.3). Performance results will also indicate which options are dominant in comparison to other options, as well as which Categories are dominant in comparison to the others. To simplify the MCA examination process in Step 7, only the values 0, 0.25, 0.5, 0.75 or 1 will be assigned to the options. These values will indicate the following:

- The value **0**: No performance and membership of the set
- The value **0.25**: Limited performance and membership of the set
- The value **0.5**: Moderate performance and membership of the set
- The value **0.75**: Good performance and membership of the set
- The value **1**: Excellent performance and membership of the set

Scoring of options in Category A, B and C were completed by using the research conducted through the literature study, the results obtained from the 2020 Potchefstroom case study and Geographical Information Systems (GISs), Google Earth Pro and Esri South Africa. The Geographical Information Systems were used to investigate aerial views of each residential area in each Category (options). The aerial views indicated the UGS availability in the areas, vegetation cover on the UGSs, the socio-economic status of the areas and property sizes. These characteristics are illustrated in Figure 7-2 to 7-13, below.



Figure 7-2: Aerial views of Category A, B and C
Source: Own composition (2020)

Source: Own composition (2020)

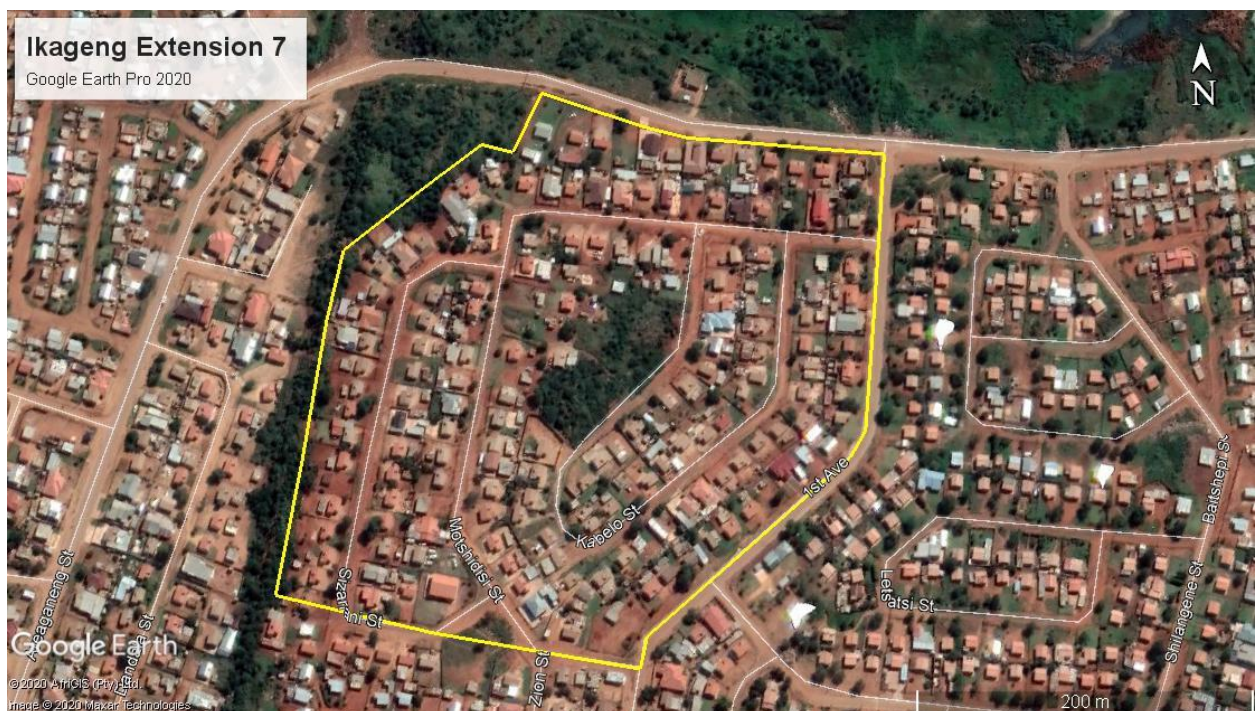


Figure 7-3: Aerial view of Ikageng Extension 7, Category
Source: Own composition (2020)

Source: Own composition (2020)



Figure 7-4: Aerial view of Mohadin, Category A
Source: Own composition (2020)



Figure 7-5: Aerial view of Ikageng Extension 4, Category A
Source: Own composition (2020)



Figure 7-6: Aerial view of Ikageng Area 2, Category A
Source: Own composition (2020)

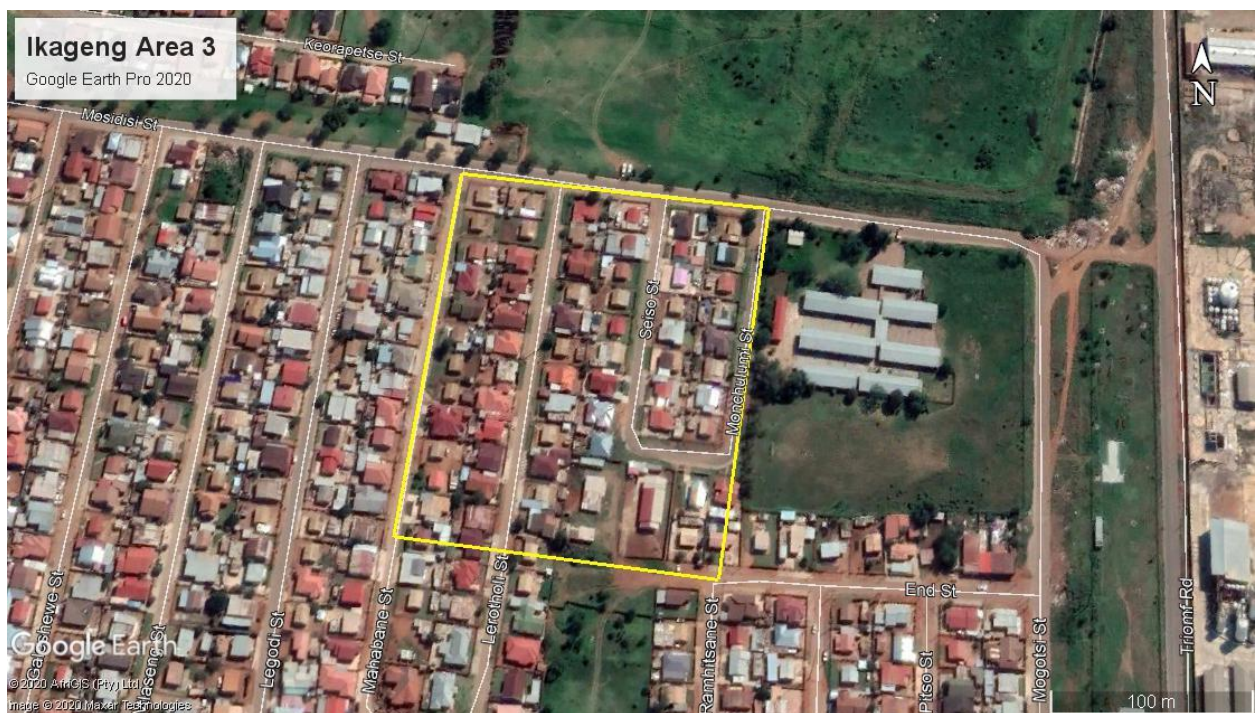


Figure 7-7: Aerial view of Ikageng Area 3, Category A
Source: Own composition (2020)



Figure 7-8: Aerial view of Grimbeek Park, Category B
Source: Own composition (2020)



Figure 7-9: Aerial view of Van der Hoff Park, Category B
Source: Own composition (2020)



Figure 7-10: Aerial view of Potchefstroom Dam Area, Category B
Source: Own composition (2020)



Figure 7-11: Aerial view of Heilige Akker, Category B
Source: Own composition (2020)



Figure 7-12: Aerial view of Oewersig, Category B
Source: Own composition (2020)



Figure 7-13: Aerial view of Tuscany Ridge Estate, Category C
Source: Own composition (2020)

Tables 7-1 to 7-3 presents the performance tables that were composed for Category A, Category B and Category C respectively. Each performance table consists of the options (residential areas), the criteria, the scores for of each option against the criteria and the overall scores for each option to examine the MCA results and make conclusions following each performance table.

Table 7-1: Multi-criteria analysis Performance table of Category A

Category A: Performance table						
Ecosystem service/green space benefits		Ikageng Extension 7	Mohadin	Ikageng Extension 4	Ikageng Area 2	Ikageng Area 3
Environmental benefits (Regulating, Provisioning and Supporting ecosystem services)	Climate and air quality regulation (tree cover)	0.25	0	0	0	0
	Natural resources (food, water, medicine)	0.25	0	0	0	0
	High biodiversity and protection of natural systems	0.25	0	0	0	0
Social benefits (Cultural ecosystem services)	Aesthetic value	0.25	0	0	0.25	0
	Social cohesion	0	0	0	0.75	0
	Health (exercise) and recreation	0	0	0	0.75	0
	Quiet environment	1	1	1	0.5	1
	Attraction for living	0	0	0.75	0.25	0
	Enhance identity of the area	0	0	0	0	0
Economic benefits	Cost saving (storm water management)	0	0	0	0	0
	Marketability	0	0	0	0	0
	Tourism	0	0	0	0	0
	Water regulation and retention	1	1	1	1	1
	Willingness-to-pay	0	1	1	1	0
Management of green spaces						
Service provision	Clean-up and infrastructure maintenance	0	0	0	0.5	0
Community needs dependent on SES						
Environmental	Parks and child-friendly spaces	1	0.5	1	1	1
Social	Open space for recreation, health benefits and social gathering	1	1	1	0.5	1
Economic	Cost saving in terms of storm water management in the residential area	0.25	0	0.75	0.25	0.25
Overall value		5.25	4.5	6.5	6.75	4.25

Source: Own composition (2020)

A direct analysis of the performance tables to examine the Fuzzy MCA scoring results were completed. It is important to bear in mind that the scoring results were examined while also considering the socio-economic and physical characteristic data of each Category as the socio-economic status levels and property sizes play a substantial role in the results. Category A included low-income residential areas (socio-economic status level 1 to 3) and the properties are barely maintained and extremely small. Ikageng Extension 7 rejected the proximity principle in the 2020 Potchefstroom case study discussed in Chapter 6, however, the overall score indicated some dominance in comparison to the other options in Category A. This results were expected as Ikageng Extension 7 links to the UGS surrounding Poortjies Dam and has dense vegetation and tree cover that resulted in a limited performance score (0.25) in the 'environmental benefits' category of the criteria in comparison to a no performance score of the other options. The densely vegetated UGS in Ikageng Extension 7 could be associated with occasional criminal activity, negatively influencing the WTP for properties bordering the UGS. Irrespective of the fact that the small property sizes increase the need for accessible public UGS, the properties bordering the UGS did not present higher value.

The other options also presented overall scores as expected with Ikageng Extension 4 and Ikageng Area 2 presenting the highest overall scores in comparison to the other options, supporting the results obtained from the 2020 Potchefstroom case study that indicated that the proximity principle was confirmed in these two areas, as well as Mohadin. The small property sizes and the good/excellent performance score (0.75 or 1) in the community needs category of the criteria, including the need for publically accessible UGS for recreational activities, health benefits and vacant land utilised by the community depending on their needs, increased the WTP for properties bordering the UGS in Ikageng Extension 4. Though Ikageng Area 2 had a no performance score in the 'environmental benefits' category of the criteria, an overall moderate score (0.5) was presented in the 'social benefits' category of the criteria, as well as the 'management' and 'community needs' category. These trends along with small property sizes motivated the need for publically accessible UGS and led to an increase in the willing-to-pay for properties located close to the UGS in Ikageng Area 2. In contrast, Ikageng Area 3 is located across from a small UGS that borders a busy road and that has little potential to be utilised by the community depending on their needs. Though the property sizes are also small, the scoring presented by the performance table (the lowest overall score) explains the results obtained from the 2020 Potchefstroom case study indicating that the proximity principle is rejected in Ikageng Area 3. From the overall scores in Table 7-1, Ikageng Extension 4 and Ikageng Area 2 are dominant in comparison to the other options in Category A, supporting the results obtained from the 2020 Potchefstroom case study that the proximity principle was confirmed in these areas.

Table 7-2: Multi-criteria analysis Performance Table of Category B

Category B: Performance table						
Ecosystem service/green space benefits		Grimbeek Park	Van der Hoff Park	Potch Dam Area	Heilige Akker	Oewersig
Environmental benefits (Regulating, Provisioning and Supporting ecosystem services)	Climate and air quality regulation (tree cover)	0.75	0	0.75	0	0.75
	Natural resources (food, water, medicine)	0	0	0.5	0	0.5
	High biodiversity and protection of natural systems	0.75	0.75	0.75	0.75	0.75
Social benefits (Cultural ecosystem services)	Aesthetic value	0.5	0	0.75	0.5	0.75
	Social cohesion	0.5	0	0.25	0.75	0
	Health (exercise) and recreation	0.75	0.5	0.25	0.75	0
	Quiet environment	0.75	1	0.5	0.25	1
	Attraction for living	0.25	0	0	0.25	0
	Enhance identity of the area	0	0	0	0	0
Economic benefits	Cost saving (storm water management)	0	0.75	1	0	1
	Marketability	0.5	0	0	0.5	0
	Tourism	0.5	0	0	0.5	0
	Water regulation and retention	1	1	1	1	1
	Willingness-to-pay	0	0	0	0	0
Management of green spaces						
Service provision	Clean-up and infrastructure maintenance	0.75	0	0.5	0.75	0
Community needs dependent on SES						
Environmental	Parks and child-friendly spaces	0	0	0	0	0
Social	Open space for recreation, health benefits and social gathering	0	0	0	0	0
Economic	Cost saving in terms of storm water management in residential area	0	0	0	0	0
Overall value		7	4	6.25	6	5.75

Source: Own composition (2020)

The overall scores presented in Table 7-2 clearly indicated that Grimbeek Park, Potchefstroom Dam Area, Heilige Akker and Oewersig are dominant over Van der Hoff Park which presented an overall lower score. Grimbeek Park presented the highest overall score as this UGS presented high scores in the 'environmental benefits', 'social benefits', 'economic benefits' and 'management of green spaces' categories of the criteria. This UGS is used for bird watching and horseback riding. Grimbeek Park presented a good performance score in the 'environmental benefits' category of the criteria as the golf course has good cover and biodiversity. This UGS also presented a moderate to good performance score in the 'social benefits' category as the golf course accommodates active uses that promote social gathering, recreational activities, health benefits and is aesthetically pleasing due to good maintenance.

The vegetation and tree cover of the UGS bordering Van der Hoff Park are limited, however, this area is a wetland with high biodiversity and species richness (Cilliers *et al.*, 1998:213) including reptiles, frogs and birds which resulted in a no performance score of the 'environmental benefits category' except for the 'high biodiversity and protection of natural systems' criterion. As the UGS in Van der Hoff Park borders to the Mooiriver in Potchefstroom which connects all the UGSs in Category B, serving as a green corridor that increases species distribution and species richness, the 'high biodiversity and protection of natural systems' criterion presented a good performance score. Similarly, Van der Hoff Park presented no performance score in the 'social benefits' category, except for the 'quiet environment' and 'health (exercise) and recreation' criteria that presented good to excellent performance scores. Though Heilige Akker also accommodates active uses similar to Grimbeek Park, this UGS presented a weaker performance in the 'environmental benefits' category of the criteria due to no/limited vegetation and tree cover, however, as this UGS also links to the Mooiriver, high biodiversity also exist. Oewersig presented similar results to Potchefstroom Dam Area in the 'environmental benefits' category of the criteria due to dense vegetation and tree cover, as well as good biodiversity, however, presented substantially lower performance scores in the 'social benefits' category as this UGSs does not accommodate active uses. The trends captured in Table 7-2 indicated an overall high performance in the 'environmental benefits', 'social benefits', as well as 'management' category. However, the WTP criterion in Category B presented no performance, as confirmed in the 2020 Potchefstroom case study. These results were expected as large and properly maintained properties in Category B eliminates the need for publically accessible UGS (cross-reference to section 4.3).

Table 7-3: Multi-criteria analysis Performance table of Category C

Category C: Performance table		
Ecosystem service/green space benefits		Tuscany Ridge Estate
Environmental benefits (Regulating, Provisioning and Supporting ecosystem services)	Climate and air quality regulation (tree cover)	0.5
	Natural resources (food, water, medicine)	0.5
	High biodiversity and protection of natural systems	0.75
Social benefits (Cultural ecosystem services)	Aesthetic value	1
	Social cohesion	0.25
	Health (exercise) and recreation	1
	Quiet environment	0.5
	Attraction for living	1
	Enhance identity of the area	0.25
Economic benefits	Cost saving (storm water management)	1
	Marketability	0.5
	Tourism	0
	Water regulation and retention	1
	Willingness-to-pay	1
Management of green spaces		
Service provision	Clean-up and infrastructure maintenance	1
Community needs		
Environmental	Parks and child-friendly spaces	0.5
Social	Open space for recreation, health benefits and social gathering	0.5
Economic	Cost saving in terms of storm water management	0
Overall value		11.25

Source: Own composition (2020)

The results presented by the performance table of Tuscany Ridge Estate were as expected with a high overall value. Moderate tree and vegetation cover together with high biodiversity resulted in a moderate to good performance in the 'environmental benefits category'. Tuscany Ridge Estate also presented good performances in the 'social benefits' criteria as this residential estate encourages social cohesion and recreational activities due to safe and child-friendly living environments. Excellent storm water management in the Estate, WTP, water regulation and retention, as well as moderate marketability of such high-income, child-friendly estates led to a good/excellent performance in the 'economic benefits' category of the criteria. The community needs category was completed based on the research conducted in the literature study of Chapter 3 and 4 (cross-reference to section 4.3 and 5.3); and the results obtained in Chapter 6. This results indicated that generally only large properties and large backyards tend to replace the need to have access to public UGS as the large backyards serve as private leisure space. As seen in Figure 7-13 in comparison to Figure 7-8 to Figure 7-12, the property sizes in well-maintained middle-income residential areas in Potchefstroom are substantially larger than the properties in Tuscany Ridge Estate which are smaller and have smaller backyard space resulting in a moderate need for accessible UGS which is aesthetically pleasing, safe and maintained in the case of Tuscany Ridge Estate.

7.3 Conclusions of the multi-criteria analysis (MCA)

The trends captured in Table 7-2 indicated a substantially higher performance in the 'environmental benefits', 'social benefits', as well as 'management' category in some cases in comparison to the results captured in Table 7-1 of Category A. However, the WTP in Category A presented excellent performance in contrast to the no performance score in Category B. These results were expected as large and properly maintained properties in Category B eliminates the need for publically accessible UGS which is a great need for communities in poor residential areas (Category A). Thus, socio-economic status levels play an extremely important role in the applicability of the proximity principle in Potchefstroom (cross-reference to section 4.3). Furthermore, Table 7-3 of Category C presented much higher overall scores than Category A and category B which was expected as high-income residential estates are characterised by maintained and aesthetically pleasing green spaces that are also safe and child-friendly providing quality environmental, social and economic benefits to residents. The main conclusion to be made from investigating the trends shown in the MCA is that the applicability of planning principles, especially principles involving environmental value similar to the proximity principle differ between different planning contexts. The applicability of these planning principles is highly dependent on community needs and maintenance levels in the South African planning context.

The needs of a community will determine the WTP for the benefits provided by UGSs and the potential to utilise the spaces according to the community's needs as in the case of Ikageng Extension 4 where community members started to utilise the UGS for residential purposes. Similarly, community members in low-income areas will appoint a higher value to vacant land in comparison to the community members in middle or high-income areas as they can utilise the space for community gardens to provide in their families' basic needs. In middle-income areas, the residents generally do not have a need for UGS, thus, their WTP more to be close to UGS are much lower. Residents in middle-income areas will also not be willing to pay more to be close to UGS that are poorly maintained and unsafe when they have access to private leisure space on their properties.

CHAPTER 8: CHARACTERISTICS OF UGSs AND SOCIO-ECONOMIC STATUS GROUPS: INFLUENCES ON PROPERTY VALUE AND UGS PLANNING

8.1 Introduction

Supporting quantitative data was collected using two structured questionnaires and four electronic interviews using one questionnaire (refer to Annexure A). The structured questionnaires were to gather information on the local knowledge of Potchefstroom residents of UGS benefits in social, environmental and economic terms and the opinions of Professional Planners regarding UGS planning in the local context. The questionnaires formed part of a mini-dissertation study conducted in 2019 to refine the study conducted by Cilliers & Cilliers (2015). To further refine the 2015 and 2019 studies, four electronic interviews were performed. The urban green spaces referred to in this Chapter are publically accessible urban green spaces. Only the most important data findings that support the literature in Chapter 4 and the data findings in Chapter 6 will be discussed in this chapter referring to the concept of WTP and Professional opinions regarding UGS planning in South Africa.

The 2020 Potchefstroom case study used the municipal property values provided in the municipal valuation roll of June 2019 of the JB Marks Local Municipality to test the proximity principle across the socio-economic gradient in Potchefstroom. As the property values in the municipal valuation roll were used in the Potchefstroom case study of 2020, more information regarding the compilation of a valuation roll is required. Electronic interviews were conducted, rather than face-to-face interviews due to strict social distancing regulations implemented in South Africa to limit the spread of COVID-19 at the time research was conducted. This limited the collection of data substantially as communication with Professional Valuers was limited. The purpose of these interviews was to gather information on (a) the process of compiling a municipal valuation roll and (b) the criteria considered when determining the municipal valuation of a property. A specific focus was placed on urban green space (UGS) in this regard. The information provided is important as it shows how property values are determined, what the law requires regarding municipal property valuation and who is responsible for or contributes to the compilation of a municipal valuation roll. The Chapter commences with the results obtained from the Potchefstroom resident survey and Professional Planner survey respectively, thereafter discussing the results obtained from the Municipal Valuation survey, as seen in Figure 8-1.

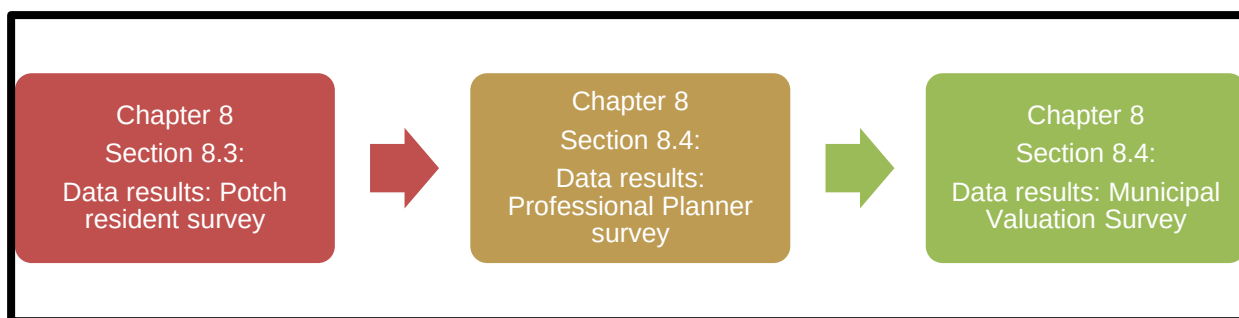


Figure 8-1: Structure and contents of Chapter 7
Source: Own composition (2020)

8.2 Data results: Potchefstroom resident survey

The results obtained from the Potchefstroom resident survey are presented in Figure 8-2, below. A total of 74 residents completed the survey, mostly residing in middle-income residential areas, thus, Category B, as explained in section 2.3.2. The survey was drafted as a structured questionnaire that included 5 questions, each with 5 potential answer options. The answer options included “Fully agree” (dark blue in Figure 8-2), “Agree” (red), “Not sure” (green), “Disagree” (purple) and “Fully disagree” (light blue). Bear in mind that when the terms social, environmental and economic values are used in the Potchefstroom resident survey, it refers to the social, environmental and economic benefits that green spaces provide.

Question 1 (Urban green spaces have environmental value) and Question 2 (Urban green spaces have social value), respectively, indicated that 92% of the respondents that completed the survey agreed that green spaces have environmental and social value respectively. Only two respondents disagreed that green spaces have environmental and social value. Question 3 indicated that 80% of the respondents agreed that green spaces have economic value. The results obtained from the survey indicated that the respondents recognise the social, environmental and economic value of green spaces, however, fewer respondents recognise the economic value of green spaces. Question 4 focused on the respondents’ perceptions of green spaces in Potchefstroom, referring to safety matters. A total of 52% of the respondents agreed that green spaces in Potchefstroom are perceived as crime hotspots, thus, unsafe neighbourhood environments (illustrated in dark blue and red in Question 4 of Figure 8-2). The last-mentioned referred to the ecosystem disservices of green spaces (cross-reference to section 2.5). In addition, 42% were unsure and 7% of the respondents disagreed with this statement. A total of 60% of the respondents agreed that they would pay more for a property that is located next to a green space in Question 5 (illustrated in dark blue and red in Question 5 of Figure 8-2), however, many respondents were unsure or disagreed. Interestingly, some respondents who perceived

green spaces as crime hotspots in Question 4, still agreed that they would be willing to pay more for a property that is located next to green space.

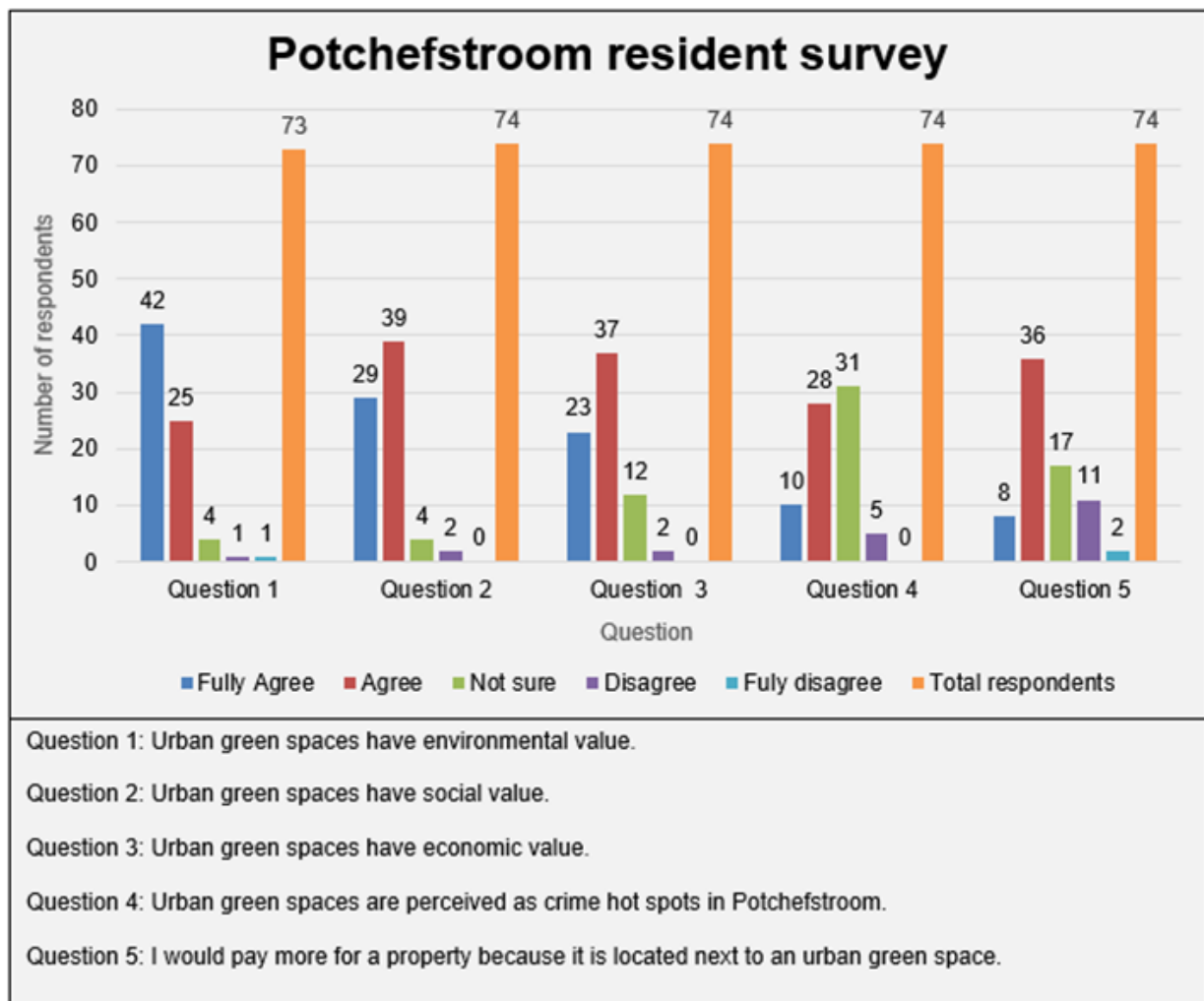


Figure 8-2: Potchefstroom resident survey results
Source: Own composition (2019)

To further analyse the data, a cross-tabulation was completed. The following questions from the Potchefstroom resident survey were cross-tabulated: Question 4 (Urban green spaces are perceived as crime hot spots) with Question 5 (I would pay more for a property because it is located next to an urban green space). Question 4 and Question 5 were chosen to be cross-tabulated as the Potchefstroom resident survey delivered interesting results and a statistical investigation was required to statistically prove the observation made in the Potchefstroom resident survey. The observation was made that residents are willing to pay more for a property that is located next to an urban green space, even though they perceive urban green spaces as crime hot spots (areas where ecosystem disservices are present). Therefore, Question 4 and Question 5 were cross-tabulated. The statistical investigation was performed using the Cramer's V test. As seen in Table 8-1, the cross-tabulation indicated 74 valid cases and a medium practical

significant difference as the Cramer's V test value was $V=0,287$ ($V \approx 0,3$) (Ellis & Steyn, 2003:52). The p-value ($p=0,106$) was only included for the sake of completeness and therefore, not interpreted. The findings of the cross-tabulation supported the observation that although residents perceive green spaces as crime hotspots (ecosystem disservices), the residents are still willing to pay more for a property that is located next to urban green space.

Table 8-1: Cross-tabulation results

Cross-tabulation	Questions cross-tabulated	Number of valid cases	Cramer's V test value	Cramer's V test approximate significance
Green spaces perceived as crime hotspots and pay more for property next to green space	Question 4 and Question 5	74	0,287	0,106

Source: Own composition (2019)

8.3 Data results: Professional Planner Survey

The results obtained from the Professional Planner survey are presented in Figure 8-3, below. A total of 26 planners completed the survey where 17 were Professional Planners, 8 were Candidate Planners and 1 was not registered as a planner. The results of Question 1 and Question 2 indicated that 88% of the planners agreed that unattractive green spaces are caused by a lack of maintenance by local authorities and a lack of community engagement. Question 3 delivered interesting results as 50% of the planners that completed the survey agreed that environmental considerations are not prioritised in the planning process (illustrated in blue and red in Question 3 of Figure 8-3), however, the other 50% were either unsure or disagreed that environmental considerations are not prioritised in the planning process (illustrated in green in Question 3 of Figure 8-3). Question 4 of the survey focused on local budgeting for green space planning and indicated that only 62% of the planners agreed that green spaces are not prioritised in local budgeting. A total of 38% of the planners were either unsure or disagreed that green spaces are not prioritised in local budgeting. The majority of the planners were familiar with green space typologies (92%).

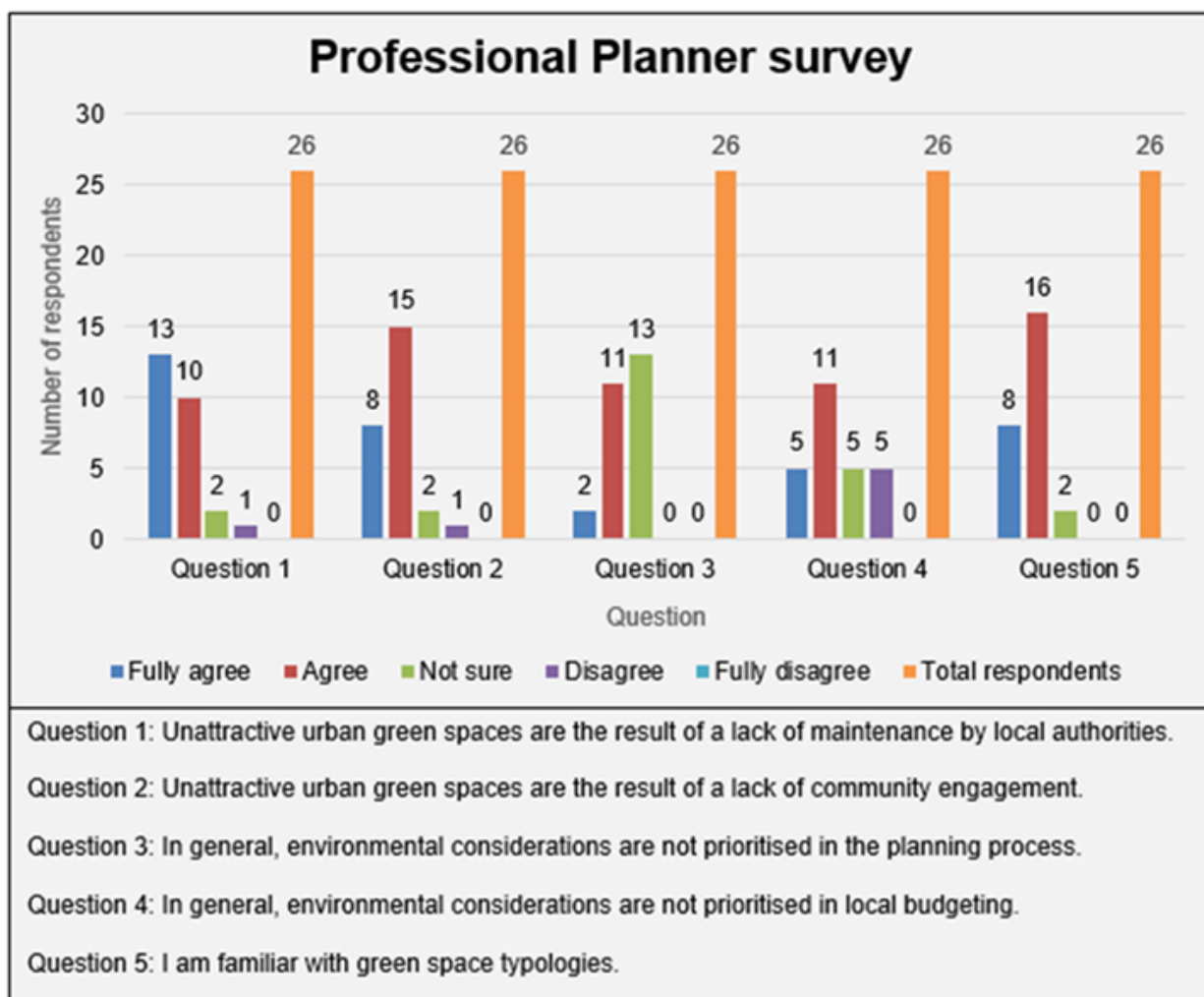


Figure 8-3: Professional Planner survey results
Source: Own composition (2019)

8.4 Data results: Municipal Valuation Survey

As previously mentioned, the questionnaire was sent to a sample of Professional Valuers, either working in the public or private sector. Four responses were captured in the e-questionnaire. The following demographic information of the respondents was gathered from *Question 1 until Question 5*:

Respondent 1 and respondent 2 work at a local municipality in the Eastern Cape and Northern Cape respectively, respondent 3 at a district municipality in the Northern Cape and respondent 4 worked at a metropolitan municipality in the Western Cape. Three of the four respondents work/worked in the property valuation or taxation sector, validating that these three respondents have knowledge of property valuation. Respondent 1 has worked as a senior revenue clerk for more than 5 years with multiple coursework completed through the municipality. This respondent had little knowledge of property valuation and could not answer the questions relating to the

process of compiling a municipal valuation roll. Respondent 2 has worked as a property taxation manager for more than 5 years and completed a National Diploma in Real Estate (valuations). Respondent 3 works as a Professional Valuer and has been for more than 5 years with a National Diploma in Real Estate, property valuation specifically. Respondent 5 has also worked for more than 5 years in his/her current position with a National Diploma in Real Estate (Property Valuation). This respondent works as a Senior Professional Officer.

All four respondents specified in *Question 6* that the person responsible for the compilation of a municipal valuation roll is a Valuer, either a municipal Valuer or a private Valuer assigned by the municipality to compile the valuation roll. The following responses of *Question 8*, investigating the process of compiling a municipal valuation roll, are quoted below:

Respondent 3:

“Tender, Obtain Deeds List, Obtain Maps, Obtain Aerial photography, Ward Meetings, Inspections, Calculations, Preliminary roll to council, Objections process, final roll to council, Appeal process, Supplementary rolls”

Respondent 4:

“Residential: Verify data, samples in submarkets, Non-linear regression (CAMA), valuation rolls, objections, implementation”

In *Question 9 until Question 11*, respondent 1, respondent 2 and respondent 3 indicated that all municipalities follow the same process to compile a valuation roll and that the municipalities are required to amend the valuation roll every 4 years. However, respondent 4 indicated that all municipalities do not follow the same process and that municipalities are required to amend the valuation roll every 2 years. *Question 12* indicated that only 2 respondents were familiar with the proximity principle before reading about the principle in the e-questionnaire, respondent 2 answered “To a limited extent” and respondent 3 answered “yes”. *Question 13* focussed on the criteria that are considered when the value of a property is determined. Table 8-2 captures, per respondent, the criteria that each respondent identified. As respondent 1 could not complete this question, only a summary of the answers provided by respondent 2, respondent 3 and respondent 4 are captured in Table 8-2.

Table 8-2: Responses captured in Question 13

Criteria	Respondent 2	Respondent 3	Respondent 4
1. Proximity to functional urban green space (e.g. recreational facilities, equestrian open spaces, child-friendly spaces)	X	X	
2. Ecosystem disservices related to urban green space (e.g. criminal activity and lack of maintenance)	X	X	X
3. Access to services and amenities (e.g. water, electricity, sanitation, waste management, public transport)	X	X	X
4. Accessibility to the property (e.g. condition of road infrastructure and safety of the area)	X	X	
5. The socio-economic status of the area (e.g. low-income, middle-income, high-income)	X	X	X
6. Surrounding land-uses (e.g. schools, shops, businesses, community facilities)	X		
7. Physical condition of the property	X	X	X
8. Property size	X	X	X
9. Inflation	X		
10. "Willingness to pay" more for properties located close to urban green space	X		
11. "View" (only applicable to respondent 4)			X

Source: Own composition (2020)

Respondent 3 added to this response in Question 13 stating: “Most of our towns are fairly small, so green space does not play such a large role. Most of the above factors are normally incorporated in the selling prices of that area, in other words willing buyers have already taken these factors into consideration, or at least most of them.”

In *Question 14*, the respondent was asked to select the five most important criteria that he/she identified in Question 13 and rank the criteria from most to least important. Table 8-3 captures the results obtained from Question 14.

Table 8-3: Responses captured in Question 14

Respondent	Level of importance	Top 5 criteria selected in Question 5 ranked from most to least important
Respondent 2	Most important	5. Socio-economic status of the area 3. Access to services and amenities 4. Accessibility to the property 8. Property size
	Least important	7. Physical condition of the property
Respondent 3	Most important	5. Socio-economic status of the area 7. Physical condition of the property 8. Property size 3. Access to services and amenities
	Least important	2. Ecosystem disservices
Respondent 4	Most important	5. Socio-economic status of the area 7. Physical condition of the property 8. Property size 11. “View”
	Least important	3. Access to services and amenities

Source: Own composition (2020)

Though none of the respondents selected criteria 1, proximity to functional urban green space, as one of the five most important criterion to consider, respondent 1, respondent 2 and respondent 3 agreed in *Question 15* that proximity to urban green space should have a bigger impact on property values. In *Question 16* the respondents were asked to elaborate on the answer provided in Question 15. Respondent 3 elaborated by explaining: “In most instances, willing buyers will pay more for properties that are closer to urban green space, if they are functional and operational”. Respondent 4 also elaborated stating: “Flats and homes with smaller gardens have a high utility of green space which are fenced/monitored to reduce crime”. *Question 17* asked whether a lack of maintenance of urban green spaces and frequent criminal activity (ecosystem disservices) result in lower property values in the respondent’s municipal area. Respondent 1 was not sure, respondent 2 and respondent 3 answered “yes” and respondent 4 answered “no”. None of the respondents elaborated on their answers in *Question 18*.

8.5 Conclusions on Chapter 8

The results obtained from the Potchefstroom resident survey indicated that the respondents of Potchefstroom that completed the survey recognised the social, environmental and economic benefits of green spaces. However, fewer respondents recognised the economic benefits of green spaces. The respondents agreed that green spaces in Potchefstroom are perceived as crime hotspots (ecosystem disservices). Some respondents agreed that they would be willing to pay more for a property that is located next to green space, irrespective of the ecosystem disservices. A cross-tabulation supported the observation that although respondents perceive green spaces as crime hotspots, the respondents are still willing to pay more for a property that is located next to green space.

The results regarding WTP support the findings in literature and the Potchefstroom case study of 2020. These findings indicated that residents residing on small properties with limited backyard space tend to show trends of increased WTP as the residents have a need for publically accessible urban green space. In the case of the Potchefstroom resident survey, the survey was sent to mainly students where most of these students reside in small apartments or hostels with limited or no private garden or backyard space increasing their WTP for a property that is located adjacent to urban green space and the benefits UGSs provide.

The Professional Planner survey indicated that the majority of the planners agreed that unattractive green spaces are due to a lack of maintenance by local authorities, a lack of community engagement and that green spaces are not prioritised in local budgeting. This results validate the data findings obtained in Chapter 6, that publically accessible urban green spaces are poorly managed resulting in a negative impact of urban green space on proximate property

value. Interesting results were obtained as 50% of the planners that completed the survey agreed that environmental considerations are not prioritised in the planning process, however, the other 50% were either unsure or disagreed with this statement. This survey showed that some Planners are still unaware of the environmental issues relating to poor planning and management of urban green spaces.

With the Municipal Valuation survey, all of the respondents work in the property valuation and taxation sector with more than 5 years' experience in their current position indicating that their responses are accurate and trustworthy. The participants indicated clearly that all municipalities are required to amend their valuation roll every 4 years except for one respondent who indicated that municipalities should amend their valuation roll every 2 years, however, this is still in line with the Municipal Property Rates Act (Act 6 of 2004). The criteria that were selected to be most important to consider when determining the value of a property were: socio-economic status (SES) of the area, access to services and amenities, the physical condition of the property and property size. Socio-economic status levels and property size were proven to be important factors influencing WTP and property value in the literature study (cross-reference to section 3.3 and 4.3), the 2020 Potchefstroom case study (cross-reference to Chapter 6), the Potchefstroom resident survey (cross-reference to section 7.3) and the MCA (cross-reference to Chapter 8). Other criteria selected to be important to consider were a view onto urban green space, ecosystem disservices and accessibility. A view of urban green space and ecosystem disservices have also been proven to be factors that influence proximate property value through WTP, especially in the South African planning context. The response from respondent 4 in Question 16: "Flats and homes with smaller gardens have a high utility of green space which are fence/monitored to reduce crime" are also consistent with literature and the results obtained from the 2020 Potchefstroom case study, the Potchefstroom resident survey and the MCA in Chapter 8. The consistency in the results validates that the results obtained throughout are accurate despite the fact that only four Valuers responded.

CHAPTER 9: CONCLUSIONS

The following conclusions were drawn based on the main findings and results obtained throughout the literature study and empirical investigation completed, in keeping with the research objectives listed in Chapter 1.

9.1 Lack of UGS quality and decrease in UGS quantity

Most of the estimated population growth over the next four decades will occur in African countries (Lategan & Cilliers, 2016:2; du Toit *et al.*, 2018:250). Environmental degradation is already a major issue in both developing and developed countries. Considering the estimated growth rates for African developing countries, urban development will pose a greater threat to urban green spaces (UGSs) in the near future. Urban green space quantity will continue to decrease within city limits as business, industrial and residential development will need to increase to satisfy the growing population's needs (Cilliers, 2012:347). The ecosystems that sustain urban life are mostly located outside city borders with some of these ecosystems far removed from the city itself (Bolund & Hunhammar, 1999:294; Rees, 2003:73).

In South Africa, the continuous growth of informal settlements also contributes to a decrease in UGS quantity in and around cities. Informal settlements often occupy open spaces between residential areas, open spaces on the periphery of cities and in rural areas, posing a threat to the existence of ecosystems (Cilliers, 2013:1). A low percentage of 10% of development areas within the Republic of South Africa are allocated to UGS (Combrinck *et al.*, 2020:2). The earth cannot sustain the continuous production of goods, this indicates that the carrying capacity of land within and around our cities is experiencing a substantial amount of strain (Finmilayo *et al.*, 2011:58). This results in damaged ecosystems and diminishing urban biodiversity (Finmilayo *et al.*, 2011:57). Thus, not only the quantity of UGSs are in jeopardy, but also the quality of these valuable spaces and the sustainability of urban life (Gupta *et al.*, 2012:325; Panduro & Veie, 2013:119). When considering the unique planning context in South Africa with regards to ecosystem disservices, urban green space planning, management and maintenance, as well as the socio-political landscape that informs the physical structure of South African cities, these factors greatly influence the quality of South African UGS's (Collinson *et al.*, 2007:78; Odindi & Mhangara, 2012:653; du Toit *et al.*, 2018:252). Unfortunately, in South Africa, these factors negatively influence the quality of UGS's in South African cities. In addition, many local authorities fail to recognise environmental issues in their local municipal areas as most of them are unaware of the magnitude of the issue and the impact green space loss has on urbanities.

9.2 Ecosystem services provide benefits for urban quality of life

Ecosystem functions delivered by UGSs provide crucial services and benefits to urbanities having a positive impact on human well-being (Bolund & Hunhammar, 1999:294; Cilliers *et al.*, 2013:682). These services and benefits are categorised into direct and indirect benefits where direct benefits include the economic benefits measured using different approaches and methods (Simpeh & Smallwood, 2018:1831). The indirect benefits include the social and environmental benefits that ecosystem provide, also known as the provisioning, regulating, supporting and cultural ecosystem services (Cilliers *et al.*, 2013:682; Gómez-Baggethun *et al.*, 2013:179; Simpeh & Smallwood, 2018:1831). The provisioning, regulating and supporting services could be seen as environmental benefits, whereas the cultural benefits could be seen as social benefits (Simpeh & Smallwood, 2018:1831).

Urban green spaces provide various economic benefits (direct benefits). This includes ecosystem services that may replace expensive conventional and technical environmental management systems (Silvennoinen *et al.*, 2017:18). The latter include microclimate regulation, storm water management, pollution reduction, water regulation and retention and health benefits (Elmqvist *et al.*, 2015:102). In addition, UGSs have an impact on property value as studies have shown that properties located in close proximity to an UGS have a higher property value reflecting on the willingness-to-pay (WTP) more for properties located close to urban green space (Cilliers, 2010:40). Urban green spaces have a positive impact on tourism, the marketability and competitiveness of a city (Cilliers & Cilliers, 2015:3).

The social benefits of urban green spaces (cultural ecosystem services) include the improvement in mental and physical health, an increase in the aesthetic value of urban areas with high densities, to encourage social cohesion and to strengthen historical and cultural heritage (Simpeh & Smallwood, 2018:1831). In addition, lively urban centers with aesthetic value, social activities and strong cultural value improve the sense of place and sense of community in cities and may also reduce criminal activity (Cilliers & Timmermans, 2013:147). Urban green spaces provide various environmental benefits to cities referring to food and water supply, resource protection (provisioning services), noise reduction, temperature regulation, runoff mitigation, erosion control, wastewater treatment (regulating services) and the provision of habitats to support and provide refuge for species (Gómez-Baggethun *et al.*, 2013:184; Simpeh & Smallwood, 2018:1831). Ecosystem services are crucial for urban quality of life, especially to develop resilient and sustainable communities (du Toit *et al.*, 2018:249).

9.3 Poor ecosystem service management in the South African context

As discussed in Section 9.2, ecosystem services namely regulating, provisioning, supporting and cultural services, provide important benefits to urbanities, including social, environmental and crucial economic benefits (Cilliers *et al.*, 2013:682; Gómez-Baggethun *et al.*, 2013:179). Not only could mismanagement of ES cause damaging environmental impacts, but also pose a threat to human well-being (Shackleton *et al.*, 2016:2). Failing to recognise the importance of proper ecosystem service management could result in uninformed decisions by local authorities, causing more harm than before to both people and the environment (Shackleton *et al.*, 2016:2). Municipalities are not only uninformed, but planning and management of urban tree cover and green spaces are inadequate in South Africa due to a lack of capacity especially in smaller and poorer municipalities (Chishaleshale *et al.*, 2015:817).

It is precisely in those small and poor municipalities where tree cover and UGSs are unavoidably important as the residents tend to rely on ES for their basic needs. However, environmental management is neglected in municipalities, failing to address poverty and inequality. In addition, studies investigating ecosystem services are in their minority in developing countries in comparison to developed countries neglecting research that could help develop environmental management approaches specifically applicable to unique planning context similar to the South African planning context (du Toit *et al.*, 2018:250). The fact that local authorities and private investors do not recognise the extremely important economic benefits that UGSs provide only ensures that UGSs remain lower priorities than other development-related activities with explicit monetary value (Schaffler & Swilling, 2013:2). All of these mismanagement and unawareness issues cause detrimental environmental impacts.

Currently, urban green space loss in cities is already a major concern and one negative result pertaining to the loss of urban biodiversity is the increase in ecosystem disservices (EDS) that decreases UGS quality. Ecosystem disservices (EDS) result in additional and unnecessary expenses including infrastructure damages that could have been avoided in the first place (Escobedo *et al.*, 2011:2081). Moreover, these expenses could not just have been avoided, but through efficient ecosystem management local authorities could receive monetary benefits. Another issue refers to how ecosystem services are planned and managed. A one-sided focus on ecosystems services are currently the most common approach followed which does not account for ecosystem service trade-offs, site-specific conditions and socio-economic context, failing to address ecosystem services as complex systems (Shackleton *et al.*, 2016:2). It should be acknowledged that while implementing measures to increase a certain ecosystem service may lead to related ecosystem disservices (trade-offs). Thus, in some cases it would be more

beneficial to address ecosystem disservices than promoting ecosystem services as it would have a positive influence on human well-being and also be more cost-effective.

9.4 Use context-appropriate methods to economically value UGSs

As discussed in the literature study (cross-reference to section 3.2) many approaches and methods exist to economically value UGSs including stated preference and revealed preference approaches, avoided cost (AC), replacement cost (RC), factor income (FI), travel cost (TC), hedonic pricing (HP) and contingent valuation (CV) (Farber *et al.*, 2002:389). However, the most challenging task would be to use the most applicable combination of techniques as some would have shortcomings in proving the monetary value of UGSs whereas others would prove that UGSs contribute to the city economy (Farber *et al.*, 2002:389; Cilliers *et al.*, 2013:684). Thus, when selecting an appropriate method, the scale of the UGSs and the context wherein they exist should be considered to create a combination of techniques that could strengthen the case for UGSs in cost-benefit analysis and generated income (Hein *et al.*, 2006:225; Cilliers, 2010:51; de Groot *et al.*, 2012:51).

The generated income should be allocated to expenditure regarding environmental conservation, planning and maintenance of UGSs, planning for sustainable communities and overall management of UGSs (Cilliers, 2010:51; de Groot *et al.*, 2012:51). In South Africa it is extremely important to consider context and scale when valuating ecosystem services. The unique socio-political landscape formed during the apartheid era left behind cities characterised by urban sprawl, informal settlements and highly fragmented areas, having an astronomical impact on urban biodiversity and ecosystem services provision (Cilliers *et al.*, 2013:686). The methods used to economically value UGSs in the South African context should consider these aspects along with the institutional scale. Most studies use either stated preference or revealed preference approaches to value UGSs (Trojanek *et al.*, 2018:359). However, after careful consideration, the methods most applicable to the planning context in South Africa are the stated preference approaches, avoided cost (AC), replacement cost (RC) and hedonic pricing (HP).

Various studies conducted throughout South Africa in Cape Town, Durban, the Eastern Cape and Potchefstroom have employed these methods to economically value UGSs, urban biodiversity and ecosystem services which delivered successful results. Hedonic pricing (HP) and a stated preference approach were used in the Potchefstroom Case Study in 2015 and 2020 to test the proximity principle in residential areas bordering an UGS. Hedonic pricing is an appropriate method as Potchefstroom is highly fragmented into areas of different socio-economic status groups. This method quantifies all the different factors that influence residential property value, including proximity to UGS in different socio-economic contexts. In addition to the hedonic pricing

model, a stated preference approach was also used to determine the willingness-to-pay (WTP) of residents (for properties that are located close to UGS). Gathering the opinions of residents is important in the South African planning context as it ensures that the needs and interests of residents are also considered.

9.5 Municipal property valuation and taxation shortcomings in South Africa

Accurate property valuation is extremely important in any municipal area as this determines the property tax that home owners are obligated to pay. Property tax serves as income utilised by the local municipality for service delivery, emergency services, infrastructure development, the maintenance and management of public facilities and UGSs (Epsey & Owusu-Edusei, 2001:491; Ramakhula, 2010:36; Nyabwengi *et al.*, 2020:1731). Property valuation in South Africa has been neglected. This is reflected in incomplete municipal valuation rolls, inaccurate property values due to a lack of physical inspections, a lack of tax registers and valuation monitoring (Almy, 2014:23; Nyabwengi *et al.*, 2020:1731).

Furthermore, local municipalities do not manage their finances, leading to poor financial stability (Channing & van der Walt, 2019:525). Not only do local municipalities lose revenue due to inaccurate and unreliable property valuation, but due to financial mismanagement as well. In addition, the Municipal Property Rates Act (Act 6 of 2004) does not make physical inspections mandatory, but optional. This encourages Valuers to use mass valuation techniques to value properties. The issue with mass valuation in South Africa is that local authorities have a lack of technological advancements to accurately perform mass property valuation. Many residential properties in rural areas and low-income residential areas are not registered and are therefore not included in the valuation process (Almy, 2014:23).

There do exist other electronic valuation techniques similar to automated valuation models (AVM), however, this also raises cause for concern as the slow adoption and implementation of automated valuation models (AVM) will further contribute to inaccurate property valuations (Boshoff & de Kock, 2013:20). Furthermore, the fact that the Municipal Property Rates Act (Act 6 of 2004) does not require Valuers to do physical inspections also adds to inaccurate property valuation (Boshoff & de Kock, 2013:20). It is important to bear in mind that the number of properties that need to be included in the process is astronomical, thus, an efficient solution for this issue should be a priority in every local municipality.

9.6 South Africa presents a unique planning context

The estimated population growth rates for African countries over the next few decades have already been discussed in section 9.1, emphasising how continuous urban development and

urban sprawl will threaten the availability and quality of UGSs (Lategan & Cilliers, 2016:2; du Toit *et al.*, 2018:250). This, however, is not the only nor the most influential factor of the unique and challenging planning context in South African towns and cities. In addition to the concerning future growth rates, especially in low-income areas, are the limited institutional and political capacity currently experienced in local authorities (Shackleton *et al.*, 2016:2). Furthermore, South African cities are unequally divided into socio-economic status (SES) groups and also highly fragmented and segregated as a result of the apartheid era (Christopher, 1990:427). This in return has led to the development of sprawling informal settlements offering shelter to mostly African communities. These areas are characterised by poverty, poor/low-quality housing structures and a lack of water and electricity provision (Jansen van Rensburg, 2006:136). Though some still blame South Africa's inequality issues on the apartheid legacy and South Africa's weak economy, the real perpetrating acts in South Africa is the current planning, management and institutional capacity that in some cases incites social exclusion (Collinson *et al.*, 2007:78; Kessides, 2006:xxii).

Spatial planning in South Africa has the potential to address poverty and inequality by following a correct approach to spatial planning and by including socio-economic factors in decision-making (Cilliers, 2009:182). However, South Africa follows a pro-development approach with the ultimate goal to generate monetary income in most cases, not with the ultimate goal to benefit the environment (Cilliers, 2009:182). South Africa's ability to implement policies and legislation that would encourage positive change, addressing inequality, poverty and environmental management issues are also cause for concern (Cilliers *et al.*, 2013:696). Without being properly informed about environmental issues, without strong institutional capacities and the correct approach to spatial planning South Africa will continue to fail to address inequality. With the high rates of inequality in South Africa, sprawling informal settlements and neglected UGSs, the planning context in South Africa will remain complex calling upon unique, thought-through and cost-effective planning approaches that prioritise communities and the environment.

9.7 Contrasting UGS characteristics across the socio-economic gradient in Potchefstroom

Similar to other towns and cities in South Africa, Potchefstroom is highly fragmented in areas of different socio-economic status (SES) (Cilliers *et al.*, 2013:686). The same perpetrating factor, the apartheid legacy, shaped and formed the physical structure of Potchefstroom that led to the development of Ikageng and Mohadin, the low-income residential areas West of Potchefstroom (Jansen van Rensburg, 2006:133). According to Lubbe *et al.* (2011:36), Potchefstroom could be categorised in five SES levels. Ikageng and Mohadin fall within level 1 to level 3 which is predominantly low-income residential areas and were included as Category A in the 2020 Potchefstroom case study. The low-income residential areas include informal settlements in

Ikageng, as well as more formal and maintained residential areas similar to Mohadin. The residential areas closer to the North-West University, Potchefstroom Dam, Mooirivier Mall and surrounding areas like Grimbeek Park, Van der Hoff Park, Heilige Akker, Oewersig and Potchefstroom Dam fall within level 4 and level 5 which includes middle to high-income residential areas and were included in the 2020 Potchefstroom case study as Category B and Category C.

The socio-economic status (SES) level of an area has a significant impact on urban green space (UGS) availability and quality as a community's income and needs determine how the community utilises UGSs and are able to manage the UGSs (Wilkerson *et al.*, 2018:107). In low-income residential areas, the residents have a need for UGSs either to be utilised as a play area for the children, a sports ground or a community or private garden (vegetables or citrus) (Lubbe *et al.*, 2011:73). Despite the high need for UGSs in low-income areas, the availability of UGSs remains extremely low due to high density dwellings, informal structures and a lack of service delivery in new projects (McConnachie & Shackleton, 2010:244; Lategan & Cilliers, 2014:430; Lategan & Cilliers, 2016:5).

In higher-income residential areas, UGS availability is substantially higher with denser tree cover, maintained private green spaces (private gardens), maintained sports grounds and equestrian open spaces with high biodiversity and species richness (Lubbe *et al.*, 2011:73). However, publically accessible UGSs are still under-maintained. Planning and management of UGSs differ between areas of different socio-economic status (SES) as residents in low-income areas are mostly not able to invest in the quality of UGSs, whereas in higher-income areas residents are more able to invest in the quality of their private leisure space (private gardens). When investigating Figure 9-1, this difference is conspicuous, especially when observing solely the contrast in the density of tree cover between low-income and middle to high-income residential areas.



Figure 9-1: Aerial point of view between areas of different socio-economic status in Boubosrand, Johannesburg
Source: Own composition (2020)

9.8 Socio-economic status and the applicability of the proximity principle

In section 9.7, the UGS characteristics between different socio-economic status levels in Potchefstroom were discussed. These characteristics are also applicable to other towns and cities in South Africa. Urban green space characteristics influence how and to what extent these spaces have an impact on proximate property values as these characteristics determine residents' perception of the spaces (Lategan & Cilliers, 2014:431). This refers to the proximity principle, suggesting that properties closer to UGS will have higher property value, reflecting the concept of willingness-to-pay (WTP) for properties close to UGS (Daams *et al.*, 2016:389). Residents prefer to avoid densely vegetated public UGSs, especially in low-income residential areas as the residents perceive such spaces as crime-hotspots (Lategan & Cilliers, 2014:431). This negatively affects the residents' WTP for properties close to public UGS. On the contrary, urban green spaces like sports facilities attract residents and increase their WTP. This was confirmed in the Potchefstroom case study of 2020 as the proximity principle was rejected in Ikageng Extension 7 that surrounds a densely vegetated UGS, however, was confirmed in Ikageng Area 2 that is located across from a communal sports ground.

Furthermore, in low-income residential areas small property sizes increase the residents' need for accessible UGS to be utilised according to their needs as revealed by the findings of this research study. Thus, the community's needs also determine how the community perceive the UGS and in return also influence their WTP and the applicability of the proximity principle. In middle-income residential areas, though the quality of public UGS remains low, residents have large properties and maintained backyards that serve as private leisure space replacing their need to access public urban green space, thus, their WTP to be close to public UGS are lower than in low-income residential areas (Trojanek *et al.*, 2018:367; Crompton, 2005:216). This statement was also confirmed in the 2020 Potchefstroom Case Study as Category B (middle-income residential areas) rejected the proximity principle.

In high-income residential estates, property sizes are smaller than in middle-income residential areas, thereby limiting residents' space for leisure, exercise and play areas for children. This increases their need to access green space. Furthermore, the green spaces in high-income residential estates are maintained, safe, within walking-distance and aesthetically pleasing, increasing consumers' WTP for a property close to an urban green space. This was also confirmed in the 2020 Potchefstroom case study as the proximity principle was confirmed in Tuscan Ridge Estate (Trojanek *et al.*, 2018:367; Crompton, 2005:216, Crompton, 2001:28). From these conclusions it is evident that SES levels, which influence UGS and property characteristics, influence how the UGSs have an impact on proximate property values.

9.9 Contrast between the 2015 and 2020 Potchefstroom case studies: context appropriate planning

The 2015 Potchefstroom Case Study aimed to economically value UGSs by employing a hedonic price analysis method (Cilliers & Cilliers, 2015). The 2015 Case Study focused solely on middle-income residential areas to test the proximity principle in Potchefstroom. The middle-income residential areas included Grimbeek Park, Van der Hoff Park, Potchefstroom Dam Area, Heilige Akker and Oewersig. None of these five middle-income residential areas confirmed the proximity principle as zone 1 in all five of the areas either presented the second lowest or the lowest value in Rand per square meter. The findings delivered by the 2015 Case Study contrasted with the findings captured in international literature which confirmed the proximity principle. However, these studies focused predominantly on developed countries including, among others, the studies by Nicholls & Crompton (2005), Crompton (2005), Mayor *et al.* (2009), Biao *et al.* (2012), Daams *et al.* (2016) and Trojanek *et al.* (2018). The contrasting results indicated that the applicability of planning principles similar to the proximity principle is different from one planning context to another, motivating the need to conduct the same study in other planning contexts. Therefore, the 2020 case study expanded the study area used in the 2015 case study by Cilliers & Cilliers and the refinement by Combrinck *et al.* conducted in 2019 which delivered the same results. The same methods to economically value UGSs in low-income and high-income residential areas was employed.

The middle-income residential areas were included again to further refine the data findings obtained in 2015 and 2019 (Category B). The low-income residential areas included four residential areas in Ikageng and one in Mohadin (Category A). The high-income residential area included Tuscany Ridge Estate (Category C). The same results were obtained for Category B as in the 2015 and 2019 case studies, however, interesting results were recorded as the proximity principle was confirmed in both low-income (Category A) and the high-income residential estate (Category C). The results delivered by the 2020 case study aligned with findings captured in international literature. The socio-economic status (SES) levels had a substantial impact on the results, as suggested in literature and confirmed in the 2020 case study.

9.10 Residents' perceptions and Planners' opinions of green spaces

The Potchefstroom resident survey focused on the social, environmental and economic value of UGSs (referred to as ecosystem services and UGS benefits in this research). The results obtained from the Potchefstroom resident survey indicated that the majority of the respondents recognise the economic value of UGSs, however not as much as the environmental and social value of UGSs (92% of the respondents that completed the survey recognised the environmental and

social value, whereas 80% recognised the economic value). This indicated that the majority of respondents have knowledge regarding the economic value of UGSs in the local context. The majority of the respondents are willing to pay more for a property that is located next to an UGS, indicating that the respondents perceive UGSs and their benefits as valuable (willingness-to-pay), regardless of the ecosystem disservices of UGSs (cross-reference to section 3.5). These findings determined that respondents are willing to pay more for UGS benefits, thus, indicating that UGSs have economic value.

The Professional Planner survey gathered information on Professional Planners' opinions regarding UGS planning. The survey included aspects of maintenance, community engagement, local budgeting and green space typologies. The majority of the planners agreed that a lack of maintenance, community engagement and efficient local budgeting exist in UGS planning. The survey delivered interesting results as 50% of the planners that completed the survey were either unsure or disagreed that environmental considerations are not prioritised in the planning process. Environmental management is a crucial component of urban planning, thus, this finding delivered evidence that planning practice lacks efficient and supportive environmental management regulations, policies and legislation. This finding also indicated that awareness should be increased regarding the importance of environmental considerations in planning practice.

9.11 The municipal property valuation criteria in South Africa

The data gathered through the Municipal Valuation questionnaire aligned with the findings in literature regarding municipal property valuation in South Africa (cross-reference to section 4.5) and the findings regarding the impact of the socio-economic status (SES) levels on proximate property value (cross-reference to section 4.3). The data gathered aligned with the conclusions made from the 2020 Potchefstroom case study (cross-reference to Chapter 6). From the responses captured it is evident that SES levels, physical property characteristics and access to services and amenities are among the most important criteria that are considered when the value of a property is determined.

Another important criterion selected by participants was a view onto UGS, most likely UGSs that are maintained and have aesthetic value. As the data gathered aligns with the findings in international literature and the Potchefstroom case study of 2020 that proposes that the latter criteria have an impact on proximate property value, shows that consistent results were conducted throughout this research. In addition, one of the most important aims of this research was to emphasise the importance of considering context in planning, thus, as property valuation considers context it also validates that the correct approach to property valuation is followed in South Africa. In section 9.5, the shortcomings in terms of property valuation in South Africa were

discussed, highlighting how institutional capacity plays a role in the accuracy of property valuation. It is important to bear in mind that the conclusions made in section 9.5 focus on the shortcomings resulting from mass valuation and technological deficiency which will be addressed in section 10.4.

9.12 Conclusions of Chapter 9

Urban green space quality and quantity in the South African context are threatened by development pressure, urbanisation, population growth, the growth of informal settlements and poor environmental management (Cilliers, 2013:347; Cilliers, 2013:1; Collinson *et al.*, 2007:78). Ecosystem services and benefits are equally important to prioritise in planning as this services and benefits greatly influence the quality of life of urbanities and human well-being (Bolund & Hunhammar, 1999:294; Cilliers *et al.*, 2013:682). The economic benefits (increased property value through WTP, marketability, property taxation, storm water management) of UGSs are crucial to be investigated and proven as this would strengthen the case for UGSs in cost-benefit analysis, decision-making processes and policy formulation (Cilliers, 2010:40). However, failing to successfully manage these services may have detrimental environmental impacts as this could increase the relating ecosystem disservices which further causes damage to ecosystems and UGSs (Shackleton *et al.*, 2016:2).

To manage ecosystem services successfully includes to frequently value these services. The most appropriate valuation methods should be applied that considers the context-specific conditions wherein the ecosystems exist, especially in countries with a unique socio-political landscape similar to South Africa (Hein *et al.*, 2006:225; Cilliers, 2010:51; de Groot *et al.*, 2012:51). Managing ecosystem services successfully and frequently valuing these services could enhance environmental quality which in return could increase the value of properties adjacent to UGSs (economic benefit). Ensuring that this economic benefit truly contributes to the financial capacity of local municipalities, the municipality should prioritise accurate property valuation as this would increase property taxation useful to municipalities for service delivery, infrastructure provision and environmental management (Epsey & Owusu-Edusei, 2001:491).

In South Africa, the accuracy of property valuation and the completeness of property registers have been neglected, lowering the amount of property taxation that could be generated (Almy, 2014:23; Nyabwengi *et al.*, 2020:1731). Not only accurate property valuation is a challenge, but also the unique planning-related challenges similar to fragmentation, inequality, social segregation, informal settlements, environmental quality and institutional capacity (Christopher, 1990:427; Collinson *et al.*, 2007:78; Shackleton *et al.*, 2016:2). These characteristics are prominent in Potchefstroom, the local case study area of this research, with SES level 1 to 3 (low-

income areas) located in the Western parts of Potchefstroom and SES level 4 and 5 (middle to high-income areas) located near the North-West University, Mooirivier Mall and Potchefstroom Dam.

Low-income areas present trends that confirm the proximity principle due to communities' need to access public UGSs and their WTP, whereas in middle-income areas residents' needs to access public UGS are not as high due to large backyards and dense tree cover, rejecting the proximity principle. In high-income areas similar to residential estates, UGSs are maintained, private, safe and child-friendly with smaller properties in comparison to properties in middle-income neighbourhoods. Thus, increasing WTP, encouraging social activities and the need or desirability to access the UGSs and approving the proximity principle (Trojanek *et al.*, 2018:367; Crompton, 2005:216). It is important that communities recognise UGS benefits, and that Planners encourage the environment in planning practice as some Planners do not recognise environmental mismanagement in South Africa. Furthermore, the issues pertaining to local-budgeting, under-maintained UGSs and poor community involvement should also be addressed as these issues lead to poor UGS quality.

CHAPTER 10: UGS PLANNING RECOMMENDATIONS: BROADER SPATIAL PLANNING APPROACH

The findings of this research informed the planning recommendations of this chapter to address environmental mismanagement and underestimated economic benefits of UGSs. The recommendations aim to enhance the quality of UGSs and increase the quantity of UGSs in cities. The recommendations also aim to raise awareness of ecosystem service benefits in social, environmental and economic terms, improve ecosystem service management, introduce planning approaches that consider context and aim to improve the accuracy of property valuation in South Africa. The following recommendations may build a compelling argument to convince local municipalities, private investors and the community to invest in UGSs. This may influence the decision-making processes regarding policy formulation to promote environmental protection, UGS planning and environmental management within cities, ultimately developing a guide towards sustainable planning in South Africa.

10.1 Enhance quality and quantity of urban green spaces

It is crucial to consider measures and approaches that will increase the quality of UGSs, as well as promote the management of these spaces to increase the economic benefits the spaces could provide. According to Haaland & van den Bosch (2015:761), this is exceedingly challenging in multiple ways. Certain challenges may occur in green-planning projects referring to high levels of densification that limit the extent of potential green-planning as urban development pressures threaten to occupy green and open spaces (Haaland & van den Bosch, 2015:763). Furthermore, using the compact-city approach comes with the same challenges as densification and in-fill development threaten the availability of both public and private UGSs (Haaland & van den Bosch, 2015:764).

It is precautionary to incorporate the insights of the residents and focus on the quality of UGSs rather than solely the quantity thereof (Zhang *et al.*, 2015:10). Including residents in the planning, management and maintenance processes of UGSs is an effective approach to promote communicative and collaborative planning increasing the quality of UGSs in return (Fors *et al.*, 2015:2). The UGSs identified may have cultural values, biodiversity value or recreational purposes. It is crucial to bear that in mind and promote existing values, rather than replacing them with alternative values (Haaland & van den Bosch, 2015:763). The mixed-use planning approach is another way to prioritise UGSs in land-use planning. Combining different complementary land-uses in urban development projects ensure effective utilisation of space in dense urban centers (Manaugh & Kreider, 2013:63). This approach could protect open spaces in cities while also

incorporating UGSs as a land-use requirement in development projects. Another approach that should be considered is incorporating green infrastructure planning that could promote the sustainability and resilience of our cities (cross-reference to section 3.2). Green infrastructure could not only promote sustainability, but increases the benefits people derive from UGSs in social, environmental and economic terms (Benedict & McMahon, 2002:12). Green infrastructure links to green-planning that also focusses on UGSs, their proximity to business nodes and residential areas, as well as the benefits these spaces deliver to citizens (Cilliers *et al.*, 2015:352). Jim (2012:243) refers to urban greening that is based on the same principles as green planning, although, urban greening proposes three important measures to bear in mind. The first is to apply urban ecological footprints that include a holistic assessment of the current ecological values and how to enrich those values by using greenways (Haaland & van den Bosch, 2015:766).

The second measure refers to the protection of “nature-in-city” assets including the preservation and conservation of high-value ecological areas (Jim, 2012:243; Haaland & van den Bosch, 2015:766). The third measure may be described as the augmentation of greening opportunities referring to the greening of compact urban areas (Jim, 2012:243). A proposal discussed by Cilliers *et al.* (2015:353) introduces the link between place-making and green-planning, namely green place-making. This proactive approach aims to create attractive, multi-functional, sustainable public/green spaces that prioritise the protection of the environment and the needs of the community (Cilliers *et al.*, 2015:354).

The approaches mentioned above aim to increase the quality of UGSs in urban areas that may also increase the economic benefits (Tekel & Akbarishahabi, 2013:348). The land-use frameworks and policies in municipal areas differ, thus, it is important to plan accordingly (Haaland & van den Bosch, 2015:763). As Planners should adhere to the requirements laid out in municipal land-use frameworks, an important and fundamental change would be to improve and amend standard-based UGS planning introducing new standards in terms of green space provision per resident (Wilkerson *et al.*, 2018:116). As South Africa is highly fragmented with a large number of the population living in informal settlements, such standard-based UGS planning should aim to increase UGS provision in these areas where limited to no green spaces exist. Dempsey & Burton (2012:11) refer to the term “place-keeping” where public spaces are maintained, managed and improved. Within the context of South African cities, public UGSs are under-maintained, unattractive and crime-hotspots that, according to Dempsey & Burton (2012:11), is due to a misconception of the concept of place-keeping.

The maintenance and management of these spaces do not only focus on the physical environment but relies on partnerships as well (Dempsey & Burton, 2012:11). Partners and community organisations should be involved in place-keeping as it ensures that local knowledge

and opinions are considered in the place-keeping planning procedures (Dempsey & Burton, 2012:11). Governance is also crucial in the process as governing bodies, governmental or non-governmental, participate in decision-making processes regarding UGSs (Dempsey & Burton, 2012:11). Public participation creates a sense of ownership in the community and encourages the residents to participate in place-making and place-keeping processes referring to the planning and maintenance of the spaces (Dempsey & Burton, 2012:11). Another aspect of place-keeping includes financial resources and investment as a lack of adequate financial support lead to unsuccessful place-keeping (Dempsey & Burton, 2012:11).

10.2 Improve ecosystem service management in planning

After considering the literature study regarding ecosystem services in section 3.4, the conclusion was made in section 9.3 that poor ecosystem management could have detrimental impacts on the environment rather than protecting, conserving and increasing environmental quality (Shackleton *et al.*, 2016:2). Not only does poor environmental quality influence ecosystem service provision, but the effect this has on human well-being is concerning. Urbanities rely on the social benefits ecosystems provide and for developing countries the contribution that ecosystems provide to the city economy should not be ignored.

The Economics for Ecosystems and Biodiversity (TEEB), a manual for cities, provides a detailed six-step approach regarding how developing countries, like South Africa, could account for ecosystem services in urban management, thus, decision-making and policy formulation (TEEB, 2011; Cilliers *et al.*, 2013:684). This approach includes to decide on a current management issue in collaboration with various stakeholders in Step 1, to select a relevant ecosystem service that could solve the identified issue in Step 2, to gather information and select an assessment method in Step 3, assess the ecosystem service/s chosen accounting for future changes in Step 4, compare management and policy options to select the most efficient option in step 5 and, lastly, assess the impact of the management and policy option on various stakeholders in Step 6 (TEEB, 2011).

The six-step approach discussed above is an appropriate approach to follow in South Africa especially with regards to the unique socio-political landscape of South African cities (cross-reference to section 5.2). This approach prioritised all stakeholders in the process, identifying management issues regarding ecosystem services in collaboration with municipal administration teams, policy-makers, environmental specialists and the public, as well as the impact the final decision will have on these stakeholders.

One of the main goals of ecosystem service management is to limit the ecosystem disservices generated ecosystem mismanagement similar to a one-sided focus on ecosystem planning (Shackleton *et al.*, 2016:2). Managing ecosystem services correctly would require to change user perceptions on ecosystem benefits. Greater realisation of how extremely important these benefits are to the social dimension, environmental quality and the city economy across various socio-economic landscapes could help to manage these services correctly. Thus, addressing a disservice similar to crime associated with densely vegetated UGSs in lower-income areas (e.g. informal settlements) would vary greatly from addressing the same disservice in other residential areas in other socio-economic groups (Wilkerson *et al.*, 2018:120). It is important to bear in mind that as South Africa presents a unique planning context, it is crucial to shift towards collaborative and community-based planning rather than attempting to implement approaches and strategies developed in first world countries.

Similarly, the same ecosystem functions that truly provide benefits to residents and the environment at a local level could likely not provide the same number of benefits at a provincial level, thus, managing ecosystem services should include an in-depth assessment of ecosystem service provision on multiple scales to ensure that the correct services are conserved and protected, as well as that the correct management approach is used for that specific services (Aronson *et al.*, 2017:191). Thus, assessing the contribution of UGSs to biodiversity and ecosystem benefits provided to urbanities the landscape configuration, population, urban matrix, land-use history and biotic interactions should be studied efficiently before attempting to develop appropriate approaches and strategies to properly manage ecosystem services (Aronson *et al.*, 2017:191).

One crucial aspect in environmental management that should be addressed is the poor planning and management for urban tree cover and UGSs due to a lack of capacity (Chishaleshale *et al.*, 2015:817). This tends to be the case in most high-risk municipal areas characterised as socio-economic status level 1 to 3 communities where communities are vulnerable. These high-risk areas should be regarded as high priority areas, thus, the lack of funding, personnel at local municipalities, unawareness and political support should be addressed in these areas. Local level capacity could be enhanced through more effective regional and national level planning allocating resources to vulnerable communities. Planning for and managing UGSs in these communities should be approached strategically.

10.3 Enhance and prioritise environmental valuation methods

Valuating the economic benefits of the environment, UGSs specifically, in South Africa calls upon valuation methods that prioritise SES levels of communities. These methods should value UGSs

from another perspective accounting for context and site-specific conditions, as well as public interest. As discussed in section 4.2, various valuation methods to economically value UGSs exist, however, the greatest challenge lies in identifying and implementing the methods most applicable to the site-specific conditions and scale of the environmental attributes being measured (Hein *et al.*, 2006:225). Ortiz (2006:40) discussed the valuation of intangibles in his work and that these assets should be valued considering time, location, supply, demand and perception, thus, the context in which the environmental assets exist (Ortiz, 2006:40). Unfortunately, the number of studies investigating the economic benefits of environmental assets from this point of view are few (Ortiz, 2006:40). This motivates the need for future research testing and investigating appropriate methods to economically value UGSs in the South African context. The research could involve employing a wide range of methods across the socio-economic gradient to compare the results obtained between methods and to determine what methods delivered the most useful results. Environmental quality promotes human well-being, thus, valuation methods should include the social component in confirming the economic benefits of UGSs (Common *et al.*, 1993:301).

One method in valuing UGSs economically is by measuring the willingness-to-pay (WTP) for environmental attributes (cross-reference to section 4.2). This method focuses on residents' interests individually, however, as the aim is to enhance the quality of UGSs to benefit communities and cities as a whole to promote human well-being and urban sustainability, the method of WTP should be enhanced to consider residents' interests jointly (Common *et al.*, 1993:309). This means that new valuation methods should not necessarily be developed, but that the social component should be incorporated in the already existing methods. These methods that have been applied worldwide and in many studies have delivered meaningful results. Thus, the same methods could be enhanced to be applied to different planning contexts. In South Africa, for example, the social component in the WTP method investigating residents' WTP more to be located close to sports grounds in low-income areas will weigh more than in high-income residential estates as the social component includes community needs, culture and perceptions (Engström & Gren, 2017:7).

Using the hedonic price analysis method to determine the economic benefits of environmental attributes, including the impact of UGSs on property value, the results only indicate whether property value increases, decreases or no influence on property value (Engström & Gren, 2017:7). This limits the ability of Planners to use the data and improve the planning and design of UGSs as the results do not indicate what benefits and how many benefits are valued by residents as a motive to increase their WTP (Engström & Gren, 2017:7). However, enhancing the method by applying additional methods and techniques to account for the size of the UGS (utilised

for relaxation, aesthetic appeal or exercising), the distance to the UGS (walkability and accessibility) and unperceived benefits (provisioning, supporting and regulating ecosystem services) will deliver more accurate results. The results could be useful to the planning and design of UGSs in multiple planning contexts and in return increase the economic benefits that people could derive from the UGSs. Thus, it is not predominantly the method that is used to economically value UGSs, however, the components and external factors that are incorporated and accounted for. Furthermore, methods that are combined enables researchers to apply the methods to different planning contexts.

10.4 Improve accuracy of property valuation and taxation in South Africa

As discussed in section 4.5, accurate property valuation is extremely important as it determines the tax revenue generated to be used by local municipalities for infrastructure provision and service provision. Tax revenue may be the most important source of revenue in both developing and developed countries (Channing & van der Walt, 2019:526). Furthermore, financial sustainability is determined by accurate property data and updated property registers (Channing & van der Walt, 2019:527). To ensure that register accuracy takes place, frequent maintenance and updating should be undertaken by local municipalities. Thus, although the Municipal Property Rates Act (Act 6 of 2004) only requires local municipalities to amend the valuation roll every four years, the data should be updated more frequently. This is proposed as land uses also change frequently, especially in economic nodes and property value can increase through upgrading which will increase the property value. Land-use applications similar to re-zonings, subdivisions and consolidations change the value of properties and in many cases increase the value of these properties which should be recorded in the municipalities' property data (Channing & van der Walt, 2019:528). Broadening the tax base is another effective approach to stabilise property tax, thus, applying a low tax rate across a broader tax base in South Africa (Collier *et al.*, 2018:17).

Many properties in South Africa have not been registered, influencing the generation of property tax substantially, thus, property ownership registers should be updated more frequently (Collier *et al.*, 2018:17). By using large-scale registration and low-cost technologies similar to local para-surveyors (that help to demarcate boundaries) can be used that is cost-effective approaches to property registration (Collier *et al.*, 2018:18). Before the necessary improvements can be made to deliver more accurate property data and increase property tax, local municipalities should undertake strategic reform, re-evaluate policies and combine administrative and policy interactions to broaden the tax base (Kelly, 2016:326).

As administration and institutional capacity are both constraints in developing countries that jeopardise property valuation and property taxation, one approach to address this issue is by

designing tax reforms and using property valuation methods that are appropriate for the unique reform environment, institutional structures, administration capacities and political will (Kelly, 2016:326). Currently, South Africa relies on mass valuation techniques, however, due to a lack of capacity, administration and good management, these methods lead to inaccurate data in some cases. Thus, South Africa should consider additional techniques and methods.

One sophisticated method that has recently gained much attention and that has delivered accurate and reliable results is Artificial Neural Network (ANN) (Sa'at & Maimun, 2019:74). Artificial Neural Network (ANN) is an advanced method that links to Artificial Intelligence (AI) (Sa'at & Maimun, 2019:74). This method mimics the human brain's learning processes and has the ability to deal with complex data sets, contains outliers in the data, is user-friendly and delivers highly precise data outputs (Sa'at & Maimun, 2019:75). Advanced methods have been developed to overcome the shortcomings of traditional property valuation methods and are ideal to use in developing countries similar to South Africa. However, methods similar to Artificial Neural Network, regardless of its accuracy and success, will only be useful in South Africa when considering available information, property use, the purpose of the valuation exercise and the type of property in the valuation process. Furthermore, when considering such a method to value properties in South Africa, there should be considered to address the institutional capacity and technological limitations of local municipalities.

10.5 The importance of Context-based planning

This section provides recommendation from a personal perspective, as well as recommendations that are supported in literature. To plan in context (local context planning), a shift in planning approaches will be required. Currently, public participation in planning is extremely limited in South Africa as the Spatial Planning and Land Use Management Act (Act 16 of 2013) only requires Planners to advertise projects to the public and organise public meetings that, in most cases, are not successful in collaborating with the public or to gain public interest. Local communities should participate in planning on a high level that empowers communities, especially in South Africa where Planners are dealing with high levels of segregation, poverty and inequality. The people on the ground know their circumstances and needs the best, thus, planners should rather provide professional opinions and formalise their recommendations to enhance their quality of life.

The people on the ground should be more involved in South African planning procedures to address the issues in informal settlements effectively by engaging in in-situ upgrading, active involvement of the community and re-blocking projects. This form of Planning have been well-documented and researched internationally. Some refer to this type of planning as community-

based planning, others use the term collaborative planning or as Kabisch *et al.* (2015:32) would call it, the citizen-science approach to research and planning. Planning should also not only focus on bottom-up approaches to UGS planning, however, consider a two-way collaboration process (Nikolaïdou *et al.*, 2016:16). Local governments could provide resources, formalise policies and provide legal frameworks, empower communities and control implementation and management processes while local communities could provide insight into the designing and maintenance processes, establishing a positive cognitive perspective and a sense of belonging or ownership towards the spaces they contributed towards (Azadi *et al.*, 2011:24). This collaborative effort could ensure UGS quality and performance (Azadi *et al.*, 2011:25).

Planners, environmental experts and local municipalities should not “think globally to act locally”, but “think locally to act globally” in UGS planning and environmental management as the issues that require attention are developed locally, and by identifying an appropriate approach to solving a local issue will move towards solving a global issue in return (Kabisch *et al.*, 2015:32). In addition, environmental research, especially in developing countries like South Africa that face unique socio-economic issues, should focus on interdisciplinary research considering both ecological and social science, establishing collaboration between researchers and communities (Kabisch *et al.*, 2015:32). For local authorities to shift towards context planning, legislative transformation will be required that will support planners in active community engagement and encourage planners to consider context in planning.

10.6 A broader spatial planning approach to increase economic UGS benefits

It is crucial to determine and confirm the economic benefits of UGSs to ensure that UGS planning is prioritised in the local context, therefore, it should form part of a broader spatial planning approach. A broader spatial planning approach could enhance UGS quality and in return contribute to the economic benefits of the spaces, increasing property value and property taxation. As been discussed throughout this research, it is important to prioritise context-specific conditions in UGS planning. Using GIS network analysis, the accessibility, availability and scale of UGSs between different cultural groups and across the socio-economic gradient can be investigated, providing a detailed framework of priority areas and issues that should be addressed (Comber *et al.*, 2008:113). The information gathered through the GIS network analysis could indicate to Planners and environmental experts the type of UGS lacking and how community access could be improved in different societal communities (Comber *et al.*, 2008:113). This information should be provided to local municipalities to include in the Spatial Development Frameworks (SDFs) of their municipal area.

The Spatial Development Framework (SDF) of every local municipality should include a section that discusses UGSs in economic terms and what is aimed to be achieved in terms of environmental management and UGS planning in the future. The amendment of the Spatial Planning and Land Use Management Act (Act 16 of 2013) should be considered referring to Section 21 regarding the content of municipal spatial development frameworks. In terms of spatial planning to enhance environmental quality through increased stakeholder involvement, South Africa should consider the workbench spatial quality method. This method was developed through a program by the Dutch government in 2005 (Cilliers *et al.*, 2011:216). This method prioritises stakeholder involvement, including experts, Planners, decision-makers and municipal officials to enhance spatial quality and promote qualitative spatial development.

The workbench spatial quality method was developed around the central idea that spatial needs and quality is dependent on diverse stakeholder opinions and visions and that spatial quality differs from one location to another, as well as between communities and individual residents. Thus, community participation is a crucial contributing factor in this method, ideal to address spatial inequalities in South Africa (Cilliers *et al.*, 2011:216). The users phase consists of capturing the users' experience regarding the space establishing a common understanding between the perceptions of the stakeholders. The initiation phase is where the users and stakeholders are asked about their interests and future values that they would prefer in the design of the space, thus, the quality profiles of the stakeholders' preferences of the space. The vision phase is where all the quality profiles of the stakeholders are combined to create a vision or design for the space accounting for user preferences and functionality. The final phase is the execution phase where stakeholders finalise the plan while thinking realistically in terms of their resources, financial and economic possibilities and networks to ensure successful implementation. The process of the workbench spatial quality method flows into the users phase once again to capture the new experiences of users and stakeholders after the space has been replanned. This is a critical phase as this phase will determine whether user preferences and qualities have successfully been incorporated and whether the objectives of the project have been met (Cilliers *et al.*, 2011:217). A method similar to the workbench spatial quality method is an appropriate method to use in South Africa as this method could account for user interests across the socio-economic gradient while also enhancing the environmental quality of UGSs. Increased environmental quality will increase the economic benefits derived from the UGSs similar to increased property value and in return property taxation used by local municipalities to engage in similar spatial development projects.

10.7 Prioritise environmental considerations in planning

Professional Planners should encourage UGS planning in the local context and collaborate with local authorities to prioritise UGS planning in local budgeting. Green space typologies that include different combinations of green planning and infrastructure development may be considered in land-use applications to increase ecosystem service provision, thus, the planner should advise the client in considering green space typologies in development projects (Neuenschwander *et al.*, 2014:99). Applications involving a land-use change should include minimum UGS requirements according to the zoning, land-uses, density and coverage of the development to encourage planners to prioritise environmental considerations in planning practice. The World Health Organisation suggests a minimum of 9 square meters per individual (Russo & Cirella, 2018:4). To include the latter in planning practice, decision consequence analysis (DCA) could be used.

Decision consequence analysis is an approach used for decision-making regarding sustainable land-use and to create a pathway between an undesired current condition and a desired future condition similar to investigating urbanisation and sustainable land-use practices (Musakwa & Van Niekerk, 2013:144). To move towards the desired condition (sustainable land-use) geographical information systems (GIS) and earth observation through satellite imagery are used (Musakwa & Van Niekerk, 2013:144). Land Use Schemes (LUS) of local municipal areas should be amended to accommodate for, not only the minimum UGS requirements in land-use applications but also mixed-use zonings. Mixed-use developments may increase the quantity and enhance the quality of UGSs. Mixed-use developments include various land-uses similar to residential, business and green spaces combined in a single development to reduce environmental and economic cost, thus, promoting sustainable development (Musakwa & Van Niekerk, 2013:151).

Currently, local authorities follow an approach to development where UGSs are perceived as potential areas for development. Local planning should follow an approach to development that encourages the protection of UGSs and natural systems, rather than the development of these areas. Other approaches to consider is to emphasize the importance of the environmental component in teaching and academics, thus, teaching students how to incorporate environmental considerations in land-use planning. This subject should not only be a priority in tertiary education of Urban and Regional Planning, but also be monitored in planning practice by frequently providing training to Planners in this regard. This training could provide crucial guidelines in green infrastructure planning to consider urban biodiversity and ecosystem services. By following these approaches, interdisciplinary thinking could be encouraged and the link between planning and urban ecology could be strengthened.

10.8 A guide to sustainable planning: bringing nature back in cities

The goal of this section is to provide a user-friendly guide to sustainable planning. As seen in Table 10-1, this guide is in the form of a matrix table (refer to Annexure B) that summarises the issues identified throughout this research (planning-related challenges) which were discussed in Chapter 9, as well as potential methods or approaches to follow, either by local municipalities or in planning practice, to address these issues as discussed in Chapter 10. Some planning solutions or recommendations could be used to address other issues as well, thus, the matrix table indicates what solutions apply to what planning-related challenges.

Table 10-1: Planning recommendations matrix table

Guide to sustainable planning		Planning-related challenges							
		UGS quality	UGS quantity	Ecosystem service management	Economic UGS valuation methods	Property valuation & taxation	Context-based planning	Environmental spatial planning	Environmental considerations in planning
Planning solutions/recommendations	Collaborative planning								
	Community engagement								
	Mixed land-use planning								
	Green infrastructure								
	Urban greening								
	Green place-making								
	Place-keeping								
	TEEB manual for cities (steps to include ES in planning)								
	Raise awareness and change user perceptions								
	Consider context-specific conditions								
	Address ecosystem disservices								
	Increase institutional capacity								
	Willingness-to-pay & Hedonic price analysis								
	Improve existing valuation methods								
	Frequently update property registers and valuation rolls								
	Broaden the tax base								
	Use low-cost technologies								
	Artificial Neural Network (ANN)								
	Amend legislation and Land Use Schemes								
	Interdisciplinary research								
	GIS network analysis								
	Workbench spatial quality method								
	Minimum UGS requirements in land-use applications								
	Decision Consequence Analysis (DCA)								
	Encourage interdisciplinary thinking								
	Emphasise ecological contributions in tertiary education								
	Ecological training for planners and frequent monitoring								

Source: Own composition (2020)

This research considered urban green spaces (UGSs) from an economic spatial perspective. The main aim of this research was to determine the impact of UGSs on property value across the socio-economic gradient in Potchefstroom to confirm that UGSs deliver crucial economic benefits so urbanities. This research captured the economic benefits of UGSs in literature (cross-reference to section 3.4) and confirmed the economic benefits in the Potchefstroom case study in Chapter 7 by testing the proximity principle. The Potchefstroom case study delivered results supporting the proximity principle in low-income and high-income residential areas, however, rejected the proximity principle in middle-income residential areas. The research results indicated that the impact of UGSs on proximate property value is different from one socio-economic status group (planning context) to another.

Each socio-economic status group has different community needs, physical neighbourhood characteristics and green space availability which determines the willingness-to-pay to be close UGSs. These trends were also investigated and supported in the multi-criteria analysis (cross-reference to Chapter 7). Further research can be conducted on this subject, investigating the same trends in other planning contexts, for example, gated communities and in other cities and towns as every planning context has unique characteristics that could influence the results. This research established clearly that planning context should be considered in the planning and design of UGSs. Further research could also be conducted on how these data results can be used to plan for and design UGSs to provide in the needs of people in different planning contexts. The planning recommendations matrix table is another guideline that can be used to promote encourage sustainable planning and, ultimately, bring nature back into cities.

BIBLIOGRAPHY

- Almy, R. 2014. *Valuation and Assessment of Immovable Property*. (OECD working papers on Fiscal Federalism, 19). https://www.oecd-ilibrary.org/taxation/valuation-and-assessment-of-immovable-property_5jz5pzvr28hk-en Date of access: 17 Jul. 2020.
- Aronson, M.F., Lepczyk, C.A., Evans, K.L., Goddard, M.A., Lerman, S.B., MacIvor, J.S., Nilon, C.H. & Vargo, T. 2017. Biodiversity in the city: key challenges for urban green space management. *Frontiers in Ecology and the Environment*, 15(4):189-196.
- Azadi, H., Ho, P., Hafni, E., Zarafshani, K. & Witlox, F. 2011. Multi-stakeholder involvement and urban green space performance. *Journal of Environmental Planning and Management*, 54(6):785-811.
- Baycan-Levent, T., Vreeker, R. & Nijkamp, P. 2009. A multi-criteria evaluation of green spaces in European cities. *European Urban and Regional Studies*, 16(2):193-213.
- Benedict, M.A. & McMahon, E.T. 2002. Green infrastructure: smart conservation for the 21st century. *Renewable resources journal*, 20(3):12-17.
- Benedict, M.A. & McMahon, E.T. 2002. Green infrastructure: smart conservation for the 21st century. *Renewable resources journal*, 20(3):12-17.
- Biao, Z., Gaodi, X., Bin, X. & Canqiang, Z. 2012. The effects of public green spaces on residential property value in Beijing. *Journal of Resources and Ecology*, 3(3):243-253.
- Bolitzer, B. & Netusil, N.R. 2000. The impact of open spaces on property values in Portland, Oregon. *Journal of environmental management*, 59(3):185-193.
- Bolund, P. & Hunhammar, S. 1999. Ecosystem services in urban areas. *Ecological economics*, 29(2):293-301.
- Borri, D., Concilio, G. & Conte, E. 1998. A fuzzy approach for modelling knowledge in environmental systems evaluation. *Computers, environment and urban systems*, 22(3):299-313.
- Boshoff, D. & De Kock, L. 2013. Investigating the use of Automated Valuation Models (AVMs) in the South African commercial property market. *Acta Structilia*, 20(1):1-21.
- Breuste, J., Qureshi, S. & Li, J. 2013. Applied urban ecology for sustainable urban environment. *Urban Ecosystems*, 16(4):675-680.
- Cassell, C. & Symon, G. 2004. Electronic interviews in organizational research. (In *Essential guide to qualitative methods in organizational research*. London: Sage. p. 23-33).
- Cepeliauskaite, G. & Stasiskiene, Z. 2020. The Framework of the Principles of Sustainable Urban Ecosystems Development and Functioning. *Sustainability*, 12(2):720.
- Chan, A.P. & Abidoye, R.B. 2019. Advanced property valuation techniques and valuation accuracy: Deciphering the artificial neural network technique. *International Journal of Real Estate & Land Planning*, 2:1-9.
- Channing, J. & van der Walt, W. 2019. Using the property register to enable municipal sustainability. <https://afres.architexturez.net/system/files/afres-2010-full-non-refereed-17.pdf> Date of access: 17 Jul. 2020.

- Chishaleshale, M., Shackleton, C.M., Gambiza, J. & Gumbo, D. 2015. The prevalence of planning and management frameworks for trees and green spaces in urban areas of South Africa. *Urban Forestry & Urban Greening*, 14(4):817-825.
- Christopher, A.J. 1990. Apartheid and Urban Segregation Levels in South Africa. *Urban Studies*, 27(3):421-440.
- Cilliers, E. J. 2010. Rethinking sustainable development: The economic value of green spaces. Potchefstroom: NWU. (Dissertation - MSc).
- Cilliers, E. J. & Timmermans, W. 2015. An Integrative Approach to Value-Added Planning: From Community Needs to Local Authority Revenue. *Growth & Change*, 46(4): 675-687.
- Cilliers, E.J. 2009. Bridging the Green-Value-Gap: A South African Approach. *International Journal of Environmental, Chemical, Ecological, Geological and Geophysical Engineering*, 3(6):615-620.
- Cilliers, E.J. 2010a. Rethinking sustainable development: The economic value of green spaces. Potchefstroom: North-West University. (Dissertation – MSc).
- Cilliers, E.J., Diemont, E., Stobbelaar, D.J. & Timmermans, W. 2011. Sustainable green urban planning: the workbench spatial quality method. *Journal of Place Management and Development*, 4(2):214-224.
- Cilliers, J. 2013. Economic value of green spaces: South Africa in contrast with Europe. *Acta Academica*, 45(3):1-27.
- Cilliers, J. & Timmermans W. 2013. Approaching value added planning in the green environment. *Journal of Place Management and Development*, 6(2):144-154.
- Cilliers, S. & Cilliers, J. 2015. From green to gold: A South African example of valuing urban green spaces in some residential areas in Potchefstroom. *Town and Regional Planning*, 67:1-12.
- Cilliers, S. S., & G. J. Bredenkamp. 1998. Vegetation analysis of railway reserves in the Potchefstroom Municipal Area, North-West Province, South Africa. *South African Journal of Botany*, 64(5):271-280.
- Cilliers, S. S., & G. J. Bredenkamp. 1999. Analysis of the spontaneous vegetation of intensively managed urban open spaces in the Potchefstroom Municipal Area, North-West Province, South Africa. *South African Journal of Botany*, 65(1):59-68.
- Cilliers, S. S., & G. J. Bredenkamp. 2000. Vegetation of roadside verges on an urbanization gradient in Potchefstroom, South Africa. *Landscape and Urban Planning*, 46:217-239.
- Cilliers, S. S., G. J. Bredenkamp, & E. van Wyk. 1999. Urban nature conservation: vegetation of natural areas in the Potchefstroom municipal area, North west province, South Africa. *Koedoe* 42(1):1–30.
- Cilliers, S. S., L. L. Schoeman, & G. J. Bredenkamp. 1998. Wetland plant communities in the Potchefstroom municipal area, North West Province, South Africa. *Bothalia*, 28(2):213-229.
- Cilliers, S., Cilliers, J., Lubbe, R. & Siebert, S. 2013. Ecosystem services of urban green spaces in African countries - perspectives and challenges. *Urban Ecosystems*, 16(4):681-702.
- Cilliers, S.S. & Siebert, S.J. 2012. Urban ecology in Cape Town: South African comparisons and reflections. *Ecology and Society*, 17(3): 33-46.

- Cilliers, S.S.; Schoeman, L.L. & Bredenkamp, G.J. 1998. Wetland plant communities in the Potchefstroom municipal area, North West Province, South Africa. *Bothalia*, 28(2): 213-229.
- Collier, P., Glaeser, E., Venables, T., Blake, M. & Manwaring, P. 2018. Land and property taxes for municipal finance. <https://www.theigc.org/wp-content/uploads/2017/08/Land-and-Property-Taxes-for-Municipal-Finance-06.07.18.pdf> Date of access: 5 Oct. 2020.
- Collinson, M.A., Tollman, S.M. & Kahn, K. 2007. Migration, settlement change and health in post-apartheid South Africa: Triangulating health and demographic surveillance with national census data. *Scandinavian Journal of Public Health*, 35(69):77-84.
- Comber, A., Brunsdon, C. & Green, E. 2008. Using a GIS-based network analysis to determine urban greenspace accessibility for different ethnic and religious groups. *Landscape and Urban Planning*, 86(1):103-114.
- Combrinck, Z., Cilliers, E. J., Lategan, L. & Cilliers, S. 2020. Revisiting the Proximity Principle with Stakeholder Input: Investigating Property Values and Distance to Urban Green Space in Potchefstroom. *Land*, 9(7):1-16.
- Common, M.S., Blamey, R.K. & Norton, T.W. 1993. Sustainability and environmental valuation. *Environmental Values*, 2(4):299-334.
- Costanza, R., d'Arge, R., De Groot, R., Farber, S., Grasso, M., Hannon, B., Limburg, K., Naeem, S., O'Neill, R.V., Paruelo, J. & Raskin, R.G. 1997. The value of the world's ecosystem services and natural capital. *Nature*, 387(6630):253-260.
- Creswell, J.W. 1999. Mixed-method research: Introduction and application. (In Handbook of educational policy. Academic Press. p. 455-472).
- Crompton, J.L. 2001. The impact of parks on property values: A review of the empirical evidence. *Journal of leisure research*, 33(1):1-31.
- Crompton, J.L. 2005. The impact of parks on property values: empirical evidence from the past two decades in the United States. *Managing Leisure*, 10(4):203-218.
- Daams, M.N., Sijtsma, F.J. & van der Vlist, A.J. 2016. The effect of natural space on nearby property prices: accounting for perceived attractiveness. *Land Economics*, 92(3):389-410.
- Davenport, N.A.; Shackleton, C.M. & Gambiza, J. 2012. The direct use value of municipal commonage goods and services to urban households in the Eastern Cape, South Africa. *Land Use Policy*, 29(3):548–557.
- de Groot, R., Brander, L., Van Der Ploeg, S., Costanza, R., Bernard, F., Braat, L., Christie, M., Crossman, N., Ghermandi, A., Hein, L. & Hussain, S. 2012. Global estimates of the value of ecosystems and their services in monetary units. *Ecosystem Services*, 1(1):50-61.
- de Vos, A. S., Strydom, H., Fouché, C. B. & Delport, C. S. L. 2003. Research at Grass Roots: For the Social Sciences and Human Service Professions. 4th ed. Van Schaik Publishers.
- de Wit, M., van Zyl, H., Crookes, D., Blignaut, J., Jayiya, T., Goiset, V. & Mahumani, B. 2012. Including the economic value of well-functioning urban ecosystems in financial decisions: Evidence from a process in Cape Town. *Ecosystem Services*, 2:38-44.
- Dobbs, C., Escobedo, F.J. & Zipperer, W.C. 2011. A framework for developing urban forest ecosystem services and goods indicators. *Landscape and urban planning*, 99(3-4):196-206.

- Dodgson, J.S., Spackman, M., Pearman, A. & Phillips, L.D. 2009. Multi-criteria analysis: a manual. http://eprints.lse.ac.uk/12761/1/Multi-criteria_Analysis.pdf Date of access: 17 Jul. 2020.
- du Toit M.J., Cilliers S.S., Dallimer M., Goddard M., Guenat S. & Cornelius S.F. 2018. Urban green infrastructure and ecosystem services in sub-Saharan Africa. *Landscape and Urban Planning*, 180:249-61.
- Ellis, S. M. & Steyn, H. S. 2003. Practical significance (effect sizes) versus or in combination with statistical significance (p-values). *Management dynamics*, 12(4):51-53.
- Elmqvist, T., Setälä, H., Handel, S. N., Van der Ploeg, S., Aronson, J., Blignaut, J. N., Gómez-Baggethun, E., Nowak, D. J., Kronenberg, J. & De Groot, R. 2015. Benefits of restoring ecosystem services in urban areas. *Current Opinion in Environmental Sustainability*, 14:101-108.
- Engström, G. & Gren, A. 2017. Capturing the value of green space in urban parks in a sustainable urban planning and design context: pros and cons of hedonic pricing. *Ecology and Society*, 22(2):1-13.
- Escobedo, F.J., Kroeger, T. & Wagner, J.E. 2011. Urban forests and pollution mitigation: Analyzing ecosystem services and disservices. *Environmental pollution*, 159(8-9):2078-2087.
- Espey, M. & Owusu-Edusei, K. 2001. Neighborhood parks and residential property values in Greenville, South Carolina. *Journal of Agricultural and Applied Economics*, 33(3):487-492.
- Esri. "Streets" [basemap]. Scale Not Given. "Property Search". July, 2020. <https://csg.esri-southafrica.com/portal/apps/webappviewer/index.html?id=34ec3dcf8d8642bb9ed7f795cbfe8faf>. (July 20, 2020).
- Farber, S.C., Costanza, R. & Wilson, M.A. 2002. Economic and ecological concepts for valuing ecosystem services. *Ecological Economics*, 41(3):375-392.
- Fontana, V., Radtke, A., Fedrigotti, V.B., Tappeiner, U., Tasser, E., Zerbe, S. & Buchholz, T., 2013. Comparing land-use alternatives: Using the ecosystem services concept to define a multi-criteria decision analysis. *Ecological Economics*, 93:128-136.
- Fors, H., Molin, J.F., Murphy, M.A. & van den Bosch, C.K. 2015. User participation in urban green spaces—For the people or the parks?. *Urban Forestry & Urban Greening*, 14(3):722-734.
- Francis, R.A., Lorimer, J. & Raco, M. 2012. Urban ecosystems as 'natural' homes for biogeographical boundary crossings. *Transactions of the Institute of British Geographers*, 37(2):183-190.
- Franken, M., Bloom, J.Z. & Erasmus, P.D. 2011. Factors that affect South African real estate price growth. *Management Dynamics: Journal of the Southern African Institute for Management Scientists*, 20(2):18-32.
- Gaston, K.J., Ávila-Jiménez, M.L. & Edmondson, J.L. 2013. Managing urban ecosystems for goods and services. *Journal of Applied Ecology*, 50(4):830-840.
- Gibbons, S., Mourato, S. & Resende, G.M. 2014. The amenity value of English nature: a hedonic price approach. *Environmental and Resource Economics*, 57(2):175-196.
- Girma, Y., Terefe, H., Pauleit, S. & Kindu, M. 2019. Urban green spaces supply in rapidly urbanizing countries: The case of Sebeta Town, Ethiopia. *Remote Sensing Applications: Society and Environment*, 13:138-149.

- Gómez-Baggethun, E., Gren, Å., Barton, D.N., Langemeyer, J., McPhearson, T., O'farrell, P., Andersson, E., Hamstead, Z. & Kremer, P. 2013. Urban ecosystem services. (*In Urbanization, Biodiversity and Ecosystem Services: Challenges and Opportunities*. Dordrecht: Springer. p. 175-251).
- Gonzalez, B., Adenso-Diaz, B. & Gonzalez-Torre, P.L. 2002. A fuzzy logic approach for the impact assessment in LCA. *Resources, Conservation and Recycling*, 37(1):61-79.
- Google Earth. 2020. *Potchefstroom*, 26°42'42.69" S, 27°05'12.01" E, elevation 1350m. viewed 20 July 2020.
- Group Areas Act 41 of 1950.
- Gupta, K., Kumar, P., Pathan, S.K. & Sharma, K.P. 2012. Urban Neighborhood Green Index - A measure of green spaces in urban areas. *Landscape and Urban Planning*, 105(3):325-335.
- Haaland, C. & van Den Bosch, C.K. 2015. Challenges and strategies for urban green-space planning in cities undergoing densification: A review. *Urban forestry & urban greening*, 14(4):760-771.
- Hein, L., Van Koppen, K., De Groot, R.S. & Van Ierland, E.C. 2006. Spatial scales, stakeholders and the valuation of ecosystem services. *Ecological economics*, 57(2):209-228.
- Inflation.eu. 2019. Inflation South Africa 2013. <https://www.inflation.eu/inflation-rates/south-africa/historic-inflation/cpi-inflation-south-africa-2013.aspx> Date of access: 29 Aug. 2019.
- Ives, C. D., Gordon, A., Oke, C., Raymond, C. M., Hehir, A. & Bekessy, S. A. 2018. Spatial Scale Influences How People Value and Perceive Green Open Space. *Journal of Environmental Planning and Management*, 61:2133-2150.
- Jansen van Rensburg, F. 2006. The first 'white' town north of the Vaal: inequality and apartheid in Potchefstroom. *New Contree*, 51(10):131-147.
- Jim, C.Y. 2013. Sustainable urban greening strategies for compact cities in developing and developed economies. *Urban Ecosystems*, 16(4):741-761.
- Jonas, R. 2007. Epigeal arthropods along an urbanization gradient in Potchefstroom. Potchefstroom: North-West University. (Dissertation – MSc).
- Kabisch, N., Qureshi, S. & Haase, D. 2015. Human–environment interactions in urban green spaces—A systematic review of contemporary issues and prospects for future research. *Environmental Impact Assessment Review*, 50:25-34.
- Kelly, R. 2014. *Implementing sustainable property tax reform in developing countries*. *Taxation and Development*. Available from Elgaronline: <https://www.elgaronline.com/view/edcoll/9781783474325/9781783474325.00018.xml> Date of access: 17 Jul. 2020.
- Kessides, C. 2006. The Urban Transition in Sub-Saharan Africa: Implications for Economic Growth and Poverty Reduction. Washington, DC: Cities Alliance.
- Kiessling, T. & Harvey, M. 2005. Strategic global human resource management research in the twenty-first century: an endorsement of the mixed-method research methodology. *The International Journal of Human Resource Management*, 16(1):22-45.
- Klimas C., Williams A., Hoff M., Lawrence B., Thompson J., & Montgomery J. 2016. Valuing ecosystem services and disservices across heterogeneous green spaces. *Sustainability*, 8(9):853.

- Lategan L. & Cilliers J. 2016. Considering urban green space and informal backyard rentals in South Africa: Disproving the compensation hypothesis. *Town and Regional Planning*, 69(1):1-6.
- Lategan, L.G. & Cilliers, E.J. 2014. The value of public green spaces and the effects of South Africa's informal backyard rental sector. *WIT Transactions on Ecology and the Environment*, 191:427-438.
- Liu, K.F.R., Liang, H.H., Yeh, K. & Chen, C.W. 2009. A qualitative decision support for environmental impact assessment using fuzzy logic. *Journal of Environmental Informatics*, 13(2):93-103.
- Lubbe, C.S. 2011. Comparison of the urban domestic garden flora along a socio-economic gradient in the Tlokwe City Municipality. Potchefstroom: NWU. (Dissertation - MSc).
- Lyytimäki, J. & Sipilä, M. 2009. Hopping on one leg - The challenge of ecosystem disservices for urban green management. *Urban Forestry & Urban Greening*, 8(4):309-315.
- Manaugh, K. & Kreider, T. 2013. What is mixed use? Presenting an interaction method for measuring land use mix. *Journal of Transport and Land use*, 6(1):63-72.
- Mayor, Karen; Lyons, Seán; Duffy, David; Tol, Richard S. J. 2009. *A hedonic analysis of the value of parks and green spaces in the Dublin area*. (ESRI Working Paper, 331).
- McCluskey, W.J. & Franzsen, R.C. 2004. *The basis of the property tax: a case study analysis of New Zealand and South Africa*. (Lincoln Institute of Land Policy Working Paper, 04).
- McConnachie, M.M. & Shackleton, C.M. 2010. Public green space inequality in small towns in South Africa. *Habitat International*, 34(2):244-248.
- McCoyd, J.L. & Kerson, T.S. 2006. Conducting intensive interviews using email: A serendipitous comparative opportunity. *Qualitative Social Work*, 5(3):389-406.
- Millennium Ecosystem Assessment. 2005. *Ecosystems and human well-being*. United States of America: Island press.
- Miller, A.R. 2001. Valuing open space: Land economics and neighborhood parks. Massachusetts: Massachusetts Institute of Technology (Dissertation - PhD).
- Morón, A.B., Calvo-Flores, M.D., Ramos, J.M. & Almohano, M.P. 2009. AIEIA: Software for fuzzy environmental impact assessment. *Expert Systems with Applications*, 36(5):9135-9149.
- Muller, M. 2019. Valuation of ecosystem services at health clinic gardens in South Africa. Potchefstroom: North-West University. (Dissertation – MSc).
- Municipal Property Rates Act 6 of 2004.
- Musakwa, W. & Van Niekerk, A. 2013. Implications of land use change for the sustainability of urban areas: A case study of Stellenbosch, South Africa. *Cities*, 32:143-156.
- National Geographic. 2019. Want to visualize inequality? View cities from above. <https://www.nationalgeographic.com/culture/2019/03/visualize-inequality-by-viewing-cities-from-above/> Date of access: 20 May. 2020.
- Native Urban Areas Act 25 of 1945.
- Neuenschwander, N., Hayek, U.W. & Grêt-Regamey, A. 2014. Integrating an urban green space typology into procedural 3D visualization for collaborative planning. *Computers, Environment and Urban Systems*, 48:99-110.

- Nicholls, S. 2004. Measuring the Impact of Parks on Property Values: New research shows that green spaces increase the value of nearby housing. *Parks and Recreation*, 39(3):24-32.
- Nicholls, S. & Crompton, J.L. 2005. The impact of greenways on property values: Evidence from Austin, Texas. *Journal of Leisure Research*, 37(3):321-341.
- Nikolaidou, S., Klöti, T., Tappert, S. & Drilling, M. 2016. Urban gardening and green space governance: Towards new collaborative planning practices. *Urban Planning*, 1(1):5-19.
- Nilon, C.H., Berkowitz, A.R. & Hollweg, K.S. 2003. Introduction: ecosystem understanding is a key to understanding cities. (In *Understanding urban ecosystems*. New York: Springer. p. 1-13).
- Nobre, A., Pacheco, M., Jorge, R., Lopes, M.F.P. & Gato, L.M.C. 2009. Geo-spatial multi-criteria analysis for wave energy conversion system deployment. *Renewable energy*, 34(1):97-111.
- Nyabwengi, L. 2020. An Evaluation of the Property Valuation Process for County Government Property Taxation, Nairobi City. *Africa Habitat Review*, 14(1):1731-1743.
- Odindi, J.O. & Mhangara, P. 2012. Green spaces trends in the city of Port Elizabeth from 1990 to 2000 using remote sensing. *International Journal of Environmental research*, 6(3):653-662.
- Ortiz, M.A.A. 2006. Intellectual capital (intangible assets) valuation considering the context. *Journal of Business & Economics Research*, 4(9):35-42.
- Panduro, T.E. & Veie, K.L. 2013. Classification and valuation of urban green spaces - A hedonic house price valuation. *Landscape and Urban planning*, 120:119-128.
- Pickett, S.T., Cadenasso, M.L., Grove, J.M., Boone, C.G., Groffman, P.M., Irwin, E., Kaushal, S.S., Marshall, V., McGrath, B.P., Nilon, C.H. & Pouyat, R.V. 2011. Urban ecological systems: Scientific foundations and a decade of progress. *Journal of Environmental Management*, 92(3):331-362.
- Qu, S.Q. & Dumay, J. 2011. The qualitative research interview. *Qualitative research in accounting & management*, 8(3):238-264.
- Ramakhula, M. 2010. Implications of the Municipal Property Rates Act (No: 6 of 2004) on Municipal Valuations. Johannesburg: University of the Witwatersrand. (Dissertation – MSc).
- Rees, W.E. 2003. Understanding Urban Ecosystems: An Ecological Economics Perspective. (In *Understanding urban ecosystems*. New York: Springer. p. 115-136).
- Roberts, D.C., Boon, R., Croucamp, P. & Mander, M. 2005. Resource economics as a tool for open space planning in Durban, South Africa. The Urban Imperative, urban outreach strategies for protected areas agencies. *California Institute of Public Affairs, Sacramento*: 44-48.
- Russo, A. & Cirella, G.T. 2018. Modern compact cities: how much greenery do we need? *International journal of environmental research and public health*, 15(10):2180.
- Sa'at, N.F. & Maimun, N.H.A. 2019. Does artificial intelligence enhance house price forecasting accuracy?—a literature review. *International Journal of Real Estate Studies*, 13(1):74-78.
- Schäffler, A. & Swilling, M. 2012. Valuing green infrastructure in an urban environment under pressure - The Johannesburg case. *Ecological Economics*, 86:246-57.

- Shackleton, C.M., Ruwanza, S., Sanni, G.S., Bennett, S., De Lacy, P., Modipa, R., Mtati, N., Sachikonye, M. & Thondhlana, G. 2016. Unpacking Pandora's Box: understanding and categorising ecosystem disservices for environmental management and human wellbeing. *Ecosystems*, 19(4):587-600.
- Silvennoinen, S., Setälä, H., Taka, M., Koivusalo, H., Yli-Elkonen, V. & Ollikainen, M. 2017. Monetary value of urban green space as an ecosystem service provider: A case study of urban runoff management in Finland. *Ecosystem Services*: 28:17-27.
- Simpeh, K. & Smallwood, J. 2018. Analysis of the benefits of green building in South Africa. *Journal of Construction Project Management and Innovation*, 8(2):1829-1851.
- Spatial Planning and Land Use Management Act 2013.
- Tekel, A. & Akbarishahabi, L. 2013. Determination of Open-green Space's Effect on Around House Prices by Means of Hedonic Price Model; in Example of Ankara/Botanik Park. *Gazi University Journal of Science*, 26(2):347-361.
- Trojanek, R., Gluszak, M. & Tanas, J. 2018. The effect of urban green spaces on house prices in Warsaw. *International Journal of Strategic Property Management*, 22(5):358-371.
- Troy, A. & Grove, J.M. 2008. Property values, parks, and crime: A hedonic analysis in Baltimore, MD. *Landscape and Urban Planning*, 87(3):233-245.
- van Wilgen, B.W., Measey, J., Richardson, D.M., Wilson, J.R. & Zengeya, T.A. 2020. Biological Invasions in South Africa: An Overview. (*In Biological Invasions in South Africa*. Cham: Springer. p. 3-32).
- Vollmer, D., Pribadi, D.O., Remondi, F., Rustiadi, E. & Grêt-Regamey, A. 2016. Prioritizing ecosystem services in rapidly urbanizing river basins: A spatial multi-criteria analytic approach. *Sustainable cities and society*, 20:237-252.
- Ward, E.W. & Winter, K. 2016. Missing the link: urban stormwater quality and resident behaviour. *Water SA*, 42(4):571-576.
- Wilkerson, M.L., Mitchell, M.G., Shanahan, D., Wilson, K.A., Ives, C.D., Lovelock, C.E. & Rhodes, J.R. 2018. The role of socio-economic factors in planning and managing urban ecosystem services. *Ecosystem Services*, 31:102-110.
- Wittmer, H & Gundimeda, H. 2012). *The economics of ecosystems and biodiversity in local and regional policy and management*. Washington, DC: Earthscan from Routledge.
- Yilmaz, S. & Mumcu, S. 2016. Urban Green Areas and Design Principles. (*In Environmental Sustainability and Landscape Management*. St. Kliment Ohridski University Press. p. 100-118).
- Zhang, Y., Van den Berg, A.E., Van Dijk, T. & Weitkamp, G. 2017. Quality over quantity: Contribution of urban green space to neighborhood satisfaction. *International journal of environmental research and public health*, 14(5):535.

ANNEXURE A: SURVEYS

Potchefstroom resident survey

This survey is part of a final year research project for the degree BSc Urban and Regional Planning. The research investigates the perceptions of residents of Potchefstroom relating to social, environmental and economic objectives to inform Urban and Regional Planning recommendations. This survey is voluntary. Consent to use the information and data obtained in this survey, is granted by virtue of completion of the questionnaire.

I am a resident of Potchefstroom.

Mark only one oval.

- ☐ Yes
- ☐ No

I am:

Mark only one oval.

- ☐ Male
- ☐ Female
- ☐ Other

I am:

Mark only one oval.

- ☐ Younger than 18 years
- ☐ 18-25 years
- ☐ 26-40 years
- ☐ 41-60 years
- ☐ Older than 60 years
- ☐ Other: _____

I have been living in Potchefstroom for:

Mark only one oval.

- ☐ Less than 1 year
- ☐ 1-5 years
- ☐ More than 5 years

1. Urban green spaces have environmental value.

Mark only one oval.

- ☐ Fully agree
- ☐ Agree
- ☐ Not sure
- ☐ Disagree
- ☐ Fully disagree

2. Urban green spaces have social value.*Mark only one oval.*

- ☐ Fully agree
- ☐ Agree
- ☐ Not sure
- ☐ Disagree
- ☐ Fully disagree

3. Urban green spaces have economic value.*Mark only one oval.*

- ☐ Fully agree
- ☐ Agree
- ☐ Not sure
- ☐ Disagree
- ☐ Fully disagree

4. Urban green spaces are perceived as crime hot spots in Potchefstroom.*Mark only one oval.*

- ☐ Fully agree
- ☐ Agree
- ☐ Not sure
- ☐ Disagree
- ☐ Fully disagree

5. I would pay more for a property because it is located next to an urban green space.*Mark only one oval.*

- ☐ Fully agree
- ☐ Agree
- ☐ Not sure
- ☐ Disagree
- ☐ Fully disagree

Professional Planner survey

This survey is part of a final year research project for the degree BSc Urban and Regional Planning. The research investigates the perceptions of Professional Urban and Regional Planners in South Africa relating to social, environmental and economic objectives to inform Urban and Regional Planning recommendations. This survey is voluntary. Consent to use the information and data obtained in this survey, is granted by virtue of completion of the questionnaire.

I am a:

Mark only one oval.

- ☐ Professional Planner
- ☐ Candidate Planner
- ☐ Not registered as an Urban and Regional Planner

I have been working as a Planner for:

Mark only one oval.

- ☐ Less than 1 year
- ☐ 1-5 years
- ☐ More than 5 years
- ☐ N/A

1. Unattractive urban green spaces are the result of a lack of maintenance by local authorities.

Mark only one oval.

- ☐ Fully agree
- ☐ Agree
- ☐ Not sure
- ☐ Disagree
- ☐ Fully disagree

2. Unattractive urban green spaces are the result of a lack of community engagement.

Mark only one oval.

- ☐ Fully agree
- ☐ Agree
- ☐ Not sure
- ☐ Disagree
- ☐ Fully disagree

3. In general, environmental considerations are not prioritised in the planning process.*Mark only one oval.*

- ☐ Fully agree
- ☐ Agree
- ☐ Not sure
- ☐ Disagree
- ☐ Fully disagree

4. In general, environmental considerations are not prioritised in local budgeting.*Mark only one oval.*

- ☐ Fully agree
- ☐ Agree
- ☐ Not sure
- ☐ Disagree
- ☐ Fully disagree

5. I am familiar with green space typologies.*Mark only one oval.*

- ☐ Fully agree
- ☐ Agree
- ☐ Not sure
- ☐ Disagree
- ☐ Fully disagree

Municipal Valuation Questionnaire

This questionnaire forms part of a Masters study in Urban and Regional Planning at the North-West University, Potchefstroom. The study reflects on urban green space as an essential component that promotes urban quality of life and the fact that these spaces are under pressure due to continuous urban development. In an attempt to strengthen the case for urban greening and to reclaim nature into cities, this study considers green spaces from an economic spatial perspective. The study tests the Proximity Principle (suggesting that properties located closer to urban green space will have a higher property value in comparison with properties located further away from urban green space) through a case study in Potchefstroom, JB Marks Local Municipality, North-West Province, South Africa. The study determines the impact of urban green space on property value in low-income, middle-income and high-income residential areas using the municipal valuation roll of June 2019. Thus, the main objective of the study is to determine the impact of urban green space on property value across the socio-economic gradient, considering the South African planning context.

As property values in the municipal valuation roll are used to test the Proximity Principle in Potchefstroom, more information regarding the compilation of a valuation roll is required. The purpose of this questionnaire is to gather information on (a) the process of compiling a municipal valuation roll and (b) the criteria considered when determining the municipal valuation of a property. A specific focus is placed on urban green space in this regard.

The questionnaire consists of 18 questions, including multiple-choice and open-ended questions. Depending on the length of your answers it will require 10-15 minutes of your time. The information provided in this questionnaire will be summarised and included in the study mentioned above (note that all responses are captured anonymously). You are free to withdraw from this questionnaire at any stage. The study mentioned above received ethical clearance (Ethics number: NWU-01473-20-A9).

1. 1. Do you work at a local, district or metropolitan municipality?

Mark only one oval.

- ☐ Local Municipality
- ☐ District Municipality
- ☐ Metropolitan Municipality
- ☐ Other: _____

2. 2. Please indicate in what province you are located in South Africa.

Mark only one oval.

- ☐ Limpopo
- ☐ Mpumalanga
- ☐ Gauteng
- ☐ North-West
- ☐ Free State
- ☐ Northern Cape
- ☐ Western Cape
- ☐ Eastern Cape
- ☐ KwaZulu-Natal

3. 3. What is your job description?

4. 4. How long have you been working in your current position?

Mark only one oval.

- ☐ 1 Year
- ☐ 2 Years
- ☐ 3 Years
- ☐ 4 Years
- ☐ 5 Years +

5. 5. Please provide your Qualification/s below.

6. 6. Who is responsible for compiling the municipal valuation roll of the municipality?

7. 7. Are you, in any way, familiar to the process of compiling a municipal valuation roll?

Mark only one oval.

☐ Yes

☐ No

8. 8. If you answered "yes" in Question 7, please explain the process (steps, equations etc.). If you answered "no" in Question 7, please be so kind as to provide the contact details of a colleague/associate who would be willing to complete this questionnaire.

9. 9. Do all municipalities follow the same process?

Mark only one oval.

☐ Yes

☐ No

10. 10. After how many years should a municipality amend the valuation roll?

Mark only one oval.

☐ 2 Years

☐ 3 Years

☐ 4 Years

☐ 5 Years

☐ Other: _____

11. 11. After how many years does your municipality amend the valuation roll?

Mark only one oval.

☐ 2 Years

☐ 3 Years

☐ 4 Years

☐ 5 Years

☐ Other: _____

12. 12. The proximity principle suggests that properties located closer to green space will have a higher property value than properties located further away from green space. Were you familiar with the proximity principle prior to reading about the principle in this questionnaire?

Mark only one oval.

- ☐ Yes
- ☐ No
- ☐ To a limited extent

13. 13. Carefully read through the following criteria and tick the boxes of the criteria that are considered when determining the value of a property in the valuation roll. You may tick multiple boxes.

Check all that apply.

- ☐ 1. Proximity to functional urban green space (e.g. recreational facilities, equestrian open spaces, child-friendly spaces)
- ☐ 2. Ecosystem disservices related to urban green space (e.g. criminal activity and lack of maintenance)
- ☐ 3. Access to services and amenities (e.g. water, electricity, sanitation, waste management, public transport)
- ☐ 4. Accessibility to the property (e.g. condition of road infrastructure and safety of the area)
- ☐ 5. The socio-economic status of the area (e.g. low-income, middle-income, high-income)
- ☐ 6. Surrounding land-uses (e.g. schools, shops, businesses, community facilities)
- ☐ 7. Physical condition of the property
- ☐ 8. Property size
- ☐ 9. Inflation
- ☐ 10. "Willingness to pay" more for properties located close to urban green space

Other: ☐ _____

14. 14. After completing Question 13, choose 5 criteria from the list provided above and rank the 5 criteria from most to least considered by providing only the numbers of the criteria (e.g. 2, 5, 9, 7, 4).

15. 15. In your opinion, proximity to urban green space should have a bigger impact on property values.

Mark only one oval.

- ☐ Agree
- ☐ Not sure
- ☐ Disagree

16. 16. If you "Agreed" to the statement in Question 15, please elaborate.

17. 17. Green spaces in South Africa are characterised by a lack of maintenance and perceived as crime hotspots. Do these negative aspects result in lower property value in your municipal area?

Mark only one oval.

- ☐ Yes
- ☐ No
- ☐ Not sure

18. 18. If you answered "yes" in Question 17 please elaborate on the extent to which these negative aspects influence property value in your municipal area.

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