URBANISATION, FORAGING AND HOUSEHOLD FOOD SECURITY IN URBAN SOUTH AFRICA

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Abstract

Over the past several decades, the world's population has been rapidly urbanising, which has resulted in a marked shift of global population from rural to urban areas. About half of the global population now reside in urban areas and is projected to increase to two-thirds by the year 2050. However, the majority of the future urban population growth is projected to be largely concentrated in Asia and sub-Saharan Africa. Despite the economic prospects normally synonymous with urbanisation, the current speed and scale of urban transformation comes with formidable challenges to contemporary urban society in these two continents. Urbanisation may presents social, economic, health and environmental challenges in urban areas, not least being a shift of the locus of food insecurity from rural to urban areas, leading to poor dietary diversity among many urban dwellers. Similarly, urbanisation alters key ecosystem services and drives habitat alteration and fragmentation, biodiversity loss, proliferation of non-native species and changes on species diversity and richness. The aforementioned changes can result in a deterioration of living conditions and decline on the quality of life for the urban dwellers. However, on the other hand, urban green infrastructure is posed as vital tool in promoting liveable cities and enhancing livelihood resilience. Against this backdrop, this study portrays wild plants, a component of urban green infrastructure, as a key resource in promoting food security and dietary diversity, thereby promoting livelihood resilience and reduced vulnerability, especially of the urban poor. Framed under the 'right to the city' approach, this study examined urban foraging practices and their potential contribution to dietary diversity and how they are shaped by and respond to urbanisation in two medium-sized South African towns.

The study was conducted in the towns of Potchefstroom and Thabazimbi, South Africa. An explanatory sequential mixed method design was employed for data collection. Multi-stage sampling was employed in selecting the study participants. Firstly, the study towns were stratified into four socio-economic zones: informal, reconstruction and development programme, township and affluent. These zones resemble high density (informal, reconstruction and development programme), medium density (township) and low density (affluent) areas. Then, a total of 374 households were randomly sampled across the socio-economic zones for the main survey (Chapter 3 and 5). A subset of this sample, i.e. 72 participants was considered for dietary recalls, alongside with a random sample of 65 non-foragers (Chapter 4). An inventory of plant species available in a given foraging space was

conducted from a total of 136 plots spread across different urban spaces (Chapter 2). Semi-structured interviews were conducted with a total of 81 participants (sub population of the main survey) for elucidating data on urban dynamics (Chapter 6). Lastly, complementary in-depth interviews with 46 participants were conducted.

The findings showed that different urban spaces were constituted by diverse vegetation, with 262 distinct plant species encountered across the spaces. The majority (60.7%) were indigenous to South Africa. Species composition and diversity varied with space type, being significantly high in protected areas as compared to the other space types. About half (53%) of the identified plant species had at least one documented use, with medicine, food and firewood being modal, in order of frequency. Species composition and diversity differed between forageable and non-forageable species, being significantly high for forageable species.

Urban foraging was widespread, about 68% of the respondents reported foraging. Foraging provided food, fuel energy, medicine, and cultural affirmation, among others. Despite the high prevalence rate of foraging, the study did not find any meaningful contribution of wild foods to overall diets. Nonetheless, wild foods demonstrated a substantial contribution in diversifying diets within particular food groups consumed such as vegetables, thus emerging essential in mitigating monotonous urban diets, particularly of the urban poor. Besides, the prevalence of foraging differed significantly between and within towns, being high for Thabazimbi (54.7%) and residents in the outskirts of town (86.2%) than Potchefstroom (45.3%) and residents in the inner part of town (33.3%). Participation in foraging was primarily a function of childhood (91.8%) exposure and experience with foraging, positive perceptions (79%) towards practice, resident in the outskirts of town (86.2%) and low household income (49.2%). The findings indicated that foraging was driven by multifaceted motivations, with culture (91.8%), health (88.7%), livelihoods needs (75.0%) and leisure (73.8%) being the most common.

Vacant spaces (54.7%), riparian areas (30%), and domestic gardens (17.9%) were the most preferred foraging spaces, albeit with differences within towns. Similarly, the mean frequency of access varied with foraging spaces, being slightly high for vacant spaces than riparian areas and domestic gardens. The majority of the respondents were unaware of both formal and informal regulations managing urban landscapes, with those acknowledging some awareness falling short of articulating on the specificities of the regulations. Besides, the

findings showed that foraging practice was threatened by urban transformation. Foragers perceived that the practice has changed over time, in terms of spaces, participants and regulations. There was a decreasing trend on the number and size of foraging spaces as well as shifting demographic trends of foragers. Moreover, urban transformation brought about a new set of regulations used for managing certain spaces within the urban landscape. However, some regulations prohibited or restricted access and rights to certain spaces for foraging. Hence, this prompted foragers to devise adaptation strategies to cope with the said changing dynamics. Exploring new foraging sites within and outside forager's neighbourhoods and negotiating access entry were the most frequently mentioned adaptation strategies. This study contributes to the emerging body of knowledge on urban foraging, which has being seldom understood in the Global South.

Keywords: Access; Dietary diversity; Food security; Green infrastructure; Regulations; Urban foraging; Urban transformation; Wild plants

Declaration

I, **Hesekia Garekae** hereby declare that this thesis is my own original work, and that all the sources consulted have been duly acknowledged within text and list of references. The thesis is submitted in fulfilment of the requirements for the degree of Doctor of Philosophy at Rhodes University, and has not been submitted for any degree or under examination at any other university.

Signature: _____ Date: 2nd March 2020

List of publications

i. Garekae, H. & Shackleton, C.M. (2020). Urban foraging of wild plants in two medium-sized South African towns: People, perceptions and practices. *Urban Forestry & Urban Greening*, 49. doi.org/10.1016/j.ufug.2020.126581

Role: I conceptualised the study, reviewed the literature, collected and analysed the data and wrote the first draft manuscript. Charlie Shackleton supervised the designing and writing process. On average, my overall contribution accounts to 95%.

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Role: I conceptualised the study, reviewed the literature, collected and analysed the data and wrote the first draft manuscript. Charlie Shackleton supervised the designing and writing process. On average, my overall contribution accounts to 95%.

Dedication

In loving memory of our sister, Galeakanye Sarepito (20/01/1977 – 27/12/2007).

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List of abbreviations

AIV	African Indigenous Vegetables
FAO	Food and Agriculture Organisation
HDDS	Household Dietary Diversity Score
NGO	Non-Governmental Organisation
NTFP	Non-Timber Forest Product
RDP	Reconstruction and Development Programme
RTC	Right to the City
SSA	sub-Saharan Africa
Stats SA	Statistics South Africa
UGI	Urban Green Infrastructure
UN-Habitat	United Nations Human Settlements Programme
UN	United Nations
WHO	World Health Organisation

Chapter 1

Introduction

1.1. Global urbanisation patterns

Rapid global urbanisation has been a dominant trend since the 19th century (Bhattacharya, 2002; Ichimura, 2003; Lal, 2012), and has evolved to be one of the greatest challenges to ever befall humankind and environmental sustainability (Lundqvist et al., 2003; Redman & Jones, 2005; Chen, 2007). The rapid urbanisation has resulted in a marked shift of global populations from rural areas to urban areas, leading to an increase in the number of megacities (cities over ten million population) and the booming of cities with over one million population across the world. Despite cities and towns occupying a mere 4% of the world's terrestrial surface, they are home to more than half of the global population (Grimm et al., 2008; Liu et al., 2014). Since 2007, and for the first time in history, the world's urban population exceeds its rural counterpart. Cities and towns are now home to approximately 55% (4.2 billion) of the world's population, and the figure is projected to increase to 68% (6.7 billion) by the year 2050 (UN, 2019). The rate of urban growth is now greater than the one for the total population of the world (UN, 2019).

Despite urbanisation mostly been a developed countries phenomena, there is a marked shift in the global urbanisation patterns, with greater rates and population now occurring in developing regions. The foreseeable future population growth, and particularly of the urban population, is expected to be largely concentrated in developing regions, with an estimated growth rate of 2.3% per year between 2000 and 2030 (Cohen, 2006; Montgomery, 2008; Yeh & Huang, 2012; UN, 2019). This means that urban populations in developing countries will more than double by mid-century, increasing from two billion in 2000 to four billion in 2030 and further increasing to 5.5 billion by 2050 (Angel et al., 2011). Simultaneously, the annual rate of urban growth in developed countries will decline to 0.4% per year.

About 90% of the projected future population growth will be largely concentrated in Asia and sub-Saharan Africa, which are projected to reach 66% and 59% urban by 2050, respectively (UN, 2019). Africa's urban population is anticipated to surpass that of Latin America (Montgomery, 2008). The main difference in urbanisation of the developing regions from the developed ones is that, it takes place amid lower levels of per capita income and often decoupled from economic development and major industrial expansions (Fotso, 2007;

Satterthwaite et al., 2010; Turok & McGranahan, 2013). This is a case for most African cities, which are rapidly urbanising despite poor economic performance in the region (Cohen, 2006).

Although the available estimates and projections are useful in demonstrating trends of urban and rural population growth globally, they are to be interpreted with caution. The statistics leave much to be desired (Montgomery, 2008). One of the critical challenges is the lack of a global standard for classifying urban environments; therefore what constitutes urban varies across countries and over time (Cohen, 2006; Montgomery, 2008; Satterthwaite et al., 2010). The available statistics are generally deficient and beset with projection errors and inconsistencies. Nonetheless, the United Nations (UN) world population prospects remain the only international and comprehensive statistics across all countries (Cohen, 2006). The results are revised and updated bi-annually and their comprehensiveness makes them the best data source available on urbanisation thus far (Redman & Jones, 2005; Yeh & Huang, 2012).

1.1.1. Drivers of urbanisation

Multiple factors are the main drivers of urbanisation, namely (1) natural population increase, (2) rural-urban migration, and (3) annexation (Cohen, 2006; Satterthwaite et al., 2010; Angel et al., 2011). Generally, because of the low rates of population growth through natural population increase in urban areas, the key determinants of the rapid urbanisation levels are rural-urban migration and annexation of towns and cities. However, the relative contribution of each towards urbanisation has remained topical. It is argued that the contribution of each is spatio-temporal, variable and contextual (Bhattacharya, 2002; Cohen, 2006).

1.1.1.1. Natural population increase

Natural population increase is the urban population growth through the 'surplus of births over deaths within the urban population in a given time period' (Population Reference Bureau, 2013). Urban population growth through natural increase is fuelled by the improved infrastructure (health, sanitation, food supply) and general human well-being in urban areas, leading to a reduction in mortality rates, particularly of infants, as well as extended life expectancy (Nsiah-Gyabaah, 2004; Redman & Jones, 2005). Natural increase is the main determinant of urban population growth in highly developed regions, where the differences between urban and rural areas are narrowed by availability of services and infrastructure in both areas, such as in Latin America. In contrast, natural population increase accounts for

60% of the urban population growth in developing countries (Montgomery, 2008; Simms, 2008).

1.1.1.2. Migration

Migration, particularly of rural to urban areas, is one of the greatest impetuses to the rapid urbanisation in developing regions (Redman & Jones, 2005; Angel et al., 2011). More often than not, rural-urban migration is mostly fuelled by economic and employment opportunities synonymous with urban centres, better services such as education, health care, electricity, water, sanitation, and the perceived modern life in urban areas. The hardships associated with rural life, such as inadequate access to resources (capital), employment and services are also one of the driving factors of rural to urban migration (Bhattacharya, 2002; Satterthwaite et al., 2010). Similarly, migration can be in the form of people coming from other areas outside the receiving country, this is particularly prominent in developed and semi-developed regions. In sub-Saharan Africa, migration accounts for most of the urban population growth (Bhattacharya, 2002).

1.1.1.3. Annexation

Annexation is defined as the process of geographic expansion of urban areas to incorporate land which was primarily rural and outside the urban boundaries to form part of the larger urban agglomerations (Edwards, 2008). It is one of the most common ways to adjusting municipal areal coverage (Edwards, 2008). This process can be a pivotal strategy in managing urban development through coordinated land-use planning (Edwards, 2008). Annexation can change the spatial coverage of the city from being a small place to a major agglomeration. This can be done by redefining what constitutes an urban environment and absorbing the land around the periphery as urban (Cohen, 2004). The rapid growth of cities and towns results in annexing neighbouring areas as their economic activities shift away from agricultural activities, leading to the development of suburbs (Cohen, 2004).

1.1.2. Effects of urbanisation

Generally, cities and towns are portrayed as engines of economic and social development (Ichimura, 2003; Yeh & Huang, 2012). They have been pivotal to economic growth and innovation, which in turn creates employment opportunities (Yeh & Huang, 2012). Despite the economic growth, social development, modernisation and innovative prospects

synonymous with urbanisation in some places, the current speed and scale of the urban transformation may come with formidable challenges to urban society and landscapes (Bapari et al., 2016; Pauleit et al., 2018; Kuddus et al., 2020). Consequently, the capacity to manage urban centres and respond to the unprecedented urban growth is likely to become ever more complex (Satterthwaite et al., 2010; Dodman et al., 2017). Urbanisation increases the costs of providing basic services in urban areas such as water, housing and sanitation (Satterthwaite et al., 2010). Consequently, in poorer areas this can results in cities and towns failing to keep pace in terms of provision of basic infrastructure and essential services to urban citizens.

Urbanisation, especially in developing settings, often presents environmental, economic, social and health challenges, such as increased demand on natural resources, damage to ecosystems, environmental degradation, pollution, unemployment, poverty, food insecurity, housing shortages, slums, lack of social cohesion, poor health and poor sanitation (Satterthwaite et al., 2010; Yeh & Huang, 2012; Dodman et al., 2017; Pauleit et al. 2018). With regard to natural resources, urbanisation may stimulate the demand for natural resources such as energy, forests and water and at the same time shrinks the spaces where the resources are found (Yeh & Huang, 2012; Lal, 2012; Schlesinger et al., 2015; Unnikrishnan et al. 2016). However, urbanisation may not necessarily result in the withering of some traditional practices such as gathering wild plants (Cunningham, 2001; Cocks, 2006). Generally, the high population growth in urban areas, particularly through rural-urban migration, increases the consumption of wild plant resources in urban areas (SCBD, 2001). Urbanisation may also catalyse trade in wild plant resources, particularly by the urban poor and through informal markets (SCBD, 2001; Drury, 2009). Consequently, this sparks the demand of wild plants in the markets to meet the desires of the increasing urban population. Hence, this requires further research to unravel how urbanisation (re)configures resource use in urban landscapes, changes the spaces or locations where the resources are endowed and how it produces and shapes access to the resource. This undertaking could be coupled with a rights based approach to understand how people and institutions bestow or claim rights over urban landscapes and resources.

Urbanisation often has sweeping effects on local ecosystems. It alters the physical environment, leading to habitat loss, biodiversity loss, climate change, waste generation and inappropriate disposal (Chen, 2007; Yeh & Huang, 2012; Mundoli et al., 2015). Biodiversity loss through urban growth is often replaced with non-native species which may posse greater

threats to the immediate environment (Gaertner et al., 2017). Consequently, this may lead to changes in species diversity and richness in urban landscapes (Grimm et al., 2008; DeFries et al., 2010). This may deteriorate the capacity of ecosystems to provide services such as provisioning and cultural services, potentially leading to deteriorating quality of human life in urban areas (Tratalos et al., 2007). For example, urbanisation frequently leads to conversion of natural landscapes and other productive lands, such as agricultural land annexed into urban landscapes (Lal, 2012; Yeh & Huang, 2012; Pauleit et al., 2018), which may reduce food security (Yeh & Huang, 2012). For example, Naab et al. (2013) stressed that the city of Tamale, Ghana, is challenged by the rapid conversion of large tracts of prime agricultural land to urban expansion, particularly land fringing the urban periphery. About 61% of the land owners in Tamale reported having converted their previously agricultural land to residential, commercial and industrial purposes. In China, urban development (expansion, industrial and residential) resulted in a loss of approximately 6.7 million hectares of cultivated land between 1996 and 2003 (Chen, 2007). Global projections estimate that approximately 27 to 35 million hectares of cropland will be converted for urban expansion between the years 2000 and 2030 (Bren d'Amour et al., 2017).

As the world's population urbanises, it also shifts the locus of poverty from rural to urban areas, with many urban areas now battling with increases in poverty (Cohen, 2006; UN-Habitat, 2006; Crush & Frayne, 2011; Kimani-Murage et al., 2014), and urban poverty is poised to surpass the rural poverty, particularly in African countries (Lesetedi, 2003). Approximately one-third of the urban inhabitants worldwide are considered to be poor, living below the poverty datum line of less than US$2 a day (UN, 2012). Consequently, urban poverty, overcrowding, development of slums and mushrooming of informal settlements contest the longstanding conceptualisation of urban areas as centres of better economic opportunities and health conditions than their rural counterpart (Fotso, 2007; Hove et al., 2013). Poverty underpins precarious living conditions resulting in limited quality of life for many (Ichimura, 2003). This underpins the importance of making cities resilient and able to cope and respond to the formidable challenges of urbanisation. Hence, this study questioned the prospects of urban green infrastructure in creating liveable cities and ameliorating the challenges emanating from urbanisation, with food security and dietary diversity being central to the study.

1.2. Green infrastructure

Generally, the rapid urbanisation and its subsequent challenges on the social, biophysical and economic environments may constrain the way of life in urban areas. This calls for exploration of interventions aimed at ameliorating the associated urbanisation challenges on the quality of urban life, particularly in those regions where urbanisation has occurred against the backdrop of weak economic growth, such as in sub-Saharan Africa. Urban green infrastructure (UGI) has been posed as one of the solutions to the many challenges faced by contemporary cities, brought about by the rapid urbanisation, through building sustainable cities. Van Leeuwen et al. (2006) established a positive association between quality of life and urban greening, thereby demonstrating the capacity of UGI towards improving urban livelihood and sustainability.

As posited by Nazir et al. (2014: 384), UGI benefits "mitigates the potential impacts of existing and future development and growth as well as to offer valuables services to the community". Therefore, the development of UGI is well placed to enhance urban liveability. Urban green infrastructure enables cities to be resilient, through providing ecosystem services (Schäffler & Swilling, 2013; Russo et al., 2017; Caliskan & Aktağ, 2019). This in turn improves urban life and enhances liveability in cities and towns. Therefore, ecosystem services and benefits generated by functional UGI are pivotal in attaining sustainable cities (Ahern et al., 2014; Hurley & Emery, 2018). Given the rapid urbanisation and the subsequent increasing demand for liveable spaces in urban areas, UGI is considered to be "… opportune for urbanisation-related research and interlinking environmental food security norms and policies" (Russo et al., 2017: 62). Green infrastructure addresses the needs of both the people and nature simultaneously.

Urban green infrastructure is a recent concept but an old idea (Benedict & McMahon, 2002; Molla, 2015). The principles of UGI can be traced back to the planning and conservation activities in the 19th century (Benedict & McMahon, 2002). However, it is only within the last two decades that it started to command a renewed interest from various sectors such as academics, policy analysists, researchers, and practitioners (Horwood, 2011; Mell, 2017; Benton-Short et al., 2017). Urban green infrastructure is considered a broad subject and to be multi-disciplinary in nature (Horwood, 2011). It has been applied in various disciplines such as health, environment, urban planning, geography, and landscape ecology. Consequently, urban green infrastructure means 'different things to different people' and a consensus

definition has not been reached (Benedict & McMahon, 2002). Kambites and Owen (2006: 484) defined UGI as "connected networks of multifunctional, predominately unbuilt, space that supports both ecological and social activities and processes". Whereas Weber et al. (2006: 94) defined it as "… the abundance and distribution of natural features in the landscape like forests, wetlands, and streams". But a more holistic definition, encompassing both the ecological and human elements of UGI is offered by Benedict and McMahon (2002: 12), who defined UGI as "… an interconnected network of green space that conserves natural ecosystem values and functions and provides associated benefits to human populations".

A notable feature emerging from the abovementioned definitions is the progressive expansion of the UGI concept from its initial focus on landscape restoration and maintenance to a more nuanced one, which conceives UGI as serving the needs of both the human and physical environment (Borelli et al., 2015). Urban green infrastructure elements include "street trees, private and public gardens, parks, riparian zones along urban drainage lines, undeveloped ridges, and a variety of urban agricultural spaces such as food and community-based gardens" (Schäffler & Swilling, 2013: 247). It also includes features such as green roofs, green spaces and natural vegetation (Nolon, 2016). Urban green infrastructure differs from grey infrastructure, which typically refers to all human-made resources on the urban landscape, which normally consist of concrete, asphalt and steel built structures that do not serve any ecological functions (Mell et al., 2013; Borelli et al., 2015). It includes elements such as line infrastructure (roads and utility lines), buildings, transport and sewerage systems. The novelty of UGI is its multifaceted nature characterised by spatial connectivity, accessibility, integration, multi-functionality and scale (Mell, 2008). Urban green infrastructure systems consists of 'hubs' and 'links', with the former anchoring UGI networks and acting as a passage for the flow of goods and services, while the 'links' are the connections sustaining the system and ensuring its functionality (Benedict & McMahon, 2002).

1.2.1. The development of green infrastructure

A comprehensive exposition on the development of the UGI concept is offered by Mell (2017), who outlined three developmental phases of UGI: exploration (1998-2008), expansion (2008-2011) and consolidation (2010-current). The exploration stage entailed the advocacy for the uptake of UGI ideas into policy, research and practice. The influential paper by Benedict and McMahon (2002) is considered the first to espouse the UGI concept. It catalysed the wide use of the concept in academia, research and practice, thereby marking the

beginning of the prominence of UGI and its benefits in development discussions, policy formulation and research. Although the application of UGI evolved in America and Europe, the expansion phase introduced it to other regions (Mell, 2017). Alongside its application across the world, the concept of UGI also became more refined in terms of its meaning and value in urban planning. On the other hand, the consolidation phase marks an established understanding of the UGI concept and the direction for its development (Mell et al., 2013). This stage is characterised by profound investment in UGI and the increasing realisation of its benefits (Mell, 2017).

1.2.2. Benefits of green infrastructure

Green infrastructure offers multiple benefits and services to both humankind and the environment. The benefits span the economic, social, health and the ecological domains. In regard to the ecological benefits, UGI has been established as pivotal in mitigating urban heat stress (Lafortezza, et al., 2009; Masoudi & Tan, 2019). Green spaces and trees in the urban landscape ameliorate heat produced from industries, built-up areas and vehicles. Consequently, this reduces the amount of energy required for cooling buildings during extreme temperatures. Simultaneously, UGI provides regulatory services to the ecosystem, such as regulating climate, carbon sinks, soil erosion and floods (Borelli et al., 2015; Nolon, 2016). Green infrastructure in the form of trees, acts as wind breaks, which in turn limit soil erosion (Nolon, 2016). Trees are also essential in sequestering carbon and removing atmospheric particulate matter (Nolon, 2016), which improves air quality.

The development of UGI is positively linked with improved human health and well-being (Nazir et al., 2014). Being exposed to and interacting with UGI amenities aids people in recuperating from illnesses as well as restoring mental well-being. Lafortezza et al. (2009) found that the use of green spaces in Italy and the United Kingdom, in terms of frequency of visits and duration, was positively related to improved well-being. Economically, UGI is poised as an important incentive for economic growth and investment (Horwood, 2011). For example, investing in recreation and leisure amenities can be an important source of revenue for local economies (Williams, 2008). Green infrastructure also plays a role in property values (Nazir et al., 2014; Nolon, 2016). It enhances property values such as houses for renting and or selling, hence generating income. On the other hand, UGI contributes to effective learning in schools. School gardens are critical teaching resources, which provides students direct contact with nature and accords them the opportunity to perform basic

ecological and inventory processes (Russo et al., 2017). Similarly, dense trees within the school landscape, particularly those adjacent to the classroom buildings have been found to aid mental restoration process and stress reduction among pupils (Matsuoka, 2010). The presence of, exposure to and contact with dense nature in school landscapes provides cognitive, social, and behaviour benefits to school children, a phenomenon resulting in improved and better academic performance, graduation rate and the desire from learners to further their studies (Matsuoka, 2010). Given the diverse benefits accorded by green infrastructure, particularly provisioning ones, it is important to understand its potential in providing edible landscapes which could act as a supply of forageable resources to some sections of the urban community.

1.3. The practice of urban foraging

Wild plant collection is an ancient activity which is generally perceived to be synonymous with rural areas (Negi & Subramani, 2015; Svizzero, 2016; Joos-Vandewalle et al., 2018). The practice of wild plant collection is commonly referred to as foraging, harvesting or gathering. However, for the purpose of this study the term foraging is used. According to Svizzero (2016: 7) "foraging is the practice of harvesting non-cultivated plants for food, medicine, floral and greenery, craft products or other purposes, for personal use or sale". Foraging is a long-standing practice which can be traced to the pre-Neolithic period when agriculture was non-existent and it was the primary source for subsistence (Svizzero, 2016). Although foraging has been considered a practice characteristic of rural areas, it is slowly gaining global recognition in urban areas as a form of interacting with nature and gathering wild foods (McLain et al., 2014; Schlesinger et al., 2015; Mollee et al., 2017; Landor-Yamagata et al., 2018).

Urban foraging is normally undertaken in public green spaces, private gardens, parks, streetways, walkways, and railroad trails (McLain et al., 2014). Foraging includes different products, such as the entire plant, selected plant part (e.g. leaves, flowers, seeds, fruits, and cones), plant exudates, fungi, mosses and lichens (Short-Gianotti & Hurley, 2016; Landor-Yamagata et al., 2018). The purposes of foraging may be grouped as follows, although not exhaustive: food, medicinal, energy and construction materials, ornamental, craft, and gifts. Urban foraging is now evolving to include other activities such as walking trails for awareness raising on edible wild plants within urban landscapes. For example, in some cities foragers are forming associations or groups for sharing knowledge on wild foods, harvesting

techniques, new recipes for wild food preparations, and relating foraging experiences (Grasser et al., 2012; McLain et al., 2014). Similarly, there are also emerging knowledge sharing platforms, such as dedicated websites for collating information on various wild plant species available for foraging in specified locations within the city and announcement of scheduled tours and other foraging related activities. All these endeavours demonstrate the intrinsic relationship between urban people and their environment, a phenomenon considered to be under threat in some regions (Soga & Gaston, 2016).

Studies in cities in North and South America showed that between 18% and 66% of the respondents had foraged within the past 12 months (Robbins et al., 2008; van Andel & Carvalheiro, 2013; Short-Gianotti & Hurley, 2016). These studies demonstrated that the practice of foraging is widespread and spans across a range of socio-cultural, demographic and economic backgrounds. The majority of the foragers harvested wild plants for food and medicinal purposes. Foraging was more than an activity undertaken for subsistence but was considered "… a deeply relational practice connecting humans with nature, other humans, and their inner selves" (McLain et al., 2014: 231). Foraging may also promotes cultural rejuvenation or maintenance in urban areas. For example, some foragers were observed to be gathering plant products which they used to gather in rural areas and or at their native countries, for the case of migrants (Poe et al., 2014).

In Berlin (Germany), Palliwoda et al. (2017) observed that about 12% of their study population who visited two public parks interacted with wild plants at a species level; mainly through consumption, decoration and biodiversity experience compared to other activities. About 26 species were utilised from the two parks and both native and non-natives species were used proportionally. Collection of wild plants for consumption was the most frequent (60%) observed activity in the two parks compared to the other uses. In the same study, foraging practices were observed to outweigh other longstanding park activities such as golfing and camping; a similar observation made in America (Robbins et al., 2008). This observation exalts the significance of urban foraging practices which are mostly obscured by the conventional green space activities.

In Asia, Gopal and Nagendra (2014) stressed the importance of foraging in mitigating poverty in urban slums of Bangalore, India. The urban trees provided multiple uses of high economic value which were significant in livelihood improvement, such as strengthening social capital, health and nutrition. Africa also is no exception to urban foraging practices.

Mollee et al. (2017) indicated that about half (47%) of the respondents were foraging wild plants in Kampala, Uganda. As observed elsewhere, foraging included an equal proportion of indigenous and non-indigenous species. On the other hand, in Cameroon and Democratic Republic of Congo, wild foods were sold in informal markets within urban areas (Termote et al., 2012; Sneyd, 2013). These wild foods were often sourced locally within the urban setting while some were collected from rural areas and transported to the urban areas. In South Africa, Kaoma and Shackleton (2014) reported that the majority of households in poor suburbs gathered at least one urban tree non-timber forest product (NTFP), with firewood and wild fruits been the most frequently used. The provision of firewood ties well with food security. Access to and availability of cooking energy is an integral aspect to attaining food security (Brouwer et al., 1996; Makungwa et al., 2013). Since most food needs to be cooked to enhance its palatability (Bogdanski, 2012; Makungwa et al., 2013), firewood gathered from the urban ecosystem services becomes instrumental in meal preparations. On that note, Murwendo (2011) and Kaoma and Shackleton (2014) revealed that at least 80% of urban dwellers in South Africa and Zimbabwe were reliant on firewood as a source of energy. Firewood is an integral component of food security, as its shortage or lack thereof can result in changes in dietary patterns and composition, cooking less important dishes and skipping/reducing the number of meals per day, ultimately having consequences on food security (Brouwer et al., 1996).

Moreover, NTFPs act as a strategy to save scarce cash resource in urban areas, which can be invested on other household needs (Maroyi, 2009; Shackleton et al., 2010). Therefore, wild and domesticated plants in urban areas emerges an important source of income generation and cash saving. Kaoma and Shackleton (2015) found that NTFPs contributed approximately 20% of the total household income in poorer suburbs in South African towns, with the contribution through sale and or direct consumption. Although the contribution of NTFPs income to urban livelihoods might be disputed, the authors contend that an additional source of income to households is important, particularly for the urban poor. This is corroborated by Chazovachii et al. (2013), who contend that income from NTFP sales helped residents of Masvingo city (Zimbabwe) to accord social services such as health, education and food, as well as procuring household assets such as livestock, property and farm inputs.

Based on the foregoing, it is evident that urban foraging is a widespread phenomenon and it is integral to many urban livelihoods. Urban dwellers derive various products from urban

forests, largely for subsistence consumption, culture and to a lesser extent for income. Taking into account the worldwide, rapid urbanisation, especially in Africa, where poverty is shifting from rural areas to urban areas, foraging is likely to remain as an essential source of livelihood for the poor. Nevertheless, some foragers are not driven by necessity or lack thereof, but undertake foraging for pleasure and enjoyment (Schunko et al., 2015). However, this observation was made in developed countries in Europe and America; hence it is subject to differ with context and geographic location. For example, in developing countries, foraging may be the primary source of subsistence or to complement other livelihood activities. This dynamics calls for further research to elucidate on the underlying motives driving foraging across different socio-economic contexts. This will inform planning and production of UGI amenities which takes into consideration the diverse needs and aspirations of the urban citizens.

Culture and ethnicity have been observed to be playing a critical role in shaping and revitalising urban foraging practices, this is in terms of the choice of species to forage (McLain et al., 2014). Migrants from different backgrounds were found to be foraging on some species available in their native countries (Poe et al., 2014). Migrants also foraged on some species which were deemed toxic in the country of residence but not toxic at their native country; this was coupled with a certain way of preparation for curbing toxicity (Poe et al., 2014). These contrasting foraging practices and beliefs generally enhance differences, and at the same time reproduce and shape foraging practices. Therefore, foraging is important in maintaining cultural practices. For example, the use of traditional medicines and foraging of certain wild foods for preparing specific traditional cuisines connects people with their established cultural practices. Foraging is viewed as more than an activity undertaken out of necessity, but one which brings people closer to nature and their immediate surroundings (Christiani, 2012; Triman, 2013). Foraging also establishes, maintains and strengthens social ties within the community. Furthermore, foraging imbues the urban dwellers with a sense of belonging and identity to their local environment (McLain et al., 2014).

Despite the small but growing body of literature on urban foraging practices, it is largely founded in works in America and Europe (Shackleton et al., 2017). Although this scant literature may serve as a basis for providing an insight on the benefits and significance of foraging on livelihoods elsewhere; Poe et al. (2014) argue that urban foraging is a "contingent, contested, and heterogeneous" phenomenon; hence the practice is subject to

differ across space, over time and context. As a result, this limits the ability to generalise the available information on foraging to other regions. Therefore, it is important to understand urban foraging across different socio-ecological contexts. Furthermore, some study methods were case specific, as they dealt with a particular population group and this further limits extrapolation of findings to other population groups. For example, Mollee et al. (2017) targeted households which had at least one child within the age ranges of two to six years old. Similarly, Short-Gianotti and Hurley (2016) surveyed only landowners. Although these studies and others alike have provided notable insights on urban foraging practices, they fall short of unravelling the dynamism of foraging to other population groups such as tenants occupying rented properties, who might be solely dependent on foraging for livelihood sustenance (Short-Gianotti & Hurley, 2016). Therefore, this prompts future studies to incorporate holistic approaches in understanding urban foraging practices.

1.3.1. Foraging, food security and dietary diversity

One of the greatest challenges faced by urban areas is the high incidence of poverty, often associated with high rates of food insecurity among the urban poor (Tacoli et al., 2013; Korir, 2015; Boonyabancha et al., 2019). Despite global efforts towards halving the proportion of people undernourished during the past quarter century (FAO, 1996), food security has remained a topical developmental problem (Tevera & Simelane, 2016; Tomayko et al., 2017; Shaheen et al., 2017). The world is challenged with meeting the ever increasing food demand, partly due to population growth, inadequate access to available food and unequal distribution. Although the current world food production is sufficient to meet the global demand, food insecurity and undernourishment rates are rising (FAO, 2017; Berners-Lee et al., 2018). Globally, about 820 million people are undernourished (FAO et al., 2019). Most (98%) undernourished people live in developing regions, with Africa (29%) being the second most undernourished continent after Asia (FAO et al., 2015). Food security is defined as "… a situation that exists when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preference for an active and healthy life" (FAO et al., 2015: 53).

Food security is underpinned by four pillars, which are availability, access, utilisation and stability of food over time (FAO et al., 2015). Availability of food considers the demand and supply nexus, and it incorporates aspects of production, stocks and net trade (FAO, 2008). This pillar is concerned with whether the available food is of sufficient quantity to feed all the

people in a given area. The dimension of access to available food entails the economic and physical access to food. It is about the incomes, preferences, household food allocation or entitlements, expenditures, markets and prices of procuring food. This pillar is important because adequate food supply does not necessarily translate to food security (Shaheen et al., 2017). Food utilisation is about how the nutrients from food are metabolised in the body. It incorporates issues of energy and nutrients, dietary diversity, food preparation practices, type and pattern of eating habits, health and intra-household food distribution (Shaheen et al., 2017). This pillar also includes aspects of hygiene and sanitation. The aforementioned food security pillars are anchored on food stability, which entails prolonged and assured availability and access to food. The four food security pillars are not independent of one another, thus the fulfilment of one is not sufficient to ensure any other (Pinstrup-Andersen, 2009; Barrett, 2010). Consequently, food insecurity "… exists when people lack secure access to sufficient amounts of safe and nutritious food for normal growth and development and an active and healthy life" (FAO et al., 2015: 53). Availability, purchasing power and distribution are the key conditioning factors of food insecurity. Food insecurity may be transitory (periodic or seasonal) or permanent (long-term or chronic) (Pinstrup-Andersen, 2009).

Despite the widespread food insecurity in the developing world, it is often conceptualised as a problem affecting rural people (Chagomoka et al., 2016). Urban areas are perceived to be better off and food sufficient compared to their rural counterparts. The global developmental interventions such as food aid and funds availed to address food insecurity are mainly focussed in rural areas (Crush & Frayne, 2011). These interventions place much emphasis on empowering smallholder farmers to produce food to meet their subsistence needs. Food insecurity has seldom been understood in urban areas (Crush & Frayne, 2011; Battersby, 2013). It has received less attention compared to several other pressing challenges and problems experienced in urban areas (Maxwell, 1999), such as high unemployment rates, shortages of housing, overcrowding and development of slums. Moreover, urban food insecurity has received little attention within research and policy arenas (Crush & Caesar, 2014).

On the other hand, rapid urbanisation over the last two decades has shifted the concentration of food insecurity from rural to urban areas (Tawodzera, 2011; Kimani-Murage et al., 2014). The prevalence of food insecurity in urban areas is often the same or higher than in rural

areas (Tawodzera, 2011; Walsh & van Rooyen, 2015; Tomayko et al., 2017). Urbanisation has given rise to the prevalence of social shocks in urban areas such as poverty, which is often fuelled by ongoing rural-urban migration. However, migrants often find it hard to secure a decent living in urban areas and they may end up being unemployed and living in informal settlements (Kriel et al., 2017). This phenomenon further exacerbates the incidence of food insecurity in urban areas as more people are less able to access food to meet their needs.

It is not just about quantities of food. Some people living in urban areas are more vulnerable to food insecurity compared to those in rural areas because of their undiversified livelihoods, limited access to land and reliance on market economies. Urban household economies are mostly cash-based and thus residents need money to purchase food from the market. For example, in Cameroon and Swaziland about half or more of poor urban household's monthly expenditure was devoted to food purchases (Sneyd, 2013; Tevera & Simelane, 2016). Limited income may inhibit the ability of some urban citizens to meet their food needs. Urban household income is mostly earned through wage labour, salaried jobs and proceeds from businesses. However, the majority of the urban dwellers rely on erratic sources such as a meagre jobs, causal labour, and petty trading (Kimani-Murage et al., 2014), which may not generate sufficient income to meet household basic needs such as adequate food supply. Consequently, this exacerbates urban dwellers' vulnerability to livelihood shocks such as poverty and food insecurity.

To circumvent such precarious living conditions, some urban people diversify their livelihoods. They indulge in land-based activities to meet their subsistence needs. Some of these activities include urban agriculture, foraging of wild foods and collection of non-timber forest products. Agriculture is widely practised in many urban areas across the world (Korir et al., 2015; Siegner et al., 2018). It provides a source of food derived from various types of crops and animals. Globally, it is estimated that about 1.3 billion people are actively engaged in urban agriculture and approximately one-quarter of them produce food for the market. Similarly, some people living in urban areas forage wild foods and collect non-timber forest products for consumptive uses and selling for generating income. About one billion people worldwide forage wild foods for food security and dietary diversity (Aberoumand, 2009). Foraging is important to livelihoods and it provides household energy, diversifies diets, improves health and a source of income generation, among others (Chagomoka et al., 2015;

Kaoma & Shackleton, 2015; Mollee et al., 2017). Wild plants are a source of food and provide edible fruits, mushrooms, leaves, bulbs, roots and tubers, culinary herbs or spices, edible seeds and stems (Sneyd, 2013; Kaoma & Shackleton, 2014; Mosina & Maroyi, 2016; Synk et al., 2017; Landor-Yamagata et al., 2018).

Although wild foods have been generally conceived to be consumed mostly by rural people, emerging literature indicates the prevalence and consumption of wild foods by urban people (Sneyd, 2016; Synk et al., 2017; Chakona & Shackleton, 2019). For example, Yang and Keding (2009) observed the consumption of wild foods, particularly African indigenous vegetables (AIV) in some urban areas of African countries to be slightly higher than in rural areas. This observation corroborates Shackleton et al. (2010) who reported the consumption rate of AIVs in Durban, South Africa mirrored the statistics reported in rural areas. Vegetable consumption enriches diets and Chagomoka et al. (2015) observed in Ghana that urban households exhibited the highest dietary diversity compared to their peri-urban and rural counterparts. Poorer urban households are the greatest consumers of AIVs (Cocks, 2006). In some regions, wild foods are an important aspect of urban household diets and they form part of traditional food cuisines (Sneyd, 2013). Therefore, apart from their importance in local diets, wild foods may also help in revitalising or maintaining traditional culture in urban areas. Generally, wild foods provide food at all times, including times of food scarcity and deficiency (Ohiokpehai, 2003).

Wild foods typically have higher nutritional contents than domesticated and or exotic plants (Yang & Keding, 2009; Fentahun & Hager, 2009; Legwaila et al., 2011). They have higher concentrations of micronutrients such as vitamins, folic acid, iron, carotenoids, zinc and other nutrients essential for human physiology (Yang & Keding, 2009; Mavengahama et al., 2013). For example, a portion of *Amaranthus* spp. (green leafy vegetable) is 200 times richer in vitamin A than cabbage (McGarry & Shackleton, 2009). Likewise, it is reported that baobab fruit (*Adansonia digitata*) has higher concentrations of vitamin C than oranges (*Citrus sinensis*), which are 360 mg/100 g and 57 mg/100 g, respectively (FAO, 1992). The micronutrients and non-nutrient phytochemicals contained in wild foods, such as green leafy vegetables, are essential in maintaining good health and prevention of chronic diseases (Smith & Eyzaguirre, 2007; Yang & Keding, 2009). Therefore, higher intakes of vegetables protect against cancer and strengthen the body's immune system. Plant leaves, herbs and vegetables are a source of relish to many urban dwellers and are eaten with the staple cereals,

hence contributing to a balanced diet. Therefore, wild foods can be integral to the nutritional intake of the poorest segment of the urban population, through provision of essential vitamins (Murwendo, 2011; Smith & Eyzaguirre, 2007).

Despite the widespread nature and benefits of urban foraging, there is limited appreciation and acknowledgement of its potential in household food and dietary diversity (Slater & Twyman, 2003; Chakona & Shackleton, 2019), and consequently it is overlooked in urban planning and development processes. Most planners and developers perceive the practice of foraging wild foods as an undesirable activity in the urban landscapes (McLain et al., 2012; Shackleton et al., 2017). This is against the potential importance of foraging in mitigating some of the precarious livelihood conditions faced by people living in urban areas. Wild and domesticated plants provide multiple uses of high economic value which may be significant in livelihood improvement, such as strengthening social capital, health and nutrition (Gopal & Nagendra, 2014). Therefore, greater understanding foraging practices and benefits in different settings will help in informed planning and development including the provision of 'edible landscapes' in urban areas. Consumption of wild foods is envisaged to grow with rapid urbanisation which has already sparked greater demand for wild foods in urban areas, especially in informal markets. For example, in Cameroon and Democratic Republic of Congo, wild foods were sold in informal markets within urban areas (Termote et al., 2012; Sneyd, 2013). Still in Cameroon, some households spent a considerable proportion of their household food budget (about 25%) in procuring wild foods from informal markets (Sneyd, 2013). The availability of wild foods in urban markets demonstrates the demand for wild plant products in urban areas. This underscored the importance of further examining those wild foods which were sourced outside the markets but within the urban landscapes and peripheries and their contribution to household diets. Consequently, wild plants as a component of urban green infrastructure in urban areas could be used as a strategy for reducing the precarious and vulnerable livelihoods of the urban poor, whilst simultaneously increasing the multifunctionality of urban green infrastructure.

1.3.2. Urban foraging regulatory frameworks

Despite the prevalence of wild plant foraging in urban areas, its legitimacy is marred by uncertainty (Shackleton et al., 2017). In many countries and cities, various regulations governing urban green spaces, streetways, parks and recreation areas generally prohibit or limit foraging activities (McLain et al., 2012; Dabady & Stark, 2017). Furthermore, foraging

practices are usually not explicitly outlined on urban forestry regulations, something which exacerbates its lack of recognition. McLain et al. (2012) and Hurley et al. (2015) revealed that foraging was generally prohibited in public parks, open green spaces and along streetways within American cities. A similar observation was also made in Europe by Palliwoda et al. (2017). The prohibition of foraging is rooted on the plans, policies and laws from various departments entrusted with urban forest planning and management. Such regulatory instruments have been conceptualised on the basis of services and recreational activities which are entirely non-consumptive. On that account, urban foraging is viewed as an illegal and or undesirable activity (Raskin, 2012). Ironically, gathering products from invasive species in some public parks was contrary to the law but the same species were subjected to total eradication as they are detrimental to the ecosystem and their removal was deemed a management priority (McLain et al., 2014). However, invasive species may be important to particular groups of foragers, such as migrants, who might be used to foraging the same species in their native countries.

In Africa, the legality of urban foraging within the city greenery remains largely unknown. The few available studies (Kaoma & Shackleton, 2014; Schlesinger et al., 2015; Sneyd, 2016; Mollee et al., 2017) on wild plant gathering in cities and towns seldom provide understanding on the position of regulatory instruments on gathering activities. Despite these studies having provided an insight on foraging practices and its contributions to livelihoods and well-being, they fall short of elucidating whether foraging was conducted within legal frameworks or prohibited (as found elsewhere). However, wild food traders in the informal markets of the cities of Yaoundé, Buea and Limbe in Cameroon decried that Forest and Fauna officers often arrest them or confiscate the products gathered from the urban forests (Sneyd, 2013). To evade this seizure, the traders are at times compelled in pay bribes to the forestry officials.

Although some foraging activities may be allowed in some countries, especially on peri-urban lands; it is often conflicted by competing land-use interests in those particular areas. For example, in South Africa, urban commonages were designated in small towns to enable the urban poor access to land to pursue livelihood activities aimed at supplementing the household economy, including, but not limited, to livestock grazing, wild plant gathering, and food gardening (Anderson & Pienaar, 2003; Davenport et al., 2011). Although the urban commonages serve various purposes, wild plant gathering is usually underrated at the expense of other land-use purposes such as grazing livestock (Davenport & Gambiza, 2009).

On a similar observation, development encroachment on remnant vegetation and formally vacant lands which were used as foraging spaces or locations may threaten the persistence of foraging practice (Grabbatin et al., 2011; Mundoli et al., 2017). Land development has replaced foraging habitats with concrete surfaces and built up environments, a situation impacting negatively on the abundance of forageable species (Grabbatin, 2008). Also, this comes along with alterations and restrictions to access to forageable spaces now encompassed by the gated communities. This motivates for further research to understand the dynamics underpinning urban foraging within the locus of competing land-use interests, multi-layered governance and changing urban dynamics. This will provide insights of how the aforementioned dynamics shape access and rights to urban spaces and the plant resources available therein.

On the other hand, public regulations prohibiting foraging generally exclude private areas. Private property owners are entrusted with the management of trees and other vegetation on their premises. As such they may or may not allow foraging activities. Nonetheless, some formal regulations may specify the type of trees to be planted in private areas, especially for those areas adjacent to essential infrastructures such as traffic ways. For example, in Seattle (USA), property owners adjacent to streetways are required to obtain a permit from the Department of Transport prior to any planting activities outside their yards, and fruiting species are commonly listed as prohibited species (McLain et al., 2012).

In a few cities, a paradigm shift has occurred in urban forest management. Urban forests are no longer viewed solely for non-consumptive ecosystem services but also as a provider of consumptive services such as food (Floberg et al., 2013; Clark & Nicholas, 2013). Urban planners and policymakers are taking cognisance of the benefits of urban landscapes to livelihoods and well-being. The city of Seattle has made strides in the provision of edible landscapes and foraging is recognised as part of the many functions of UGI. For example, various government departments working jointly with local residents established a food forest which was later devolved to the community (McLain et al., 2012). Recognising foraging activities in urban landscapes is a fundamental step to foster active community involvement in management of urban forests. Communities may establish forest stewardship programs as well as sharing their local ecological knowledge with the green space planners and developers.

1.4. Rationale

The world's population has been rapidly increasing in urban areas. On that account, about half (55%) of the global population now resides in urban areas and is projected to increase to 68% (6.7 billion) by the year 2050 (UN, 2019). About 90% of the projected world's urban population growth will be concentrated in Asia and sub-Saharan Africa. Despite the economic prospects normally synonymous with urbanisation, the current rapid urbanisation occurring in most of the developing regions is taking place amidst poor economic performance (Fotso, 2007; Satterthwaite et al., 2010). This phenomenon makes it difficult to achieve urban sustainability, a topical issue among academia, planners and policy makers (Clark & Nicholas, 2013). Urbanisation in Asia and sub-Saharan Africa frequently presents social, economic, health and environmental challenges (Nsiah-Gyabaah, 2004; Simms, 2008; Yeh & Huang, 2012). Central to this study, is the socio-economic and environmental impacts brought about by urbanisation. In regard to the environment, urbanisation alters key ecosystem services and habitat integrity, biodiversity loss, introduces non-native species and changes species diversity and richness (Grimm et al., 2008; McKinney, 2008; Yeh & Huang, 2012). While the socio-economic challenges include, but are not limited to, poverty, food insecurity, over-crowding, land-use conversion, development of slums and mushrooming of informal settlements (Kuchelmeister, 2000; Lesetedi, 2003; Satterthwaite et al., 2010). All these challenges undermine the quality of urban life and increase vulnerability. Urbanisation has shifted the locus of poverty and food insecurity from rural to urban areas (Kimani-Murage et al., 2014). This calls for exploration of alternative strategies, aimed at diversifying urban dwellers' dietary diversity and subsequently lessening food insecurity.

Urban green infrastructure is advanced as one potential strategy to address rising levels of food insecurity and many other contemporary challenges faced by cities (Kuchelmeister, 2000; Clark & Nicholas, 2013; Russo et al., 2017). Given the multi-functionality of UGI, it becomes an important tool to promote urban sustainability and resilient cities (Russo et al., 2017). Promoting UGI offers suites of ecosystem services and benefits to people and the environment. For example, remnant vegetation within an urban landscape can offer wild foods, which could help in sustaining and diversifying household diets, but at the same time offering environmental services such as carbon sequestration and air filtration.

Against this background, this study portrayed wild plants, a component of UGI, as a key resource in circumventing vulnerability and poverty in urban areas, particularly food

insecurity and dietary diversity. However, the potential of wild plants in sustaining and diversifying diets may be constrained by rapid urbanisation. Rapid urbanisation is foreseen to place immense pressure on UGI (Cohen, 2006; Unnikrishnan et al., 2016) and subsequent biodiversity loss through habitat alteration and fragmentation (McKinney, 2006, 2008; DeFries et al., 2010). This is likely to engender changes in wild plant foraging in urban settings (Mollee et al. 2017). Therefore, it is of utmost importance to understand how urbanisation (re)produces and shapes urban foraging practices, how rights and access to resources are defined and forager's adaptability and responses to changing urban dynamics. This is important because urban transformation presents novel landscapes and 'new' but complex management regimes defining the provision, location, availability and access to wild plant resources in urban landscapes (Hurley et al., 2013; McLain et al., 2014).

There is paucity of knowledge on wild plant foraging and rules and regulations governing access and rights to forageable resources in urban landscapes generally (Short-Gianotti & Hurley, 2016; Mollee et al., 2017; Shackleton et al., 2017; Charnley et al., 2018) and also in South Africa. The prevalence, frequency, and motivation for foraging wild plants and rights and access to resource spaces or locations in urban settings remain largely unknown. In the face of widespread urban food insecurity, it is vital to establish the potential contribution of foraging wild foods in household food security and dietary diversity, a phenomenon which has been largely overlooked in the literature. The few studies on foraging wild plants are largely from America (McLain et al., 2014; Kowalski, 2014; Short-Gianotti & Hurley, 2016; Synk et al., 2017) and Europe (Svizzero, 2016; Palliwoda et al., 2017; Landor-Yamagata et al., 2018). Notwithstanding that, there are some studies conducted in Asia and Africa (Gopal & Nagendra, 2014; Kaoma & Shackleton, 2014, 2015; Schlesinger et al., 2015; Mollee et al., 2017) that explored foraging practices. African literature on foraging wild plants has largely placed much emphasis on medicianl uses (Oreagba et al., 2011; Petersen et al., 2012; Furukawa et al., 2016) compared to other uses such as wild foods (Ward & Shackleton, 2016). Likewise, other studies focused on trading of wild plant products in urban markets (Termote et al., 2012; McMullin et al., 2012), but much of which originates from surrounding rural zones. This motivates for further research to examine urban foraging practices and how they are impacted by and respond to urbanisation, together with the potential role of foraging wild foods to food security and dietary diversity.

1.5. Aim and objectives

The aim of this study was to examine urban foraging practices, their potential contribution to household dietary diversity and how they are shaped by and respond to urbanisation dynamics. To achieve this aim, the following specific objectives were addressed:

1. To examine the prevalence and distribution of forageable wild plants
2. To assess the prevalence and pattern of wild plant collection and uses
3. To determine the contribution of wild plants to household dietary diversity
4. To establish the formal and informal regulations governing access to and defining rights to wild plant resources
5. To determine how urban dynamics influence urban foraging practices and how people adapt to and respond to the changes

1.6. Conceptual underpinnings

This study invokes the 'right to the city' (RTC) concept to understand the dynamics of foraging practices in the context of rapid urbanisation. The study sought to unravel how urban dwellers claim rights over the production of urban space, which takes into consideration their needs, desires and aspirations. The right to the city concept has become topical in urban studies in the past two decades (Purcell, 2014). The concept has been invoked in academia (Dikeç, 2001; Harvey, 2008; Marcuse, 2009; Attoh, 2011; Purcell, 2014), several international conferences convened centred on the concept (Rights to the City, 1998, 2002) and global organisations (UN-Habitat, UNESCO) and activist groups (Right To The City Alliance-USA) on human rights have infused the RTC ideologies into their core mandates. Likewise, some countries, such as Brazil, have recognised and enacted the RTC ideology into their governing laws (Friendly, 2013) and also charters were developed (World charter for the right to the city, European charter for human rights in the city and Montreal charter for the right to the city and responsibilities). Outside academia and activism, the RTC concept has received interest from other pertinent discourses such as on housing and homelessness (Glass et al., 2014; Darcy & Rogers, 2014; Kriel et al., 2017), transport and mobility (Coggin & Pieterse, 2015; Manji, 2015) and migration (Fernández, 2011).

The origins of the RTC concept can be traced back to the late 1960s. The concept was first coined by the French Marxist philosopher and sociologist Henri Lefebvre in his pioneer book

Le Droit à la ville (The right to the city; 1968). The concept was further developed in his subsequent writings on *La révolution urbaine* (The urban revolution; 1970), *Espace et politique* (Space and Politics; 1973) and *La production de l'espace* (The production of space; 1974). The conception of the RTC came about as a result of the European unrests in the 1960s, which were attributed to capitalism and state dominance. The right to the city conceives a city as an arena shaped by industrial capitalism but one which is independent of it. Thus, cities existed before the reigns of capitalism.

According to Lefebvre, the RTC is a radical approach towards transformation of cities that is free from the bonds of capitalism, state and the proliferating consumer society (Purcell, 2014). It is a "… call for radical restructuring of social, political, and economic relations, both in the city and beyond" (Purcell, 2002: 101). The proposition of the RTC counters the capitalist dominion over the production of urban space. The capitalist regime excluded urban dwellers in the making of the city space they inhabit. Capitalist industrialisation reconfigured and reduced cities into a marketable commodity. Commodification of the urban space sparked the development of property rights in the city space; entitlements which were accorded to few elites over and above the majority of urban inhabitants (Purcell, 2002; Mitchell, 2003). The valorisation of city space defined its form, production and shape. However, this valorisation obscured the social use value of city space over and above its worth and exchange value. Hence the conception of the RTC which exalts the use value of the city space by its inhabitants against commodification and market value (Purcell, 2014). In this context, the RTC is a struggle to emancipate urban inhabitants from the burgeoning private property rights in city spaces and its production. Whereas private property rights are mostly self-centric, the RTC strives for a collective claim over the production of the urban space (Harvey, 2008). Moreover, the RTC infuses social connections of space and its inhabitants (Purcell, 2008).

Based on the foregoing, the notion of space is central to the RTC concept. In this context, space is conceptualised as more than the concrete and physical dimensions but an arena for the production of urban life (Purcell, 2002). Purcell (2008: 93) argues that "…space is connected to everyday life, social relations and political struggle and it is socially produced through everyday life and through political struggle". Through the RTC lens, space is conceptualised into the triad of perceived, conceived and lived space (Lefebvre, 1991). Perceived space is the actual, physical and concrete space people encounter in their daily

environment. This is the space where the interaction between daily reality and urban reality unfolds. Conceived space refers to the abstract, symbolic and codified representation of space. This space is often associated with planners, professionals and scientists. On the other hand, lived space is the experienced space where life form exists.

The RTC is centred on two propositions, which are the right to appropriation and the right to participation. Simply put, appropriation means taking control of something and claiming its ownership. Appropriation entails the right of the inhabitants to physically access, occupy, and use urban space (Purcell, 2002), for example, spaces for urban foraging. It means the urban inhabitants taking ownership of the space in the city and its production. Appropriation enfranchises inhabitants with the right to the city space. The right to appropriation counters the capitalist perspective on urban space, as a commodity and its value defined by its economic exchange. But appropriation promotes the use value of urban space. As demonstrated by Grabbatin et al. (2011), the valorisation of urban space through property development in Charleston city (Mount Pleasant, USA) disrupted the longstanding traditional foraging activities in the city. The commodification of Charleston's city space produced gated communities which redefined access to and displaced resource spaces or locations. The booming resorts and private neighbourhood's restricted access to the remnant sweetgrass habitats, but wherever it was allowed, it was placed under tacit agreements which were subject to change at the discretion of the property owner. Subsequently, this gave birth to 'new' and complex resource regimes which mostly infringed on the RTC inhabitants over access to the resources found in their environment. In contrast, the right to appropriation is an inclusive approach which promotes inhabitant's connections and interaction in city spaces and embraces joint vision for the development of the city. The right to appropriation empowers city dwellers to be able to produce the urban space according to their needs, desires and aspirations.

On the other hand, the right to participation entails inhabitants being in the centre of the management of urban space. The right to participation reframes decision-making power away from the state and towards urban inhabitants (Friendly, 2013). This right entrusts inhabitants with taking key decisions on the production and reproduction of urban space (Purcell, 2002). Therefore, the right to participation upholds the voices of urban dwellers in decision-making structures. For example, the right to participation may entail engagement of city dwellers in decision-making pertaining to the provisioning of edible landscapes, designing regulations

and undertaking developments which take into consideration the needs of urban dwellers sourced through their immediate environment. Through the right to participation, inhabitants would be centrally and directly taking part in the production of urban space. Moreover, the right to participation is not only concerned with decision-making within state governance, but beyond to include other structures such as civic, corporate and global levels. As discussed in the right to appropriation, participation also strives for a more inclusive city space that promotes equitable seizing of opportunities (Purcell, 2008). The right to participation proposes that decision making processes be made at various scales, such as local, provincial, national and global (Purcell, 2002).

Through the lens of the RTC concept, claiming the right over the city space is a collective responsibility and is vested in the exercise of collective agency by inhabitants (Harvey, 2008; Marcuse, 2009). The RTC assigns membership to the city based on one's presence in the city space and forming part of its lived body of experience (Purcell, 2014). In this context, urban citizenship is not a function of nation-state citizenry. Therefore, the RTC accords all inhabitants claim over urban citizenship and this membership transcends demographic and socio-economic backgrounds such as nationality, ethnicity and others (Purcell, 2002). This notion will extend the urban citizenship to non-natives such as migrants and they will be accorded the same opportunity as everyone else to benefit from the city resources. In the context of urban foraging, access and rights to UGI will be accorded to all the urban inhabitants regardless of their demographic and socio-economic backgrounds. This notion is crucial, given that urban areas are home to people of diverse backgrounds. For example, migrants were sighted foraging at their host countries and they also foraged some of the species from their native countries (Poe et al., 2014).

Although the RTC framing has demonstrated its ideals in countering capitalist and state dominion in the production of urban space, it has also attracted criticisms. Scholars argue that the RTC concept appears to be fluid in nature, hence it gets attributed to many things which may not necessarily be harmonious with the initial expositions of Lefebvre (Purcell, 2014, 2008). This results in the renewed interest on the concept shifting the focus from the original premises and leading to its meaning becoming even more blurry. The concept has also been critiqued for being too radical and utopian (Friendly, 2013; Purcell, 2014). The RTC has also been critiqued for narrowly equating urban inhabitants mostly with the working class

(Purcell, 2002, 2008). Therefore, it has conceived the working class as the impetus to the social force requisite for dethroning capitalist and state dominion (Marcuse, 2014).

Using the RTC lens, this study frames the practice of foraging edible wild plants and other useful plant resources as counteracting the dominant regimes presiding over the production and management of urban space. Drawing from the propositions of the right to appropriation and participation, this study explored how the urban dwellers use or wish to use the urban space they inhabit for foraging wild plants. Similarly, the study established how urban dwellers appropriate the spaces where wild plant resources are found and how they participate in the decision making governing these spaces.

1.7. Structure of thesis

This thesis is organised into seven chapters, with chapters 2-6 presenting empirical results of the study. Chapter 1 presents a comprehensive background and situates the research within the global debates and theoretical framings. Following this section, the chapter presents a description of the study setting and research design.

Chapter 2 expands on the concept of UGI, particularly focusing on urban vegetation and examines the prevalence and distribution of forageable plant species across different spaces forming part of the urban landscape. The chapter determined the differences in species composition and diversity between forageable and non-forageable species across the different spaces sampled.

Chapter 3 provides insights on the prevalence and pattern of urban foraging. The nature and form of urban foraging is analysed, with a particular focus on forager's socio-economic and demographic characteristics, foraging spaces, motivations and barriers to foraging, perceptions towards foraging and knowledge production and sharing.

Chapter 4 narrows down on the role of foraging wild foods in diversifying urban diets. The chapter assesses the composition and diversity of household diets and how it differs with socio-economic characteristics. The pattern and perceptions towards wild foods are explored. Following, the chapter determines the differences in household dietary diversity scores between foragers and non-foragers across the study towns.

Chapter 5 explores the formal and informal regulations governing access and rights to forageable plant resources within urban landscapes. The different spaces where foraging

occurs are identified and their associated land tenure regimes explained. The frequency of access to the identified foraging spaces is quantified. The chapter also explores the formal and informal regulations governing urban spaces, their position towards foraging and how urban citizens are involved in their formulation.

Chapter 6 assesses the socio-spatial dynamics shaping urban foraging practices and how foragers adapt and respond to change. The chapter elucidates changes in form and nature of foraging practice, in terms of spaces, people and regulations. The various adaptation strategies employed by foragers in the face of change are explored. Lastly, Chapter 7 presents an integrated synthesis of the key findings drawn from the five empirical result chapters and suggests recommendations for practice, policy and research.

This thesis is written in paper-based format, whereby the five empirical result chapters constitute a stand-alone manuscripts and each comprising of the following sections: Introduction, Methods, Results, Discussion, Conclusion and References. The chapters were prepared ready to submit for consideration in suitable peer-review journals, with two of them already being published at *Urban Forestry & Urban Greening* (Chapter 3) and *Sustainability* (Chapter 4). To a certain extent, repetitions and overlaps between the general introduction (Chapter 1) and introductions and methods sections of the individual empirical chapters was inevitable. However, the format and style of all empirical result chapters was harmonised to maintain uniformity of the thesis.

1.8. Study setting

The study was conducted in two medium-sized towns in South Africa, namely Potchefstroom and Thabazimbi (Figure 1.1). These towns are situated in North West and Limpopo provinces, respectively. Limpopo province is located in the northern part of South Africa, bordering the country with three international boundaries: Botswana on the north-west, Zimbabwe on the north-east and Mozambique on the east. Locally, Limpopo borders with the provinces of North West in the south-west, Mpumalanga in the south and Gauteng in the south-east. The province occupies a total land area of 125, 806 km^2, constituting about 10.3% of the country (STATS SA, 2017b). Limpopo province has approximately 5.8 million inhabitants which accounts for 10.2% of South Africa's population (STATS SA, 2016a). In terms of governance, Limpopo province is divided into five districts, which in turn compose

26 local municipalities. The five district municipalities are Capricorn, Greater Sekhukhune, Mopane, Vhembe, and Waterberg (STATS SA, 2016b).

Just like the national population structure of South Africa, Limpopo province is multi-racial, with Black Africans (97.1%) constituting the majority across the province, followed by Whites (2.3%) and small proportions of Coloureds (0.3%) and Indians or Asians (0.3%) (STATS SA, 2016a). The dominant ethnic groups are Sepedi (56%), Tshivenda (17.1%), and Xitsonga (16.6%) (STATS SA, 2016a). The majority of the people (20 years and above) have attained primary education (75.2%) as their highest education level while a considerable proportion (13.9%) have no formal education (STATS SA, 2016a). Limpopo province is among the provinces which experienced a high net out-migration between 2006 and 2011 (STATS SA, 2012a). Limpopo province is by far the leading province with a highest proportion of households (93.6%) displaying adequate access to food (STATS SA, 2019). However, it is still the second poorest province in South Africa, with a reported headcount poverty level of 70% (STATS SA, 2017a).

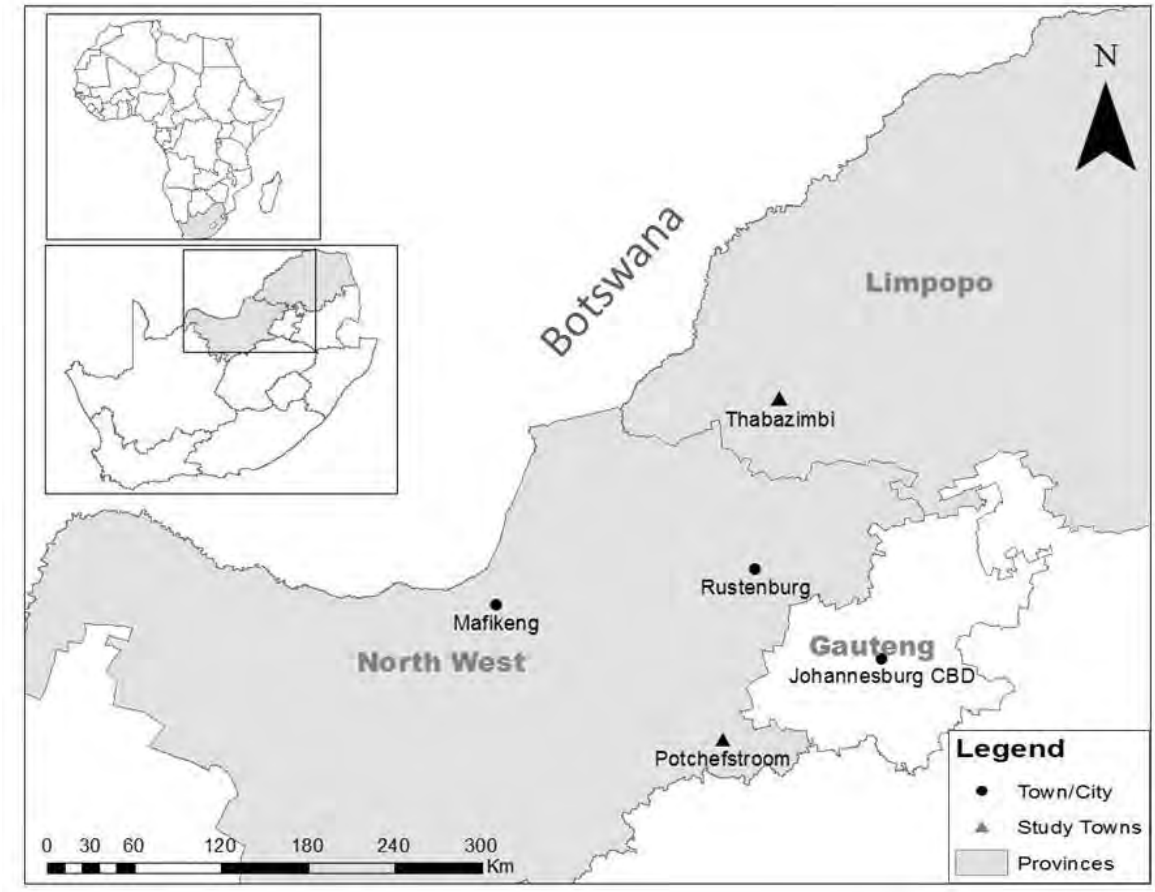

Figure 1.1: Location of the study towns

Limpopo province is predominately within the savanna biome, coupled with some small areas of grassland and forest biomes (Mucina & Rutherford, 2006). It is characterised by summer rainfall and mild winters which are mostly frost-free (Limpopo DFED, 2004). The province's western part is semi-arid, while the eastern part is largely sub-tropical. Limpopo province is prone to recurrent droughts, particularly experienced at the western and northern parts of the province.

North West province is located on the northernmost part of South Africa and shares an international border with Botswana to the north. Locally, the province borders with Northern Cape in the west, Free State in the south, Gauteng in the east and Limpopo in the north-east (Figure 1.1). North West province covers 105, 238 km^2, representing 8.7% of South Africa (STATS SA, 2017b). The province is home to about 3.8 million people (STATS SA, 2016a). North West province is divided into four districts, which in turn comprises of a total number of 18 local municipalities.

The majority (91.6%) of the province's inhabitants are Black Africans. Whites, Coloureds and Indians or Asians represent 6.4%, 1.6%, and 0.4%, respectively (STATS SA, 2016a). The Batswana constitute the majority (71.5%) across the province while Afrikaners (7.2%), Basotho (5.8%), and amaXhosa (5.1%) are few. The majority (76%) of the people aged 20 years and above have attained primary education as their highest educational level while a few (2.6%) have attained tertiary education (STATS SA, 2016a). North West province experienced an out-flow migration between 2006 and 2011 (STATS SA, 2012a). Despite the economic prospects of North West province, mostly from the mining industry which contributes a large share to the province's economy, the province experiences high poverty rates (64.3%) (STATS SA, 2017a). Similarly, the province recorded a highest proportion of households (25%) reporting inadequate access to food, which is higher than the national rate of 16% (STATS SA, 2019).

Most (71%) of the province falls in the savanna biome, with the remaining proportion been grassland (Walmsley & Walmsley, 2002). Climatically, the province experiences well-defined hot summers and cool, dry winters. The province rainfall pattern is erratic, with the mountainous and eastern regions receiving a significantly more rainfall compared to the semi-arid western part (Walmsley & Walmsley, 2002). The rainfall season normally spans from October till March.

1.8.1. Potchefstroom

Potchefstroom (26^{o} 42' 53" S; 27^{o} 5' 49" E) is located in the JB Marks Local Municipality, in the south-eastern part of the North West province (Figure 1.1). The JB Marks municipality falls under the administration of Dr Kenneth Kaunda District Municipality. The town of Potchefstroom was founded in 1838 by the then Dutch settlers and it was the first capital of the South African Republic (ZAR). The Mooi River runs through the town, separating it into two parts. Potchefstroom sits at 1,350 m above sea level. The town covers an estimated area of 55 km^2 and is home to approximately 250,000 people (Tlokwe City Council, 2012). The area comprises of the main town and its four adjacent townships, namely Ikageng, Ikageng extension, Mohadin and Promosa. The commonest languages in Potchefstroom are Setswana, Afrikaans and English. Approximately 80% of the inhabitants live in formal dwellings, although almost half of the households have incomes of less than R1,000 per month (US$70). The economy is anchored in mining, manufacturing and agriculture (Tlokwe City Council, 2012). In regard to mining, gold is the predominate mineral mined in the area, with the world's deepest gold mines situated herein. The unemployment rate is 21.6%. Nearly half of the people in the local municipality had some secondary (46.5%) and primary (42.9%) education while a few attained tertiary (4.9%).

Potchefstroom is regarded as a historical and educational centre (NWDACERD, 2010; Tlokwe City Council, 2012). The first constitution of the Republic was formulated in this town. The town has a historical university, North-West University (Potchefstroom campus), which was established in 1869 as the then Potchefstroom University for Christian Higher Education. The town also has several schools (primary and secondary) and other tertiary institutions. Potchefstroom is also a culturally vibrant town and hosts one of South Africa's biggest cultural events, the *Aardklop* festival (NWDACERD, 2010). Potchefstroom also hosts numerous national and international sporting events, as it is renowned for the best sports training centres in South Africa.

The climatic conditions of the town are evenly defined, with wet summers and cold, dry winters which are often accompanied by frost. Potchefstroom receives an annual rainfall averaging 600 mm, normally between October and May. The maximum and minimum daily temperatures are 30^{o} C and 0^{o} C, respectively. Potchefstroom is located in the grassland biome (Mucina & Rutherford, 2006).

1.8.2. Thabazimbi

Thabazimbi (24° 35' 30" S; 27°24' 42" E) is situated in the south-western part of the Limpopo province (Figure 1.1). Thabazimbi is commonly known as 'Iron Mountain', a name derived from the town's rich iron ore deposits. The town lies at the foot of the Ysterberg Mountains. Thabazimbi was proclaimed as a town in 1953, shortly after the commencement of the iron mining industry in the area (Thabazimbi Local Municipality, 2016). Besides iron, mining of platinum, andalusite and limestone also occurs. Besides minerals, Thabazimbi is a tourism destination, due to its diverse wildlife on surrounding game farms. The town is administered by the Thabazimbi Local Municipality, which in turn falls within the Waterberg District Municipality. Thabazimbi is situated at 1,042 m above sea level. The population is 28,847 inhabitants (STATS SA, 2011). Setswana (53.8%) is the most spoken language in the town, followed by Afrikaans (17.2%) and Sepedi (9.9%) (STATS SA, 2011). The majority have an average household income within the ranges of R3,000 to R6,400 per month (US$200 to 420). However, a considerable proportion (13%) of households report zero income (STATS SA, 2011). About two-thirds (63.9%) of the people residing in Thabazimbi Local Municipality had some secondary education while a few attained only primary (19.4%) or tertiary (7.6%) (STATS SA, 2014). The economy is dominated by the mining industry, along with agriculture and tourism (Thabazimbi Local Municipality, 2015). Despite the seemingly diverse economy in the area, Thabazimbi is battling with high unemployment rates (20.6%).

Thabazimbi is semi-arid, characterised by wet summers and cold to dry winters with the possibility of fairly frequent light frost. The maximum and minimum temperatures average 36.6^{o} C and -3.7^{o} C, respectively. Rainfall is erratic in the area, averaging 450 mm per year and normally received between October and April (Thabazimbi Local Municipality, 2016). The town is situated in the savanna biome consisting of mixed bushveld vegetation types (Mucina & Rutherford, 2006).

1.9. Research design

The study data collection was framed using a mixed method approach. According to Creswell et al. (2003: 212), mixed method approaches involve "the collection and analysis of both qualitative and quantitative data in a single study in which the data are collected concurrently or sequentially …and involve the integration of data at one or more stages in the process of research". Mixed methods combine the elements of both qualitative and quantitative research

approaches (Creswell, 2014). The essence of this approach is that it provides a nuanced exposition of the phenomenon under study compared to when a single approach is used. Therefore, mixed method approaches offer a more comprehensive analysis of the overarching goal of the study. Teddlie & Tashakkori (2003) postulated that mixed method approaches are superior to single approach designs, because they answer research questions that other methodologies cannot, enable stronger inferences and collate divergent views. Further to that, integration of both quantitative and qualitative data in a single study offers an opportunity to cross-check the accuracy of the data, hence promoting validity (Creswell, 2014). Moreover, mixed method approaches enhance the collected data, as one method potentially serves to compliment the weaknesses of the other.

There are several typologies of mixed method research designs, but the most common and widely used are (i) convergent parallel, (ii) explanatory sequential and (iii) exploratory sequential mixed method designs (Creswell, 2014). In this study, an explanatory sequential mixed method design (Figure 1.2) was used for data collection. This design entails "…collecting and analysing first quantitative and then qualitative data in two consecutive phases within one study" (Ivankova et al., 2006: 4). The essence of this design is that emerging issues from quantitative results are further interrogated and explained through the qualitative data. This design is termed explanatory because qualitative data are used to explain quantitative data and it is sequential because it first begins with execution of the quantitative phase which gives way to the qualitative phase.

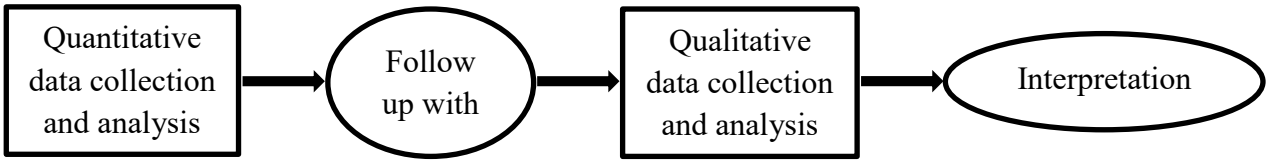

Figure 1.2: Explanatory sequential mixed method approach (Source: Creswell, 2014)

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Chapter 2

Forageable plant species in urban spaces: Prevalence, composition and distribution in two medium-sized towns of South Africa

Abstract

Globally, the importance of urban vegetation in the quality and maintenance of life in urban areas is increasingly recognised. As the basis of urban green infrastructure, urban vegetation provides a diversity of ecosystem services, including provisioning services. However, there is limited understanding of the potential of urban vegetation as a supply of forageable resources within urban landscapes. This study examined the prevalence and distribution of forageable plant species across different spaces in the towns of Potchefstroom and Thabazimbi, South Africa. A multi-stage sampling technique was employed for selecting study sites, with a total of 136 plots sampled for vegetation inventory. In total, 262 plant species were encountered across the sample plots, with over half (61%) indigenous to South Africa. Overall, mean species richness and diversity was 9.0±2.81 and 1.8±0.38 per plot, respectively, albeit varying across the type of spaces. Approximately half (53%) of the identified species had at least one documented use, either for food, medicine, energy and or other purposes. But medicine, food and firewood were the most dominant plant uses, in order of frequency. Abundance, richness and diversity of plant species differed significantly between forageable and non-forageable species, being markedly higher for the former than the latter. The findings show that the fragmented urban spaces are endowed with a diversity of plant species, with some valuable to particular sectors of urban society, such as foragers. Moreover, the high proportion of forageable species demonstrates the potential of urban greenery as a supply of provisioning and cultural ecosystem services. Hence, urban greenery should be promoted for enhancing liveability and overall well-being in urban areas.

Keywords: Diversity, Green infrastructure, Livelihoods, Urban foraging, Urban ecology

2.1. Introduction

Globally, the importance of urban vegetation in the quality and maintenance of life is increasingly recognised (Larondelle & Strohbach, 2016; Hurley & Emery, 2018; Caliskan & Aktağ, 2019). As the basis of urban green infrastructure, urban vegetation provides diverse ecosystem services such as provisioning, regulating, supporting and cultural services (TEEB, 2011; Haase et al., 2014). Provisioning services include tangible benefits derived from ecosystems such as food, raw materials, fresh water and medicinal resources (Haase et al., 2014; McLain et al., 2014; Shackleton et al., 2015; Russo et al., 2017) while regulating services maintain the ecosystem functions such as air quality, flood control and carbon sequestration (Lafortezza et al., 2009; Borelli et al., 2015; Nolon, 2016; Masoudi & Tan, 2019). Cultural services are intangible, psychological and cognitive benefits enjoyed through human-biodiversity interaction such as tourism, recreation, aesthetic inspiration, spiritual, mental and physical health well-being (Lafortezza et al., 2009; Nazir et al., 2014; De Lacy & Shackleton, 2017a). Supporting services are existential to other ecosystem services through providing conducive environments for plants, animals and microorganisms to survive, diversify and adapt to changing dynamics (Haase et al., 2014). These ecosystem services play a vital role in enhancing urban liveability and promoting sustainable cities (Russo et al., 2017; Caliskan & Aktağ, 2019). Moreover, urban vegetation is essential in establishing and strengthening social ties within neighbourhoods (Gopal & Nagendra, 2014), a phenomenon critical for community's resilience and adaptation to urbanisation challenges (Pierce et al., 2011). Over and above, urban vegetation is often the only avenue for human-biodiversity interaction in urban areas (Jaganmohan et al., 2012).

Although there is abundant literature on urban vegetation and ecosystem services, a greater proportion of the literature has largely concentrated on non-consumptive benefits such as supporting and regulation functions (Shackleton, 2012; Poe et al., 2013; Russo et al., 2017; Hurley & Emery, 2018). In contrast, the prospect of urban vegetation as a source of consumptive benefits has received limited attention, particularly from urban planners and developers (Larondelle & Strohbach, 2016; Hurley & Emery, 2018). This might result in underestimating the potential contribution of urban vegetation to livelihoods and human well-being (Kaoma & Shackleton, 2015a) and therefore misaligned policies and interventions. Nonetheless, emerging studies demonstrate that urban vegetation is multifunctional in providing a suite of ecosystem goods and services to both the human and physical environment (Haase et al., 2014; Russo et al., 2017). For example, urban vegetation is a

source of forageable resources in many countries worldwide (Shackleton et al., 2017). Many urban residents forage various plant resources from a mosaic of urban green spaces for their subsistence and well-being needs. This is documented in North America (Poe et al., 2013; McLain et al., 2014; Short-Gianotti & Hurley, 2016; Synk et al., 2017); Germany (Palliwoda et al., 2017; Landor-Yamagata et al., 2018) and sub-Saharan Africa (Kaoma & Shackleton, 2014a; Schlesinger et al., 2015; Mollee et al., 2017). These studies conclude that urban foraging is a ubiquitous practice, transcending different socio-demographic attributes and contexts. Moreover, several plant taxa have multiple uses. In Berlin (Germany), a total of 125 distinct plant taxa were foraged (Landor-Yamagata et al., 2018). In USA, about 486 and 170 plant taxa were foraged in the cities of Seattle and Baltimore, respectively (Poe et al., 2013; Synk et al., 2017), and approximately 48 in Kampala (Uganda) (Mollee et al., 2017).

Although the above studies demonstrates the potential of urban vegetation as a supply of forageable resources, there is still limited research quantifying the proportion of forageable species within the entire species pool within the urban landscape (Hurley & Emery, 2018). There has been examination of urban vegetation compositional patterns across different land-use types, such as sacred sites (De Lacy & Shackleton, 2017b; Jaganmohan et al., 2018; Caliskan & Aktağ, 2019), homesteads (Jaganmohan et al., 2012; Kaoma & Shackleton, 2014b), parks (Nagendra & Gopal, 2011; Talal & Santelmann, 2019), street-ways (Nagendra & Gopal, 2010; Gwedla & Shackleton, 2017) and urban commons (Jha et al., 2019). These studies have quantified the composition, distribution, abundance and structure of urban vegetation in these urban landscapes. Although this information is important in informing planning, conservation and sustainability of urban vegetation; it overlooks the multifunctionality and diversity of urban ecosystems. Thus, there is a need to quantify the composition of forageable plant resources across different urban spaces. This will provide insights on the spaces endowed with valuable resources. Furthermore, this will inform management and conservation of ecological hotspots within the urban landscapes. Hence, the aim of this study to examine the prevalence and distribution of forageable plant species across different spaces in the towns of Potchefstroom and Thabazimbi, South Africa.

2.2. Methods

2.2.1. Study areas

Refer to Chapter 1 for the detailed information on the study areas.

2.2.2. Data collection

A multi-stage sampling technique was employed in selecting sites for vegetation sampling. Firstly, a household survey was conducted with a random sample of 374 households drawn from the study towns (Chapter 3). The household survey elicited data on the prevalence and patterns of foraging practice. Secondly, regular foragers identified during the household survey interviews were asked to volunteer their time and lead the researcher to the various spaces they visit for foraging. The subsequent spaces visited consisted of public and institutional green spaces, remnant vegetation, gardens, private spaces, informal spaces, and interstitial spaces. The identified spaces were grouped into five broad types: cemeteries, domestic gardens, protected areas, riparian areas and vacant spaces. In this study a cemetery refers to a piece of land designated for burying the remains of human beings, domestic garden refers to a section within a homestead which is normally reserved for cultivating crops, flowers, vegetables, herbs, etc. while riparian area simply means a piece of land situated within water bodies, such as along rivers, streams and lakes. A vacant space denotes a piece of land that has no building infrastructures on it. This land can be situated within and at the edges of towns. On the other hand, the study adopted the IUCN definition of protected areas, which refers to "… a clearly defined geographical space, recognised, dedicated and managed, through legal or other effective means, to achieve the long term conservation of nature with associated ecosystem services and cultural values" (IUCN, 2008: 8). However, these zones are not exhaustive and foraging occurs in wide range of spaces, depending on forager's decisions. The unit of analysis for this study was green spaces situated within the five types, where foraging normally takes place. Since the population of the actual foraging spaces was unknown, a purposive sampling technique was deemed suitable in selecting the sample sites. With the assistance of regular foragers, 28 sites spanning across the five types were purposively sampled. At each foraging site, an average of 4.9 plots of 20 x 10 m size was sampled for vegetation inventory. Within each plot, five 2 x 2 m quadrats were demarcated for identifying herbaceous layer, one at each corner and middle of the plot, respectively. A total of 136 plots were purposively sampled.

Within each plot, all the plant species were listed. The percentage cover of woody plants and herbaceous layer was visually estimated following the Braun-Blanquet cover-abundance scale (Mueller-Dombois & Ellenberg, 1974). Unknown species were collected, pressed and deposited to the following herbariums for identification: Selmar Schonland Herbarium

(Rhodes University), AP Goossens Herbarium (North-West University) and Larry Leach Herbarium (University of Limpopo).

2.2.3. Data analysis

The data were captured into Microsoft Excel 2010. Statistical analysis was conducted in 'R' version 3.5.1. Descriptive statistics were used for summarising the data about species distribution, composition and abundance. Species diversity was determined using species richness (S) and Shannon-Wiener index of diversity (H). Species richness was calculated as the total number of different plant species (woody and herbaceous) represented within foraging spaces. On the other hand, species diversity took into account the richness and the relative abundance of each species within a given community. The Shannon-Wiener index of diversity is the most widely used index for analysing species diversity, expressed as follows:

$$H' = -\sum_{i=1}^{S} p_i \ln p_i \quad (1)$$

Where H' = Shannon index, S = species richness, p_i = proportional relative abundance of the i^{th} species.

Kruskal-Wallis tests were used for comparing variations in species abundance, richness and diversity across the five spaces. An ordination was conducted to establish associations between plant species composition and space types using detrended correspondence analysis (DCA) (Hill & Gauch, 1980). T-tests were conducted to determine significant differences in species diversity between forageable and non-forageable species across the five spaces.

2.3. Results

2.3.1. Species composition and abundance

A total of 262 different plant species were encountered, with 163 identified to the species level, 23 partially identified (either genus or family) while 76 were unidentified. The most common species were *Vachellia karroo*, *Senegalia caffra*, *Grewia flava*, *Amaranthus hybridus* and *Aloe greatheadii*. These species accounted for 15.8% of the total species recorded across the sites. The aforementioned species are the most sought after forageable species for energy, food and medicine in the study towns. Of the 163 identified species, over half (60.8%) are indigenous, 32.3% are non-native, while the remainder were unidentified. The top ten species were indigenous to South Africa. The mean species richness per plot was

9.0±2.81, ranging from 3 to 16 species. The mean species diversity per plot was 1.8±0.38, ranging from 0.7 to 2.6.

2.3.2. Species distribution, composition and abundance across the different spaces

Species composition differed with space type. Vacant spaces were dominated by *Combretum apiculatum* and *Melinis repens*, while riparian areas were dominated by *Amaranthus hybridus* and *Vachellia karroo* (Table 2.1). The most prevalent species in protected areas were *Aloe greatheadii* and *Senegalia caffra* while domestic gardens were *Amaranthus hybridus* and *Capsicum frutescens*. Cemeteries were dominated by *Vachellia karroo* and *Brachiaria brizantha*.

Table 2.1: The most common plant species across the different space types

Species	Cemetery	Domestic	Protected	Riparian	Vacant
Vachellia karroo	+	+	+	+	+
Eragrostis trichophora	+		+		
Ziziphus mucronata	+			+	
Tribulus terrestris	+			+	
Senegalia caffra			+	+	+
Grewia flava			+		+
Dichrostachys cinerea				+	+
Amaranthus hybridus		+		+	
Vangueria infausta		+			+
Brachiaria brizantha	+				
Paspalum spp.	+				
Solanum elaeagnifolium	+				
Sida dregei	+				
Chamaecyparis lawsoniana	+				
Capsicum frutescens		+			
Prunus persica		+			
Solanum lycopersicum		+			
Spinacia oleracea		+			
Cucurbita maxima		+			
Dactyloctenium australe		+			
Cleome gynandra		+			
Aloe greatheadii			+		
Themeda triandra			+		
Asparagus laricinus			+		
Searsia leptodictya			+		
Datura stramonium				+	
Bidens pilosa				+	
Senegalia burkei				+	
Combretum apiculatum					+
Melinis repens					+
Ximenia americana					+
Searsia pyroides					+

Note: + denotes occurrence

Of the top ten common species, only three occurred in all space types: *Vachellia karroo, Grewia flava* and *Aloe greatheadii*, albeit with differing cover abundance (Table 2.2). *Vachellia karroo* was more abundant in the vacant spaces, protected areas and riparian areas as compared to the other two spaces, while *Grewia flava* and *Aloe greatheadii* only had the highest cover in the protected areas.

Table 2.2: Mean percentage cover of the common species appearing in all the spaces

Species	Cemetery	Domestic	Protected	Riparian	Vacant
Vachellia karroo	3.2±6.04	1.0±1.91	6.3±10.37	5.3±8.58	6.6±11.72
Grewia flava	0.2±0.58	0.3±0.76	4.0±5.40	1.3±4.24	2.5±5.05
Aloe greatheadii	0.2±1.01	0.1±0.38	6.1±2.25	0.5±2.19	1.3±3.82

Species abundance, richness and diversity varied with space type. In regard to species richness, it was significantly higher in protected areas as compared to other spaces ($\chi^2_{4, 136}$ = 27.32, p = 0.001) (Figure 2.1a). The same applied to species diversity, which was significantly higher in protected areas as compared to other spaces ($\chi^2_{4, 136}$ = 31.84, p = 0.001) (Figure 2.1b). In contrast, species abundance did not differ significantly across the space types ($\chi^2_{4, 136}$ = 4.93, p = 0.295) (Figure 2.1c).

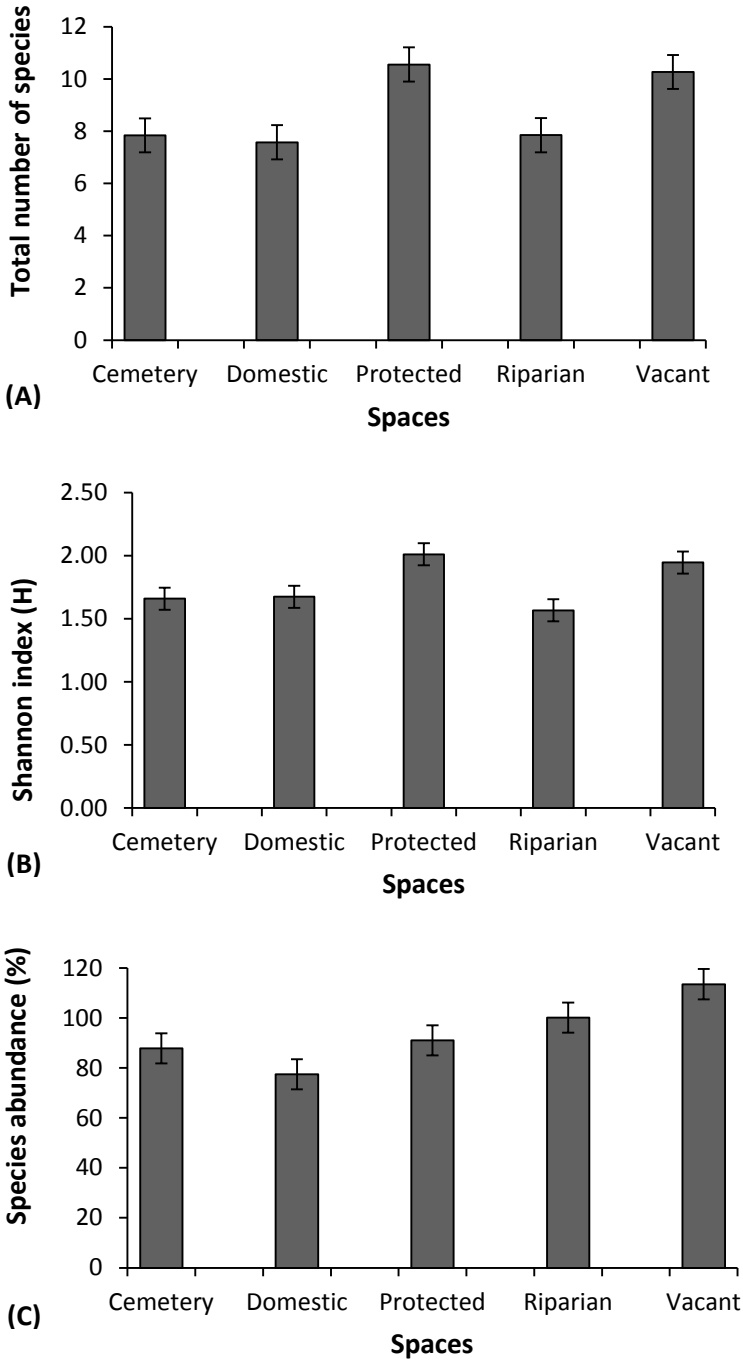

Figure 2.1: Species richness (A), diversity (B) and cover abundance (C) across the different spaces

2.3.3. Similarities in flora across the different spaces

The extent of species similarity across the five spaces was relatively low, as evidenced by the divergence of spaces away from each other in the DCA ordination plot (Figure 2.2). Three of the five spaces displayed moderate levels of species similarity, namely protected areas,

riparian areas and vacant spaces (Figure 2.2). In contrast, cemeteries and domestic gardens were relatively dissimilar to these spaces. *Ziziphus zeyheriana*, *Ximenia americana*, *Grewia flava* and three other unidentified species were primarily associated with vacant spaces. The cluster for the cemeteries was characterised by the presence of species such as *Chamaecyparis lawsoniana*, *Sida dregei*, *Pentarrhinum insipidum*, *Eragrostis trichophora*, *Ehretia rigida*, *Conyza bonariensis* and *Bidens pilosa*. Domestic gardens were weakly associated with *Amaranthus hybridus*. In regard to riparian areas, they were strongly associated with *Datura stramonium* but weakly associated with *Vachellia karroo*. Protected areas were characterised by greater presence of *Elephantorrhiza elephantina*.

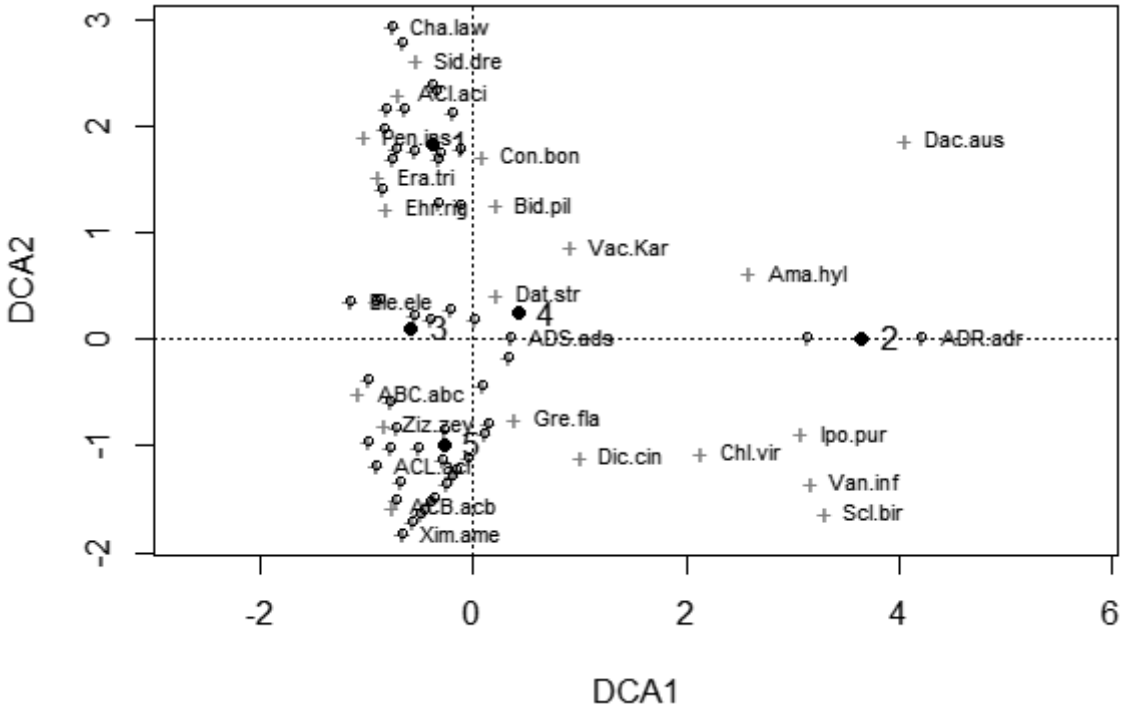

Figure 2.2: DCA plot showing distribution of plant species across the different space types. The abbreviated species names are represented by (+) symbol while space types being (•). The numbers represent space types, where 1=cemeteries, 2=domestic gardens, 3=protected areas, 4=riparian areas and 5=vacant spaces.

2.3.4. Proportion, abundance and uses of forageable species

Of the 163 identified species, nearly one-quarter (23%) were reported forageable by the foragers. Additionally, 39% of the remainder had at least one documented use for food, medicine, energy or other purposes (Venter and Venter, 2002; van Wyk & Gericke, 2000; van Wyk et al., 2009). Therefore, about half (53%) of the species are forageable and provides

household energy, dietary and health needs and other purposes. However, most of the species had multiple uses, with one or more distinct plant parts collected for various uses. Approximately 144 distinct plant uses were identified, mostly dominated by food, medicinal, energy and others such as crafting and carving; with fruits, leaves, branches, bark and roots being the principal sources. Most tree species provided more than one uses, with one and three uses being modal (Figure 2.3a). In contrast, shrubs and herbaceous were mostly dominated by one use. The most dominant species use was medicine, followed by food and firewood (Figure 2.4). However, a considerable proportion of species also provided other uses such as crafting, carving and construction materials. Trees were mostly a source of food or a combination of firewood, medicine and other uses while herbaceous was food and medicine. However, we would like to acknowledge that the boundary between 'food' and 'medicine' is often blurry and commonly overlaps, thus forageable species providing food can be considered as medicine and vice versa.

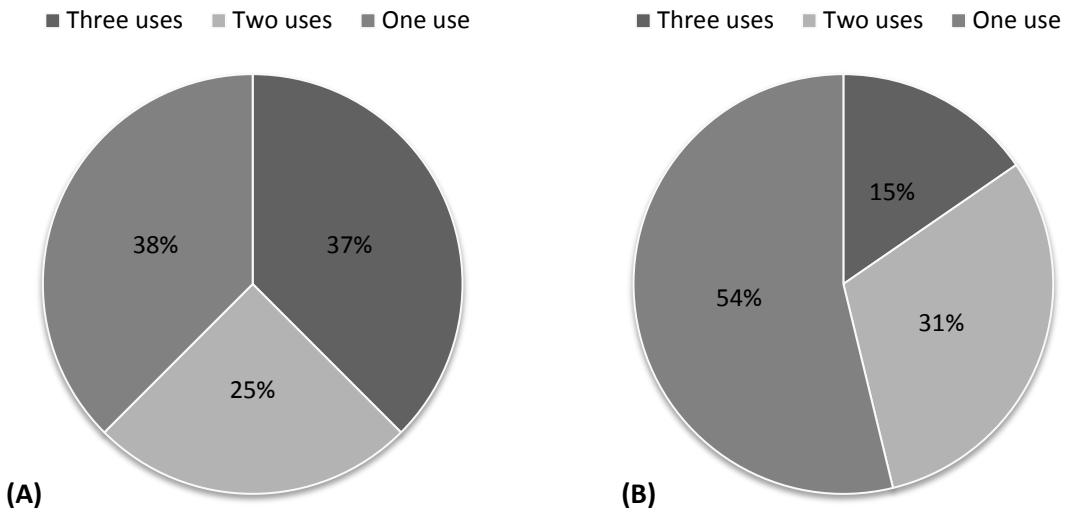

Figure 2.3: Proportion of number of uses for trees (A) and shrubs (B)

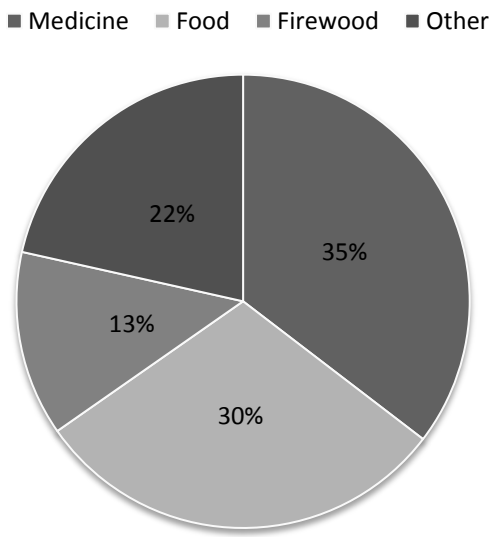

Figure 2.4: Proportion of plant species uses

Species cover abundance differed significantly between forageable and non-forageable species (t_{136} = 2.92, p = 0.04), being markedly higher for forageables (40.1±28.28) than non-forageables (29.5±31.10). With the exception of cemeteries, forageable species were more abundant than non-forageable ones across all spaces (Figure 2.5a). Similarly, species richness was significantly higher for forageable species (4.7±2.24) than non-forageable ones (2.1±1.64) (t_{136} = 11.01, p = 0.001). Protected areas, domestic gardens and vacant spaces recorded higher mean forageable species richness than the other sites (Figure 2.5b). Species diversity was markedly higher for forageable (1.2±0.49) than non-forageable (0.5±0.55) species, which significantly differed from one another (t_{136} = 9.84, p = 0.001) (Figure 2.5c).

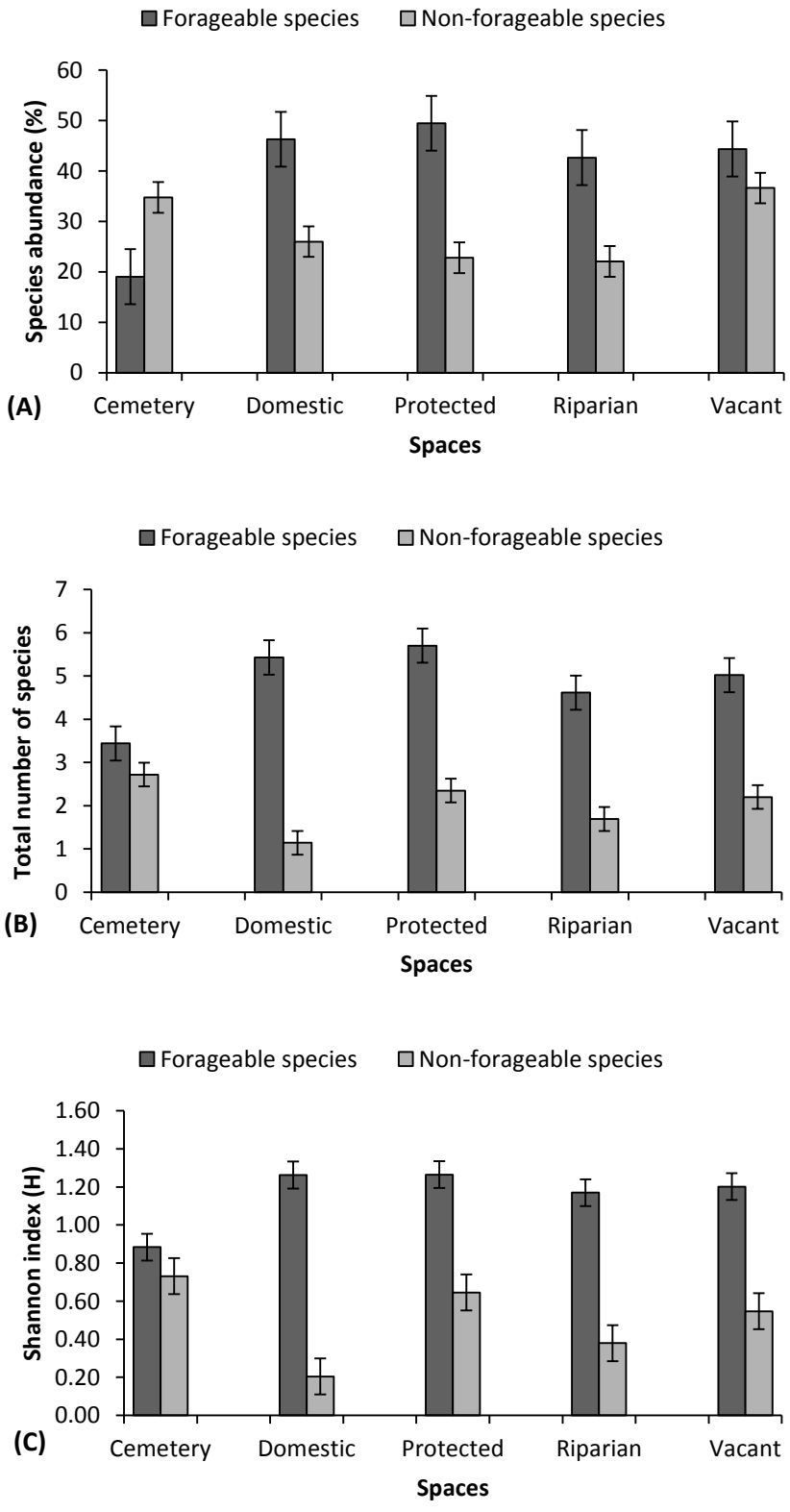

Figure 2.5: Species cover abundance (A), richness (B) and diversity (C) between forageable and non-forageable species across the different spaces

2.4. Discussion

The results demonstrate that fragmented spaces within the urban landscape are endowed with a diversity of plant species, with many valuable to urban people. The notable number of plant species encountered across the different spaces demonstrates the potential of urban vegetation in supplying ecosystem goods and services. Urban vegetation provides provisioning, regulating, supporting and cultural services (Haase et al., 2014; De Lacy & Shackleton, 2017a; Hurley & Emery, 2018; Masoudi & Tan, 2019). Studies from elsewhere also recorded a notable number of plant species across a range of spaces within the urban landscape. In Istanbul (Turkey), Caliskan and Aktağ (2019) showed that sacred sites within urban areas were a host to rich biodiversity, with one (64 ha) out of five sacred sites (132 ha) sampled having 118 distinct plant species. A total of 93 plant species were recorded from various sacred sites within Bengaluru, India (Jaganmohan et al., 2018) and De Lacy and Shackleton (2017b) recorded a total of 139 woody plant species across different sacred sites in Grahamstown, South Africa. Secluded areas such as sacred sites were found to be home to some of the rarest ecological species within a particular urban environment (Jaganmohan et al., 2018). The species found in sacred sites add to the diversity of species within the urban environment. Moreover, some studies contended that sacred sites may be composed of a larger proportion of native species when compared to other land-use types within the urban landscape (Nagendra & Gopal, 2011; De Lacy & Shackleton, 2017b; Jaganmohan et al., 2018). Therefore, sacred sites could act as a sanctuary of native biodiversity amidst urban transformation brought about by the urbanisation. Vacant spaces can also teem with diverse plant species, with about 141 plant species encountered in the vacant spaces of Bengaluru slums in India (Gopal & Nagendra, 2014). The majority of the species were known for medicinal uses. In regard to homestead spaces, Kaoma and Shackleton (2014b) indicated that over three-quarters (90%) of the sampled households had at least one tree species in their homesteads in three medium-sized towns of northern South Africa.

The findings show that species diversity significantly differs with space types. This is in keeping with Nero et al. (2017) finding in Kumasi (Ghana), where species diversity differed across the sampled nine urban green spaces, being significantly higher in home gardens, institutional spaces and public parks. Similarly, Bourne and Conway (2014) observed that species composition and diversity differed across eight land-use types in the Peel region, south-eastern Ontario (Canada). In the present study, protected areas displayed a significantly

higher species diversity (Shannon-Wiener index and richness) relative to other space types. This could be attributed to land-use tenure, as the protected area was once fenced off and access and harvesting of resources controlled. In principle, cutting or harvesting of any plant products within the protected area is prohibited unless sanctioned by the manager. This is consistent with Löki et al. (2015) who contend that biodiversity in secluded urban areas has the opportunity to flourish, given the management and conservation interventions and reduced threats from anthropogenic activities. In contrast, biodiversity existing in other areas, such as urban commons is threatened by urban transformation, as demonstrated by results from Bengaluru, India (D'Souza & Nagendra, 2011; Mundoli et al., 2017). Plant species similarity differed across space types, with the highest proportion of species similarity displayed between protected areas, riparian areas and vacant spaces. Nero et al.'s (2017) contend that variation in species composition across different urban green spaces in Kumasi (Ghana) could be, in part, a result of the extent of human interventions or management strategies over the production of urban green spaces. In contrast, cemeteries and domestic gardens were characterised by different species. This could be possibly attributed to human intervention in species preference, which might differ with the ones found in natural and semi-natural environments. The findings corroborates Bourne and Conway's (2014) notion that differences in species composition and pattern across different urban spaces are mediated by the general heterogeneity of urban landscapes in terms of their purpose, management objectives and diverse decision-makers.

Slightly over half of the identified plant species were forageable, either for food, medicine, energy and or others purposes. However, most of the species had multiple uses and distinct plant parts were collected for various uses. Nearly one-quarter (22.1%) of the plant species provided two or more uses. This finding is similar to the observation made by Hurley and Emery (2018) in New York (USA), where over three-quarters of the known plant species in the city had at least one documented use. Just like in this study, the individual plant species had multiple uses and various parts of the same species were collected for different purposes. The finding on the proportions of forageable plant species across the different space types demonstrates the potential of urban vegetation as a source of provisioning and cultural ecosystem services. This is despite the limited attention paid to the potential of urban landscapes in the production of provisioning services. Nonetheless, the increasing number of studies conducted in urban areas demonstrates that various urban spaces are endowed with a

variety of species stocks with multifunctional uses (Gopal & Nagendra, 2014; Hurley & Emery, 2018).

Medicine, food and firewood were the most dominant plant uses, in order of frequency. This finding is consistent with Hurley and Emery (2018) in New York (USA), Gopal and Nagendra (2014) in Bengaluru (India) and Furukawa et al. (2016) in Nairobi (Kenya). Medicine, food and ornamental occupied the largest proportion of the identified total plant uses in these studies. In regard to Nairobi and Bengaluru, the plant resources were of utmost importance to the urban poor living in the fringes of the city. Traditional medicine is integral to people's health needs and overall well-being. Moreover, it could emerge as important sources of health to some quarters of the urban society, particularly those without adequate access to institutional health care systems. Therefore, medicinal plants could be a viable but affordable primary health care option for treating minor discomforts and ailments. Approximately 80% of the developing world's population rely on traditional medicine, either as a complement to the institutional health care system or as the only source of health care (Mahomoodally, 2013). In Africa, the use of traditional medicines is widespread and in some countries it is the primary health care option (Mahomoodally, 2013; WHO, 2013). From a political ecology perspective, medicinal plants are an integral part of attaining health security and sovereignty (Kassam et al., 2010). Through this lens, people are able to source medicines that suit social, cultural and ecological contexts as well as being affordable and reliable in the long run. This is particularly important in the context of the rapid urbanisation worldwide, which increases the costs of providing basic but essential services in urban areas, such as adequate health care system (Bhattacharya, 2002). Therefore, urban vegetation could contribute to fulfilling health needs and in turn promoting health sovereignty.

In regard to plant species used for food and firewood, they are essential in provision of household energy and dietary diversity to some urban residents. Since time immemorial, humans have subsisted on wild foods as their primary food source (Hall, 2013; Sachdeva et al., 2018). At least one billion people worldwide rely on wild foods for meeting food and dietary needs (Aberoumand, 2009). Besides, firewood has remained an indispensable source of energy for the majority of the households in both rural and urban contexts (Shackleton et al., 2006; Makonese et al., 2017). The above insights on plant uses show the role of urban vegetation towards enhancing liveability and in turn promoting sustainable cities.

The diversity of forageable species differed significantly with space type. Cover abundance, richness and diversity of forageable species were slightly higher in the protected areas and domestic gardens compared to the other three spaces. The notable forageable species diversity in these two spaces could be influenced by land-use tenure and land management. As explained earlier, the spaces are governed under private tenure, which may limit and or restrict access to the resources therein. In contrast, forageable species composition differed significantly in New York's five boroughs albeit not following a uniform pattern (Hurley & Emery, 2018). But of noteworthy in latter study, was the high prevalence rate of forageable species in densely populated boroughs such as Manhattan. This could be associated with human manipulation for priority species. Overall, the present study finding on the distribution of forageable species is important to urban space planners and developers, as it will assist them in identifying and zoning ecological hotspots endowed with valuable species worth of conservation and at the same time being a source of provisioning and cultural ecosystem services.

2.5. Conclusion

This study demonstrates that a range of spaces within the urban landscape are habitat to a diversity of plant species. The notable number of plant species recorded in this study and elsewhere points to urban green spaces as a key supply of ecosystem goods and services, particularly the provisioning services which are of interest to some segments of the urban community, such as foragers. Over half of the identified plant species were indigenous to South Africa. Therefore indigenous trees, particularly edible ones should be prioritised during tree planting initiatives and urban greening campaigns, thereby increasing the resource stock across the urban landscape. Plant species diversity varied with space types, being significantly higher in protected areas than any other spaces. Some of the species found therein are forageable and of interest to foragers. It is important to formulate holistic but encompassing regulations promoting conservation and management of species hotspots in the urban landscape but at the same time promoting human-biodiversity interactions. Following, about half of the identified plant species were forageable and had at least one documented use. This finding calls for the attention of urban space managers and developers. These role-players need to take into consideration the various remnant spaces endowed with valuable species into spatial planning and development.

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Chapter 3

Urban foraging of wild plants in two medium-sized South African towns: People, perceptions and practices[1]

Abstract

Urban ecosystems provide goods and services critical to livelihood sustenance, environmental protection and sustainability. However, the potential role of some urban ecosystem services such as the provisioning services, to promote liveable cities and livelihood resilience is seldom considered. This study reports on the prevalence and pattern of wild plant foraging and uses in the towns of Potchefstroom and Thabazimbi, South Africa, based on a random sample of 374 households. Descriptive and inferential statistics were used for analysing data. Foraging wild plants was integral to livelihoods and traditions and provided household energy, dietary diversity, health, and cultural affirmation, among others. About 68% of the respondents reported foraging wild plants, albeit at varying degrees between and within towns. The prevalence of foraging differed significantly between and within towns, being higher in Thabazimbi and for residents on the outskirts of town. Although urban foraging transcends demographic and socio-economic backgrounds, the likelihood of foraging significantly differed in relation to childhood foraging background, perception towards the practice, location of residence in town and household affluence. Nevertheless, foraging was not limited to poorer households, as one-third of the more affluent households also foraged. Foraging occurred in both public and private green spaces, with public spaces being the most frequently visited. Motivations towards foraging were quite diverse and varied across space, context and over time. Overall, the high prevalence of foraging exhibited in this study and that from elsewhere should not be overlooked in urban landscape planning and development.

Keywords: Green infrastructure; Non-timber forest products; Perceptions; Urban foraging; Wealth; Wild plants

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3.1. Introduction

Urban ecosystems provide goods and services critical to human wellbeing, sustenance, environmental protection and sustainability (TEEB, 2011; Haase et al., 2014). Despite the marked shift of people from rural to urban areas, the attention given to urban ecosystems in supporting a conducive living environment and quality of life has been relatively little explored compared to rural ecosystems (Gómez-Baggethun et al., 2013). Urban ecosystem goods and services are classified into four types: provisioning, regulating, habitat or supporting and cultural services (TEEB, 2011). There is abundant literature on some types of urban ecosystem goods and services, such as regulating services, in promoting environmental sustainability (Russo et al., 2017). However, provisioning services have been largely overlooked in urban systems, particularly foraging of wild plants, hereafter termed urban foraging (McLain et al., 2012; Mollee et al., 2017; Shackleton et al., 2017). Foraging is generally perceived to be synonymous with rural areas (Joos-Vandewalle et al., 2018). Moreover, the literature on urban foraging is dominated by works from the Global North (Poe et al., 2013; McLain et al., 2014; Short-Gianotti & Hurley 2016), even though it is widely practised globally (Shackleton, et al., 2017). According to Svizzero (2016: 7) "foraging is the practice of harvesting non-cultivated plants for food, medicine, floral and greenery, craft products or other purposes, for personal use or sale", thereby being synonymous with plant non-timber forest products (NTFPs), our study adopts foraging in its broadest sense – incorporating other benefits such as energy, construction materials and other useful plant products.

Although foraging is a ubiquitous practice, there is a relative dearth of empirical knowledge on foraging practices in urban contexts (Short-Gianotti & Hurley, 2016; Mollee et al., 2017). This obscures the prevalence of urban foraging in development agendas and landscape planning. However, given the rapid urbanisation worldwide, it is envisaged that the foraging of wild plant resources could increase in many urban areas (Drury, 2009), because foraging practices do not necessarily decline as people shift from rural to urban areas (Cocks, 2006; Schlesinger et al., 2015). However, during the past decade and a half, urban foraging has received increasing interest because it provides social, economic, cultural and psychological benefits to some urban residents.

An emerging body of knowledge has provided some insights on urban foraging, particularly on foragers' profiles, the nature of the practice and knowledge production and sharing (Short-

Gianotti & Hurley, 2016; Synk et al., 2017; Landor-Yamagata et al., 2018). The influential works by Poe et al. (2013) and McLain et al. (2014) drawing upon ethnographic research from several cities in USA demonstrated that foraging is a widespread practice. Foragers gathered wild plants for food, medicine, floral, crafts and decoratives, among others. In Boston, Short-Gianotti and Hurley (2016) showed that almost half (49%) of the respondents were foraging. In Berlin (Germany), 12% of visitors' to formal urban parks foraged wild plants for various purposes (consumption, decoration and biodiversity experience), with consumption the most frequently cited purpose (Palliwoda et al., 2017), whilst Landor-Yamagata et al. (2018) reported that 125 different plant taxa were foraged in the city. Furthermore, foraging outweighed other commonly known park activities such as golfing and camping, echoing the observations of Robbins et al. (2008) in New England (USA). In Bangalore (India), urban foraging was critical in mitigating vulnerability of the urban poor from social shocks (Gopal & Nagendra, 2014), along with strengthening social capital, improving health and diversifying diets. Urban foraging is also prevalent in Africa, with most households foraging at least one wild plant resource (Kaoma & Shackleton, 2014; Schlesinger et al., 2015) and contributing an average of 20% of household cash and non-cash income (Kaoma & Shackleton, 2015). Urban foraging may transcend demographic, social and economic attributes, and it occurs in all types of formal and informal green spaces, including, but not limited to, parks, domestic gardens, remnant vegetation, urban forests, abandoned lots, street ways, public green spaces, walkways and railroad trails (McLain et al., 2014; Shackleton et al., 2017). Generally, foragers advance multiple motivations, including subsistence, culture, health, connection with nature and leisure (Palliwoda et al., 2017; Synk et al., 2017; Landor-Yamagata et al., 2018). Some studies noted that foraging was more than just meeting people's consumptive needs but a pleasurable and enjoyable activity in which to engage (Schunko et al., 2015).

From the above, it is evident that urban foraging is a globally ubiquitous practice and integral to some urban livelihoods. Whilst practiced for various reasons and needs, it potentially offers an important strategy for mitigating against livelihood vulnerability of some of the urban poor, thereby promoting livelihood resilience and sustainability (Ward & Shackleton, 2016; Synk et al., 2017). This calls for recognition and appreciation of urban foraging practices in urban development agendas and landscape planning and management. This would enable urban planners and policy makers to formulate holistic approaches which include the needs and aspirations of foragers in benefiting from the urban landscapes. Despite

the increasing knowledge on urban foraging, there are still significant aspects to be understood (Synk et al., 2017). Moreover, urban foraging is considered a "… contingent, contested, and heterogeneous practice" (Poe et al., 2014: 902) which differs across space and over time. Consequently, it is necessary to understand foraging practices in different settings across the globe (Palliwoda et al., 2017; Shackleton et al., 2017). Most of the literature has not examined the sources of foraged resources, despite this being a critical information gap if foraging is to be accommodated in land-use planning (Mollee et al., 2017). Against this background, this study aimed to assess the prevalence and pattern of wild plant foraging and uses in Potchefstroom and Thabazimbi, South Africa. To achieve this aim, the following research questions were addressed: (1) Who forages and where? (2) What is the pattern and nature of foraging practices? (3) What perceptions are held about foraging? (4) What are the motivations and barriers to foraging? (5) How is knowledge on foraging practice produced and shared?

3.2. Methods

3.2.1. Study areas

Refer to Chapter 1 for the detailed information on the study areas.

3.2.2. Data collection

An orthophoto for each town, stratified into four socio-economic zones (informal, Reconstruction and Development Programmes (RDP), township and affluent) was used as the sampling frame. Following Kaoma and Shackleton (2015), informal settlements are residential areas established by the newly migrants in towns or cities, without being sanctioned by the municipal officials. The RDP houses are a high density residential area, comprising of a national housing programme by the post-apartheid government for the indigent. While the township and affluent suburbs are medium and low density residential areas, which were formerly occupied by the black South Africans and the whites, respectively. ArcMap 10 software was used to randomly select 50 households per zone, equating to 200 households per town. However, the sampling quota for affluent areas was not achieved due to limited interest from residents despite several approaches. Consequently, the actual sample size was 374 participants from the two towns. The household survey was conducted between May and July, 2018. A standardised, semi-structured questionnaire was administered to any adult member of the household by face-to-face interviews. The

questionnaire elicited the following issues: foragers' socio-economic and demographic characteristics, foraging practices, foraging spaces, motivations and barriers to foraging, perceptions towards foraging and knowledge production and sharing. Prior to the interview, the term wild plant was explained to each respondent. In the context of this study, wild plant refers to plants growing in natural or semi-natural environments, without having been purposively planted and growing independent of or with very minimal human management. This also extends to plants growing in people's homesteads but wild in nature, as long as their existence is independent of human interventions.

A household wealth index was determined by asking respondents about the number of each asset in the household, which was then normalised per asset and totalled. To assess the respondents' perceptions, motivations and barriers towards foraging, they were presented with evaluative statements with which they were asked to agree or disagree on a five-point Likert scale. The scale ratings ranged between two extremes: strongly agree to strongly disagree. During analysis, the frequencies of similar options for all the statements comprising each construct were summed to derive composite values. The perceptions statements denoted feelings, beliefs and actions towards foraging. In regard to motivations, the statements considered culture, health, livelihoods and leisure. For the barriers, the statements revolved around foraging spaces, knowledge and information about foraging and regulations governing urban landscapes. Unfavourable and favourable statements were randomised to curb bias. Ethical approval of the study and questionnaire was provided by the Department of Environmental Science's Ethics Review Committee, Rhodes University (No. ES18/04).

3.2.3. Data analysis

Data were managed using Statistical Package for Social Sciences (SPSS) version 21. Descriptive and inferential statistics were used for presenting and analysing data. Measures of central tendency and dispersion, frequencies and proportions were used for summarising descriptive data. Chi-square and t-tests were used for determining significant differences between categorical and continuous variables, respectively, such as foraging practice, attitudes and foragers profile. Since perceptions, motivations and barriers towards foraging were assessed by a set of evaluative statements, the statements composing each construct were subjected to an internal consistency reliability test using Cronbach coefficient alpha, which returned the values of 0.78, 0.72 and 0.89 for perceptions, motivations and barriers, respectively, suggesting good internal consistency of the scale statements.

3.3. Results

3.3.1. Respondent profile

The sample consisted of 374 respondents with an average age of 44.1±15.6 years, ranging from 18 to 94 years. Most were female (55.6%), unemployed (35.8%), with at least some secondary education (54.5%) (Table 3.1). The majority were generally poor, as nearly half (43.4%) self-reported low household income and exhibited low mean wealth index value of 0.96±0.65, ranging from 0.08 to 5.28 across the sample. Almost two-thirds grew up in rural settings (64%), with the majority acknowledging that their households foraged during their childhood years (82%).

Table 3.1: Summary of respondents' profile

Variable	Category	Foragers (%)	Non-foragers (%)	Test statistic	Standardised residuals	
					F	NF*
Gender	Male	126 (75.9)	40 (24.1)	$\chi^2 = 7.07$, $p = 0.008$	1.2	-1.7
	Female	130 (62.5)	78 (37.5)		-1.0	1.5
Age	Mean± SD	45.9±15.61	40.1±14.71	t = 3.42, $p = 0.001$		
Education	None	29 (11.6)	2 (1.7)	$\chi^2 = 51.67$, $p = 0.001$	1.7	-2.5
	Primary	72 (28.8)	12 (10.3)		2.0	-2.9
	Secondary	132 (52.8)	68 (58.1)		-0.4	0.5
	Tertiary	17 (6.8)	35 (29.9)		-3.1	4.5
Employment	Full-time	52 (20.6)	40 (33.9)	$\chi^2 = 13.84$, $p = 0.017$	-1.4	2.0
	Part-time	35 (13.8)	10 (8.5)		0.8	-1.1
	Self	13 (5.1)	12 (10.2)		-1.0	1.4
	Student	9 (3.6)	5 (4.2)		-2.0	0.3
	Unemployed	97 (38.3)	36 (30.5)		0.7	-1.0
	Retired	47 (18.6)	15 (12.7)		0.7	-1.1
Household size	Mean± SD	5.0 ± 3.0	4.2 ± 2.11	t = 2.88, $p = 0.004$		
Town	Potchefstroom	116 (45.3)	68 (57.6)	$\chi^2 = 4.42$, $p = 0.034$	-0.9	1.3
	Thabazimbi	140 (54.7)	50 (42.4)		0.9	-1.3
Residence	Informal	89 (34.8)	13 (11.0)	$\chi^2 = 75.48$, $p = 0.001$	2.3	-3.4
	RDP	86 (33.6)	15 (12.7)		2.0	-3.0
	Township	58 (22.7)	44 (37.3)		-1.4	2.1
	Affluent	23 (9.0)	46 (39.0)		-3.5	5.2
Length of residence (years)	Mean± SD	21.3±15.24	19.7±15.97	t = 0.93, $p = 0.352$		
Childhood	Farm	88 (34.5)	15 (12.7)	$\chi^2 = 49.14$, $p = 0.001$	2.1	-3.1
	Rural village	102 (40.0)	36 (30.5)		0.8	-1.2
	Township	56 (22.0)	42 (35.6)		-1.3	2.0
	Inner town	9 (3.5)	25 (21.2)		-3.0	4.3
Childhood foraging	Yes	235 (91.8)	74 (62.7)	$\chi^2 = 45.58$, $p = 0.001$	1.6	-2.4
	No	21 (8.2)	44 (37.3)		-3.5	5.2
Household income	Low	124 (49.2)	36 (30.8)	$\chi^2 = 11.58$, $p = 0.003$	1.4	-2.1
	Average	85 (33.7)	50 (42.7)		-0.7	1.1
	High	43 (17.1)	31 (26.5)		-1.1	1.6
Wealth status (see methods)	Mean ± SD	0.89±0.64	1.13±0.66	t = 3.29, $p = 0.001$		

Note: F and NF denotes foragers and non-foragers, respectively

3.3.2. Who forages?

Two-thirds (68%) of the 374 respondents indicated that they foraged wild plants. Foraging transcended different demographic and socio-economic backgrounds (Table 3.1). The likelihood of foraging significantly differed with gender, age, education level, employment status, childhood background, study towns, location of residence, household income, wealth status and perceptions about foraging practice (Table 3.1). Males (75.9%) were more likely to forage than females (62.5%). Foragers were slightly older than the non-foragers. The prevalence of foraging was higher among respondents with low education and unemployed as compared to those with higher education levels and some form of employment. Most of the foragers (74.5 %) grew up in rural areas and their household foraged during their childhood years (91.8%). The prevalence of foraging significantly differed between and within the study towns. Thabazimbi residents were more likely to forage compared to those in Potchefstroom. Similarly, residents in the outskirts of town (informal and RDP areas) were more likely to forage than those in the core/inner (affluent areas) part of town. Nonetheless, about one-third (33.3%) of the residents from the core/inner part of town foraged. The likelihood of foraging significantly differed across household income levels and wealth status. Those respondents who perceived their income to be better than others in their neighbourhood and in possession of several household assets were less likely to forage than those who reported lower income and fewer assets. However, one-third of households from affluent areas foraged. Besides, respondents who harboured positive perceptions towards foraging exhibited greater chances of foraging compared to those with negative perceptions. Overall, the odds of foraging were strongly influenced by childhood foraging background, perception towards the practice, location of residence in town, wealth and to a lesser extent household income.

3.3.3. Foraging spaces

Foragers took into consideration an array of factors in selecting where to forage, chief among them being personal safety (50.0%), quality of resources (45.6%), distance (26.6%) and access to resources (25.8%). Very few foragers considered land management practices (4.0%) or land-use history (6.5%). Foraging occurred in a variety of both formal and informal green spaces, including: domestic gardens, vacant spaces, riparian zones, parks, institutional grounds, cemeteries, farms and dumping sites (Figure 3.1). Vacant spaces were the most visited foraging site (54.7%), followed by riparian zones (29.7%) and domestic gardens (18.0%). About 13% of the foragers specified other spaces such as peri-urban farms and

dump sites. The proportion of visits across different spaces differed between and within towns. Foragers in Potchefstroom visited mostly vacant spaces ($\chi^2_{1, 256} = 43.21$, $p = 0.001$) and parks ($\chi^2_{1, 256} = 6.57$, $p = 0.004$), while in Thabazimbi foragers favoured riparian areas ($\chi^2_{1, 256} = 54.80$, $p = 0.001$). Of the 116 foragers from Potchefstroom, over three-quarters (77.6%) visited vacant spaces compared to 35.7% of the 140 foragers in Thabazimbi (Figure 3.1). Only foragers from Potchefstroom visited parks. On the other hand, nearly half (49.3%) of foragers from Thabazimbi visited riparian zones compared to 6% in Potchefstroom.

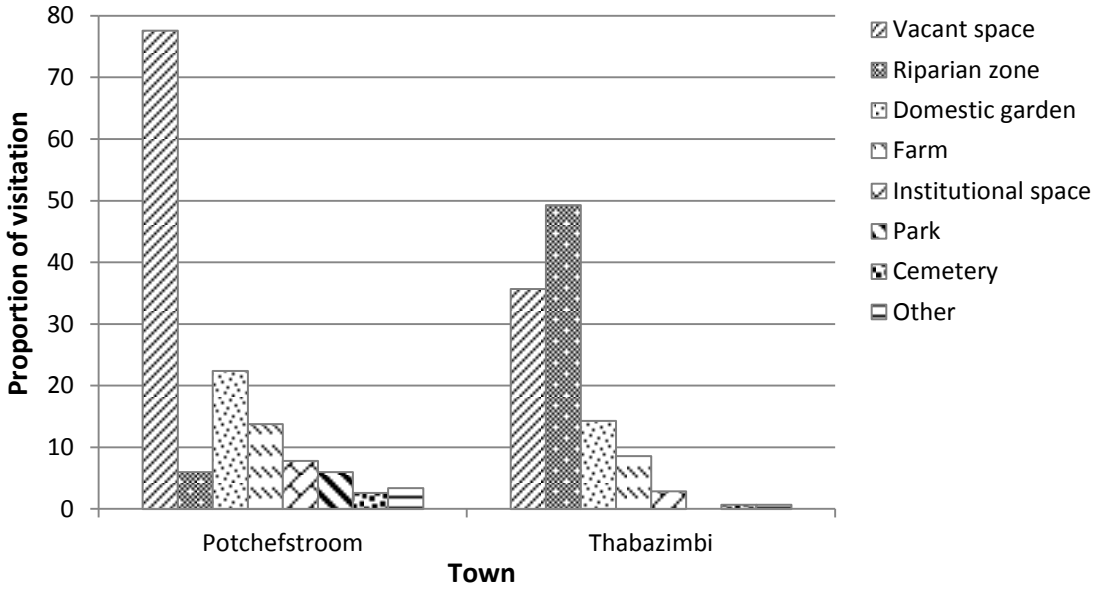

Figure 3.1: Frequency (%) of foraging spaces in the study towns (Note: the question was posed as a multiple response, hence the values of the foraging spaces within town sum up to more than 100%)

Foragers from RDP, informal and township areas were more likely to forage from vacant spaces compared to foragers from affluent households ($\chi^2_{3, 256} = 6.48$, $p = 0.09$) (Figure 3.2). Two-thirds of foragers from RDP areas mostly foraged from vacant spaces compared to 55% from informal areas, 50% of township foragers and 35% of affluent foragers. On the contrary, affluent foragers favoured riparian areas (43.5%) compared to 34.8% of informal area ones and one-quarter of RDP (24.4%) and township (24.1%) foragers ($\chi^2_{3, 256} = 5.22$, $p = 0.16$). The frequency of foragers who visited domestic gardens significantly differed with the residential zones ($\chi^2_{3, 256} = 15.39$, $p = 0.002$), being highest amongst those from affluent neighbourhoods (43.5%).

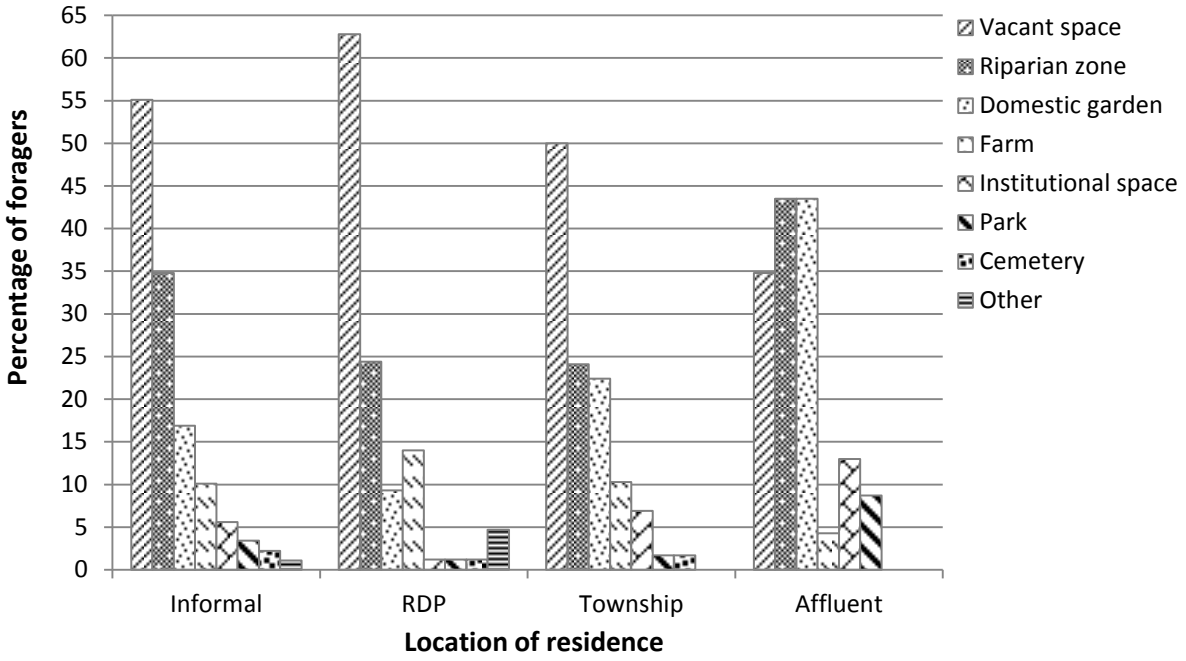

Figure 3.2: Frequency (%) of foragers from informal, RDP, township and affluent areas foraging in different spaces (Note: the question was posed as a multiple response, hence the values per foraging space across the town zone sum up to more than 100%)

3.3.4. Patterns of foraging practice

The frequency of foraging was almost identical for various resources (Figure 3.3). For most resources, the modal frequency of collection was a few times per week or per month. However, medicinal plants were an exception, with most of them sourced only a few times per year (Figure 3.4). Generally, foraging was not the main source of subsistence for most of the foragers, even for the widely used resources such as firewood (Figure 3.4). Although most wild plants were foraged throughout the year, the intensity of collection of some resources varied seasonally (Figure 3.4). The majority of resources were foraged more during the rainy season than the dry season, except for firewood, for which the peak was during the dry and cold winter season.

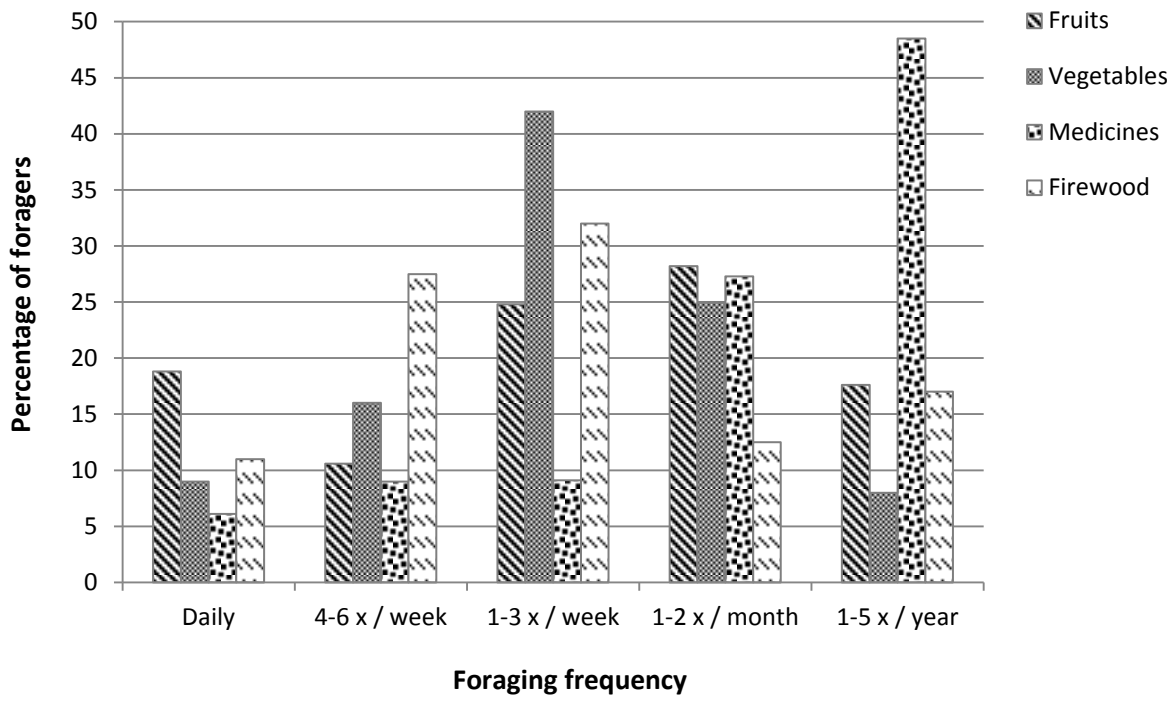

Figure 3.3: Frequency of foraging for each resource types

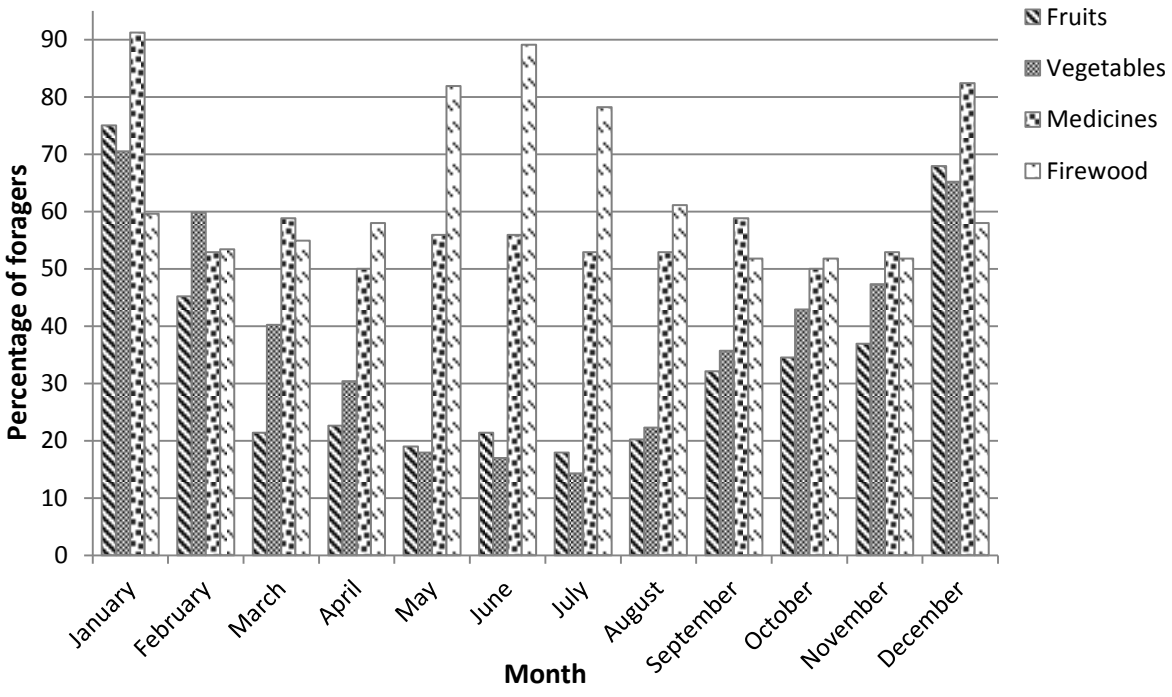

Figure 3.4: Seasonal variation in foraging for different resource types

3.3.5. Perceptions towards urban foraging practice

Almost two thirds of the respondents (62%) had positive perceptions towards urban foraging, 26% were neutral and 12% were negative (Figure 3.5). Most of their ratings on the evaluative statements denoting perceptions towards foraging were very favourable (Table 3.2). However, perceptions towards urban foraging differed significantly between foragers and non-foragers ($\chi^2_{4, 374} = 134.7$, $p = 0.001$), and across location of residence in town ($\chi^2_{12, 374} = 66.2$, $p = 0.001$). Over three-quarters of the foragers harboured favourable perceptions towards foraging as compared to one-quarter of the non-foragers (Figure 3.5). In regard to location of residence, foragers residing on the outskirts (informal and RDP areas) were more positive about foraging compared to those living in the township and affluent areas. However, perceptions did not vary between towns ($\chi^2_{4, 374} = 5.07$, $p = 0.280$).

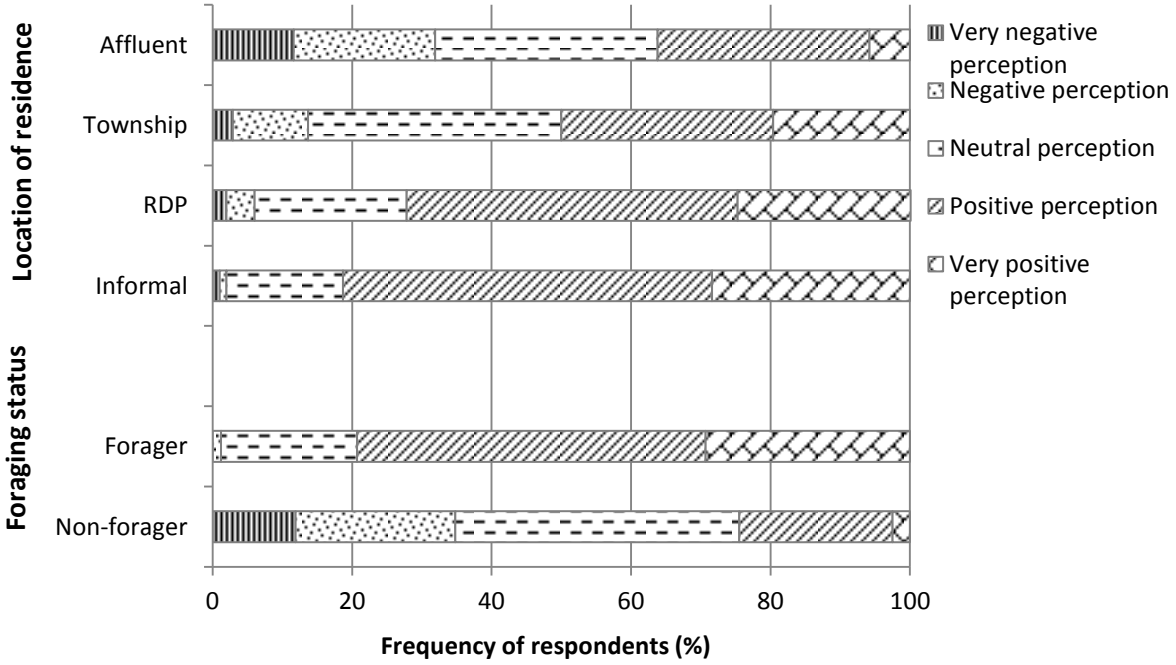

Figure 3.5: Distribution (%) of respondents' perceptions towards foraging across location in town and between foraging status

Table 3.2: Respondents level of agreement with statements regarding perceptions towards urban foraging (%)

Domain	Item	SA	A	N	D	SD	DK
Affective (Feelings, emotive)	I feel ashamed when people see me gathering wild plants	9.6	4.3	9.6	9.6	66.3	0.5
	I like gathering wild plants	41.7	18.7	12.6	9.6	16.6	0.8
	Wild plants are readily and freely available	40.4	23.5	10.7	5.1	12.6	7.8
Cognitive (Beliefs)	It is part of our lifestyle	44.4	18.2	11	9.4	16.8	0.3
	It enhances social ties among urban citizens	42.5	23.0	10.4	4.0	6.4	13.6
	It maintains culture	55.3	23.5	7.8	3.2	5.9	4.3
Behavioural (Actions)	It is the practice for the poor	16.6	6.1	16.8	9.1	49.2	2.1
	I have been gathering wild plants for a long time	44.1	19.8	6.7	9.4	19.8	0.3
	Is an activity supposed to be undertaken in rural areas	17.1	9.1	13.9	10.2	47.6	2.1
	Gathering is a tiresome activity	30.7	19.3	7.2	8.8	29.1	4.8

Note: SD, D, N, A, SA, and DK are Likert type scale options: Strongly disagree, Disagree, Neutral, Agree, Strongly agree and Don't know, respectively.

3.3.6. Motivations and barriers to foraging

The principal motivations for foraging were grouped into four themes, depicting the different facets driving engagement in foraging (Table 3.3). The most frequently cited motivations were culture (91.8%), health (88.7%), livelihood needs (75.0%) and leisure (73.8%). On the other hand, the barriers hindering respondents from engaging in foraging were grouped into five themes (Table 3.3). Lack of time (47.6%), inadequate foraging spaces (36.6%) and limited knowledge on foraging practice (36.1%) were the most frequently mentioned barriers, along with unfavourable regulations governing urban landscapes (31.5%).

Table 3.3: Respondents level of agreement with statements depicting motivations for and barriers to foraging

	Theme*	Item	SA	A	N	D	SD	DK
Motivation	Culture	Is our tradition	82.0	9.8	0.8	3.9	2.3	0.4
	Health	Wild plants offer quality products	75.0	16.4	2.0	0.8	2.0	3.9
		Wild plants (food) are beneficial for health	72.3	16.8	2.3	0.8	1.2	6.6
	Livelihoods	Wild plants are essential in meeting our subsistence needs	68.4	19.5	5.1	1.6	1.2	4.3
		It saves money	74.6	8.2	5.1	3.1	5.9	3.1
		It is a form of income generation	39.5	16.4	5.5	9.0	26.2	3.5
	Leisure	It connects us with our environment	57.0	20.3	8.6	3.1	6.6	4.3
		Is a pleasurable activity	55.1	19.5	7.8	3.5	12.9	1.2
		Is a form of recreation	44.9	21.9	12.5	5.9	13.3	1.6
Barriers	Time	It is time consuming	24.6	23.0	5.9	7.8	35.6	3.2
	Gathering spaces	Gathering locations too far	34.0	24.9	8.0	9.9	19.0	4.3
		Gathering locations are engulfed by private properties	28.9	24.3	14.2	6.1	22.7	3.7
		Inadequate gathering locations	32.4	18.7	14.2	7.8	23.0	4.0
		Limited species availability	27.0	19.3	16.8	4.3	27.0	5.6
		Gathering spaces are dirty	17.9	11.5	17.1	8.0	25.4	20.1
	Knowledge	Inadequate knowledge of gathering locations	25.7	20.6	12.6	9.1	29.9	2.1
		Inadequate knowledge of species identification	27.0	17.9	11.8	7.8	32.6	2.9
		I don't know how to prepare gathered products	23.8	10.7	10.4	8.3	44.4	2.4
	Regulations	Regulations prohibiting gathering	20.3	13.1	17.1	8.6	29.4	11.5
		Gathering is considered illegal	18.4	11.8	13.6	8.8	41.2	6.1

Note: SD, D, N, A, SA, and DK are Likert type scale options: Strongly disagree, Disagree, Neutral, Agree, Strongly agree and Don't know, respectively.

3.3.7. Knowledge production and sharing

Most foragers regarded their family as the primary source of information for learning about foraging practices (91.8%), species identification (93.0%), plant uses (93.3%) and foraging spaces (61.1%) (Figure 3.6). Foragers also consulted colleagues in the practice as well as relying upon personal observations, albeit less frequently. Most foragers (83.2%) acknowledged passing on knowledge about foraging practices across generations, through family participation (70.0%), oral tradition (25.1%) and, to a lesser extent, foraging tours

(3.9%). Similarly, half (52.2%) of the foragers reported teaching other people in their neighbourhoods about urban foraging. The majority (82.4%) performed such through joint foraging trips, production of information materials (10.8%) and public lectures (6.9%).

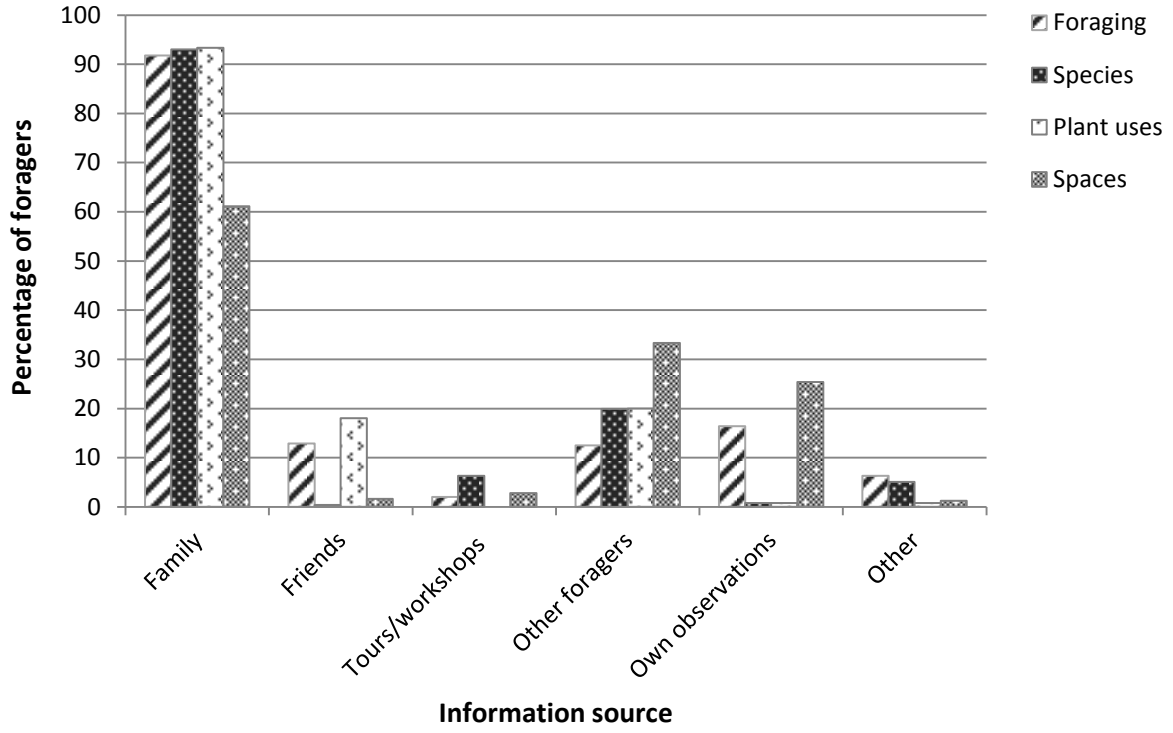

Figure 3.6: Different information sources used by foragers for knowledge production and sharing

3.4. Discussion

3.4.1. Urban foragers

About two-thirds (68%) of the respondents in the two towns reported foraging wild plants. Wild plants were regarded as important in the provision of household energy, dietary diversity and improvement of health, with most foragers collecting a few times per week or per month. For most, foraging was not the main source of subsistence but rather a complementary livelihood strategy. This is in keeping with Mollee et al.'s (2017) finding in Uganda, where foraging wild foods was not the primary form of subsistence for Kampala residents but rather provided complementary food resources. The plausible explanation to this observation in the context of our study could be the widespread provision of government social welfare grants and basic services to the vulnerable segments of the society, as one way

of mitigating risks and socio-economic shocks. Such social protection measures may play an indispensable role in cushioning vulnerable people against the impact of socio-economic shocks such as poverty, food insecurity, illness and income loss (Altman et al., 2009; Satumba et al., 2017). Nevertheless, foraging was not necessarily driven by necessity or lack thereof, as nearly one-tenth (9%) of the foragers were from wealthy neighbourhoods, and one-third of the more affluent households foraged. The overall prevalence of foraging (68%) is generally higher than reported from studies elsewhere. Mollee et al. (2017) found that nearly half (47%) of the surveyed households foraged wild plants in Kampala, Uganda. Similarly, about 49% of the respondents acknowledged foraging in Massachusetts (USA) (Short-Gianotti & Hurley, 2016). The high prevalence of foraging exhibited in our study and that from elsewhere should not be overlooked in urban landscape planning and development. There is need for designing multi-functional urban spaces, which promote a suite of land-based activities, foraging included. The practice of foraging needs to be recognised and appreciated in the regulations used for managing various urban green spaces. Consequently, this will support and sustain access to spaces endowed with a variety of species of value and interest to foragers.

Although urban foraging transcends demographic and socio-economic backgrounds (Robbins et al., 2008; McLain et al., 2014; Arrington et al., 2017; Shackleton et al, 2017; Paddeu 2019), our results reveal that the likelihood of foraging was strongly influenced by a childhood foraging background, positive perceptions towards the practice, location of residence and household affluence. Those respondents whose households foraged during their childhood years were more likely to engage in foraging compared to those who grew up in non-foraging households. This observation could be attributed to the exposure and experiences about foraging juxtaposed with the skills and knowledge acquired during their formative years. This finding is consistent with previous studies (Chipeniuk, 1995; Hosaka et al., 2017; Landor-Yamagata et al., 2018) that showed a positive association between childhood exposure to nature and their resultant connection with nature as an adult. Childhood play experiences with biodiversity greatly influences interests in and interaction with nature, as well as support for coexistence later-in-life (Bixler et al., 2002; Hosaka et al., 2017). Regardless of the impetus, foraging evokes memories of collective traditional practices and contributes to a sense of identity (Hall, 2013). These insights could be harnessed to promote and strengthen green infrastructure initiatives within the urban landscapes. Overall, our findings demonstrate that foraging is an intergenerational practice,

and hence, it can serve as an essential medium for transmitting local ecological knowledge and practices (Poe et al., 2013).

Secondly, respondents who harboured positive perceptions towards foraging were more likely to engage in foraging as compared to those with negative perceptions. Respondents who were positive about foraging easily identified with the practice. Therefore, to promote and foster support for foraging within the urban landscape, it is necessary to reorient ambivalent views portrayed towards the practice, especially if held by decision-makers or planners.

Thirdly, the likelihood of foraging varied with location of residence within a town. Respondents residing on the outskirts of town (informal and RDP areas) were most likely to forage compared to those in the core/inner parts of town. This could be attributed to, among others, proximity to areas endowed with forageable resources, inadequate resources (household economy) and possibly long distances to shops. Residential areas situated on the outskirts of town were contiguous with the fringing peri-urban, semi-natural landscapes likely with a diversity of forageable resources. In contrast, the inner/core parts of the towns were mainly of modified landscapes, with limited green infrastructure, as there was some, mostly endowed with ornamental plants. This might reduce the prospect of foraging despite the interest in doing so. This calls for sparing pockets of land with remnant vegetation during property developments in inner/core parts of town, for provision of ecosystem goods and services to some people. Similarly, planting of edible species, particularly indigenous ones, should be promoted in urban greening activities, as this will increase the supply of forageable species. With regard to inadequate resources, residents living on the outskirts of town possessed fewer assets and reported lower household incomes. Although this study didn't find foraging as solely a practice for the poor, it might be an essential form of subsistence or a complement to livelihoods. Similarly, foraging might be widespread on the outskirts of town as a strategy for circumventing food deserts. Since these areas are generally characterised by inadequate access to affordable and healthy food (Battersby & Crush, 2016), foraging bears prospects of providing cheaper but fresh food produce, potentially of good quality and rich in nutrients. The variance of foraging with regard to location of residence within towns was also observed by Schlesinger et al. (2015) and Mollee et al. (2017) in East Africa and by Short-Gianotti & Hurley (2016) in the USA. In these studies, the peri-urban

and rural residents foraged the most compared to those within the city centre. This was attributed to proximity to spaces rich in biodiversity and generally easier access.

Fourthly, the probability of foraging differed with household wealth. Households who reported higher income were less likely to forage than those with low income. Similarly, there was a strong but negative association between wealth index and foraging. Households with better income could afford alternative products from the market, hence lessening the likelihood of foraging for subsistence needs. This corroborates Davenport et al. (2011), Kaoma and Shackleton (2014), Short-Gianotti and Hurley (2016) and Mollee et al. (2017). Notwithstanding the greater prevalence of foraging amongst the poor, it was not only limited to them, because one-third (33.3%) of the affluent residents foraged. This is in keeping with Robbins et al.'s (2008) finding in New England (USA), where the wealthier people were more likely to forage compared to their poorer counterparts.

3.4.2. Foraging spaces

Foraging occurred in both public and private spaces. The most frequently visited public areas were vacant and riparian spaces, while private ones were domestic gardens. This insight could enlighten managers and planners in identifying and zoning specific locations for promoting human-biodiversity interaction during spatial planning. Public spaces were mostly visited by foragers residing on the outskirts of town while private ones were those residing in the core/inner parts of town. Public spaces, particularly vacant spaces, were visited the most because they were deemed to be endowed with higher biodiversity and accessed freely. This finding is in accordance with Mollee et al. (2017) and Joos-Vandewalle et al. (2018). In these studies, public spaces were frequently visited compared to private ones, mostly by the peri-urban and rural foragers. Therefore, urban planners and policy makers need to take into account the social use value of urban landscapes by urban inhabitants. This is a crucial step in formulation of holistic approaches which take into consideration diverse land-use types. On the other hand, private areas, particularly domestic gardens, were visited the most by affluent foragers. For example, some of the affluent foragers had wild fruit trees in their gardens, such as *Sclerocarya birrea*. Also, affluent foragers noted that they salvage the branches they trimmed from the trees for firewood. Similar findings on affluent foragers relying the most on private spaces were noted by Short-Gianotti and Hurley (2016) and Mollee et al. (2017).

3.4.3. Patterns of foraging practice

Foraging generally occurred a few times per week or month. Moreover, foraging might be conducted while in pursuit of other activities such as recreation, e.g. visits to parks or walking along public green spaces. McLain et al. (2014) and Mollee et al. (2017) also found a similar foraging frequency pattern, where foraging was mostly conducted from a few times per week to less frequently. Although foraging occurred throughout the year, the intensity of collection of particular resources varied seasonally. Fruits and vegetables were foraged more during the rainy season while firewood and medicines were fairly constant throughout the year but with peaks recorded between May and July and January and December, respectively. Seasonality is pivotal in foraging practice, as it affects the actual contribution of foraging to livelihoods. Also, it defines the availability of certain resources such as vegetables as well as maturity of fruits. Seasonal variation of foraging was also observed by Poe et al. (2013) and Mollee et al. (2017), where foraging events peaked during the rainy season.

3.4.4. Perceptions towards urban foraging practice

The majority of the respondents' harboured positive perceptions towards urban foraging. The positive perceptions were possibly mediated by childhood foraging experiences. On this note, over three-quarters of the respondents grew up in a household that foraged. Hence, these respondents are more likely to embrace and support foraging practice later-in-life. Secondly, the positive attitudes could be attributed to the benefits derived from foraging. Foraging provided households with energy, diversified diets, medicines, recreation, socialisation and cultural identity. Over and above, foraging connects people with their environment (McLain et al., 2014). Consequently, these benefits promote favourable views towards foraging. The findings are consistent with those of Short-Gianotti and Hurley (2016) and Mollee et al. (2017), where foraging was positively evaluated as the preferred activity among other established activities such as recreation and sports, conducted in urban landscapes. Perceptions towards foraging varied with respondent's foraging status and location of residence in town. Foragers were more likely to hold favourable perceptions about foraging as compared to the non-foragers. This association could be tied to the earlier explanation of the benefits derived from foraging, where it complements livelihoods and contributes towards psychological wellbeing, among others. Since perceptions predispose behavioural outcomes (Ferguson & Bargh, 2004; Garekae et al., 2016), foragers could be persuaded to participate in any future urban greening activities aimed at building sustainable and healthy landscapes.

Besides foraging status, perceptions varied with location of residence in town. Residents in the outskirts of town portrayed strong positive perceptions towards foraging compared to the ones in the inner/core part of town, which ties with their greater likelihood to forage.

3.4.5. Motivations and barriers to foraging

Motivations towards foraging were quite diverse and key among them were culture, health, livelihoods and leisure, in order of importance. Most of the foragers concurred that foraging is part of their tradition, passed through generations. In regard to health, foragers opined that wild plants are beneficial to overall wellbeing and a source of quality products. Some foragers expressed that wild foods are medicinal and protect them against ailments. Some foragers contend that the current widespread diseases were not prevalent in the past, since they were subsisting heavily on wild foods. This view is buttressed by Turan et al. (2003) who report that some foraged species contains higher levels of micronutrients than store bought food.

For some, foraging was perceived as a form of income generation through selling of foraged products, as well as a form of income saving by way of not procuring the same or alternative products from the market. Indeed, Kaoma and Shackleton (2015) found that urban foraging contributed an average of 20% of total household income (direct use value and sales) in the small towns of Tzaneen, Bela Bela and Zeerust, South Africa.

Over and above, foraging was also viewed as a source of leisure and a pleasurable activity connecting people and the environment. A common narrative among foragers was that interacting with nature replenishes their psychological wellbeing. The underlying motives for foraging in our study are in accordance with those established elsewhere (Schunko et al., 2015; Palliwoda et al., 2017; Synk et al., 2017; Landor-Yamagata et al., 2018). The most common motivations were recreation, connection to nature, health, subsistence and culture. However, the principal motivations driving foraging are multifaceted, and hence, subject to differ across space, context, time, and obviously, forager's needs and interests. This dynamic underscore the importance of understanding context specific forces driving human-biodiversity interactions for formulation of holistic and inclusive approaches to urban landscape design and governance. This is imperative for production of spaces which conform to the diverse needs, aspirations and motivations of urban citizens.

On the other hand, lack of time, inadequate foraging spaces and limited knowledge on foraging practices were the most frequently cited barriers towards foraging. Many respondents decried that foraging is time consuming, as it needs adequate time for locating spaces and preparation of collected products. Inadequate foraging spaces were a cause of concern for many, with some available spaces situated far from the respondents' homesteads. Moreover, some of the available spaces were on the verge of been engulfed by urban transformation. Other spaces were steadily degraded through dumping of waste in green spaces. Respondents also cited limited knowledge on, among other things, foraging spaces, species and preparation of foraged resources. This notion was commonly associated with the youth. The findings on the barriers to foraging are consistent with Schunko et al. (2015) and Synk et al. (2017), who elucidated lack of time, inadequate knowledge and safety concerns as underlying barriers hindering people from foraging. Since lack of time was closely tied to inadequate foraging spaces, it is imperative for urban planners and developers to set aside spaces endowed with appropriate species for foraging and other activities during early stages of urban development, which can be easily accessed by the people. Inadequate knowledge can be overcome by documentation of foraging practice, and participation in foraging trips.

3.4.6. Knowledge production and information sources

Knowledge production and sharing is integral to fostering urban foraging practices across generations. Family members and other foragers were the main sources of information regarding foraging practices, spaces, species and their uses. The results corroborate previous studies (van Andel & Carvalheiro, 2013; Synk et al., 2017; Landor-Yamagata et al., 2018), which also found that family members, other foragers and friends to be the primary information sources for learning about and transmitting foraging information. The majority of foragers affirmed passing on knowledge about foraging practices across generations, with the most used mediums being family participation and oral traditions. The older foragers acknowledged that at times their children accompany them whilst foraging, where they will be taught about the species, their uses and identification. This is a fundamental step in instilling pro-foraging behaviour at childhood. Besides, foragers also taught others in their neighbourhood about foraging. This was mostly accomplished through joint foraging trips with the neighbourhood people. Recently, there are emerging platforms for preserving and sharing foraging information, such as websites (https://www.fourseasonforaging.com),

mobile phone applications and interactive maps (https://fallingfruit.org/). These measures bear the prospects of reaching out to a wider population across space, culture and identity.

3.5. Conclusion

This study demonstrates that urban foraging is a widespread practice, spanning across different demographic and socio-economic attributes. Foraging was favoured, with the majority of the respondents harbouring positive perceptions towards the practice. Foraging was integral to livelihoods and traditions and provided household energy, dietary diversity, health, and cultural affirmation, among others. Public and private spaces were visited for foraging, with the former being the most frequently visited, especially vacant and riparian spaces but spaces differ between and within towns. The high prevalence of foraging requires ensured access to green infrastructure and urban landscapes with a variety of species of value and interest to foragers. This study suggests that the social use value of the urban spaces need to be factored into spatial planning. This could be achieved by identifying and reserving spaces endowed with appropriate species, within easy access, as a core component of more holistic green infrastructure planning. Early childhood exposure and experience with foraging greatly influenced the prospects of a positive attitude towards and engaging in the practice later in life. Thus, there is a case for the implementation of formal and informal education initiatives, including in schools, about useful and traditional species available from local landscapes and their preparation and cultural significance. Moreover, urban foraging activities could be integrated with other environmental activities, such as Arbour week, a proclaimed national activity in the country and elsewhere. In South Africa, Arbour week is celebrated annually, during the first week of September. This week is marked for raising awareness on the importance of trees to the environment and their associated benefits to people, and it is normally accompanied by tree planting. This opportunity could be harnessed for planting indigenous, edible species and other useful ones within urban landscapes, which can provide a range of benefits to people and the environment at large. Despite the widespread foraging practice, it is threatened by urban transformation. Therefore, future studies should examine the spatio-temporal changes in foraging practice and how foragers respond and adapt to the changing dynamics. Additionally, in light of the role of urban planners and green space managers in providing (or not) forageable spaces and species, it is necessary to gauge their views on the subject and the barriers and enablers that affect their perceptions and practices.

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Chapter 4

Foraging wild food in urban spaces: The contribution of wild foods to urban dietary diversity in South Africa[2]

Abstract

Globally, approximately one billion people benefit from contributions of wild foods to their food security and dietary diversity. Wild foods are known to be important in rural communities in terms of food and micronutrient provision, diversifying diets, reducing vulnerability to non-communicable diseases and overall health. However, the potential contribution of wild foods towards food security and dietary diversity in urban food systems has been largely overlooked. This study examined the contribution of wild foods to household dietary diversity and livelihoods in two towns in South Africa, based on a survey of 137 households. Household diets were quite diverse, with half (51%) having consumed ≥ 8 food groups, 39% consumed 6 or 7 food groups, and only 10% recorded ≤ 5 food groups in the previous 48 hours. Wild foods were prevalent across the sample, with 62% of the households consuming them to some degree. Wild vegetables and fruits were the most common wild foods, consumed by 96% and 79% of the households, respectively. Although wild foods had limited significance on overall dietary diversity, they exhibited substantial contributions within particular food groups. For example, the consumption of vegetables and oil and fats was most prevalent among households consuming wild foods than those who did not. The findings show that wild foods could contribute towards diversifying urban diets at a micro-level, within particular food groups consumed, such as vegetables and fruits. Hence, wild foods are important in ameliorating the monotonous diets of some households and in turn promoting dietary diversity.

Keywords: Dietary diversity; Food security; Perceptions; Urban foraging; Wild foods

4.1. Introduction

Food security remains a topical developmental problem worldwide, despite the global efforts of halving the proportion of people undernourished (Walsh & van Rooyen, 2015; Tevera &

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Simelane, 2016; Shaheen et al., 2017). More than 820 million people worldwide are undernourished, with the greatest proportions situated in developing countries (FAO et al., 2019). The prevalence rate of undernourishment is most alarming in Africa and Asia, being 20% and 13%, respectively (FAO et al., 2019). In Africa, the prevalence rate is highest in the eastern region (30.8%) while lowest in the southern region (8.0%) (FAO et al., 2019). Despite the lower prevalence rate of undernourishment in southern Africa, some countries are still battling with high income inequality and poverty, which frequently translates into inadequate access to food despite its availability. This is the case for South Africa, which is considered food secure at national level but not at household level (STATS SA, 2019).

In South Africa, nearly half (46%) of the people were food secure, while 28% were at the risk of hunger and 26% regularly experienced it (Shisana et al., 2013). Although the prevalence of food insecurity was higher in the rural formal (29%) than urban formal localities (19%), the risk of experiencing hunger was slightly high in the urban formal (26%) than rural formal (20%) areas (Shisana et al., 2013). Similarly, the risk of hunger was slightly high in urban informal (36%) than rural informal (33%) areas. In 2017, almost two-thirds (63%) of the households who experienced hunger were living in urban areas (STATS SA, 2019). Since poverty is generally associated with greater experiences of hunger (FAO, 2017), urban dwellers are more vulnerable to food insecurity and undernourishment, given the shift in the locus of poverty from rural to urban areas (Crush & Frayne, 2011; Kimani-Murage et al., 2014). Moreover, the market-based economy and undiversified urban livelihoods exacerbate the prevalence of urban food insecurity (Boonyabancha et al., 2019). For example, studies have noted that many poor urban households spend at least half of their monthly expenditure to food purchases (Sneyd, 2016; Tevera & Simelane, 2016; Boonyabancha et al., 2019). Therefore, those with limited income to transact in the urban market might find it hard to ensure adequate food supply despite the availability of food in stores.

However, some urban people diversify livelihood and food acquisition activities in a bid to ameliorate their vulnerability to food insecurity and undernourishment. Some of these activities include urban agriculture, foraging of wild foods and collection of non-timber forest products (NTFPs). The potential contribution of urban agriculture to food security and dietary diversity has received enormous attention (Crush et al., 2010; Zezza & Tasciotti, 2010; Korir et al., 2015; Siegner et al., 2018). Approximately 1.3 billion people worldwide participate in urban agriculture. In Africa, about 40% of urban people engage in urban agriculture (Zezza &

Tasciotti, 2010; Tawodzera, 2011). Similarly, some urban people forage wild foods. About one billion people worldwide collect wild foods for food security and dietary diversity (Burlingame, 2000; Aberoumand, 2009). Wild foods are important in terms of food and micronutrient provision, enriching diets and as a source of income generation (Burlingame, 2000; Chagomoka et al., 2015). Hence, wild foods are an integral part of livelihood sustenance for many (Bharucha & Pretty, 2010). In regard to nutrition, some wild foods are rich in micronutrients compared to many conventional foods (Yang & Keding, 2009; Legwaila et al., 2011; Stadlmayr et al., 2013). Wild foods are advocated as a vital food sources for attaining the World Health Organisation (WHO) recommended minimum daily intake of 400 g of vegetables and fruits per person per day (Smith & Eyzaguirre, 2007). Overall, wild foods are critical in curbing malnutrition, reducing vulnerability to non-communicable diseases and overall good health.

In developing countries, many of poor peoples' diets are monotonous, typically composed of staple cereals and very limited intake of vegetables and fruits (Faber et al., 2010). Hence, wild foods, particularly wild vegetables and fruits, could diversify diets and, in turn, reduce the vulnerability to micronutrient deficiencies. For example, wild foods purchased from urban informal markets made a substantial contribution to diets and dietary diversity in the cities of Buea, Limbe and Yaoundé in Cameroon (Sneyd, 2016). This underscores the importance of understanding the contribution of wild foods sourced within the urban environment, as proximity to the plant resources might sustain foraging. In South Africa, wild foods emerged as the third most common food source after large-scale commercial and small-scale food production, respectively, especially in rural and peri-urban areas (Ncube et al., 2016). Moreover, wild foods act as important safety nets during times of livelihood shocks and risks (Shackleton et al., 2007). Some wild plant species are resilient to adverse climatic conditions, hence they can be a critical source of food during times of food scarcity and deficit such as drought (Ohiokpehai, 2003).

There are increasing studies on urban foraging of wild foods worldwide (Shackleton et al., 2017). They provide insights on forageable species, forager profiles, perceptions and motivations to foraging, knowledge production and sharing, and toxicology of wild species (Poe et al., 2013; Mollee et al., 2017; Synk et al., 2017; Stark et al., 2019). Nevertheless, the potential contribution of wild foods towards food security and dietary diversity in urban food systems has rarely been examined (Chakona & Shackleton, 2019). Wild foods are often

overlooked in national and regional food composition data (Bharucha & Pretty, 2010). Consequently, this results in limited appreciation and acknowledgement of the contribution of wild foods to urban diets (Slater & Twyman, 2003). This may result in designing food insecurity and undernourishment interventions which fail to acknowledge other food sources contributing to household food baskets, such as wild foods. Therefore, understanding the role of wild foods in urban food systems is pivotal in formulation of holistic food security policies and interventions, informed urban planning and demarcation of compatible urban land-use types. This calls for more research to elucidate the contribution of wild foods to urban diets. Hence, the aim of this study was to examine the contribution of wild foods to household dietary diversity and livelihoods in two towns in South Africa. Specifically, the following research questions were addressed: (1) What is the composition and diversity of household diets? (2) How does dietary diversity differ across a range of household attributes? (3) What is the pattern of wild foods consumption? (4) What is the contribution of wild foods to household dietary diversity?

4.2. Methods

4.2.1. Study areas

Refer to Chapter 1 for detailed information on the study areas.

4.2.2. Data collection

Multi-stage sampling was employed in selecting study participants. The study towns were stratified into four socio-economic zones: informal, RDP (Reconstruction and Development Programme), township and affluent. Following Kaoma and Shackleton (2015), informal settlements are residential areas established by the newly migrants in towns or cities, without being sanctioned by the municipal officials. The RDP houses are a high density residential area, comprising of a national housing programme by the post-apartheid government for the indigent. While the township and affluent suburbs are medium and low density residential areas, which were formerly occupied by the black South Africans and the whites, respectively. Then, 50 households per zone were randomly sampled using ArcMap 10. However, the actual sample sized attained was 374 households, with 62% acknowledging foraging wild foods. Based on foraging frequency, 31% of the foragers were considered for this study, i.e. 72 participants, along with sample of non-foragers. The households were visited and asked whether or not they consume wild foods, with those affirming being

omitted from the sampling frame and the next household visited. A total of 65 non-foragers were sampled. The sample size accounted to 137 households. The survey was conducted between January and March, 2019.

A survey questionnaire comprising of three sections was administered to the participants. Firstly, dietary intake was elicited based on a recall of all food prepared and consumed within the household during the past 48 hours (FAO, 2010). In regard to meals composed of mixed dishes, the respondents were asked to detail all the ingredients used and their equivalent sources. The dietary recall questions were specifically asked to the person who prepared the household meals. Secondly, the questionnaire narrowed down to wild foods. This section enquired on the types of wild foods consumed, frequency of consumption, months of consumption and perceptions towards wild foods. Lastly, respondents' demographic and socio-economic backgrounds were captured. Perceptions towards wild foods were assessed through 15 evaluative statements rated according to five-point Likert scale options, ranging from two extremes: very negative to very positive. The order of favourable and unfavourable statements was randomised to curb bias. For computing a household wealth index, the respondents were asked to identify the total number of each of various assets owned (such as car, tractor, motorbike, bicycle, cattle, goats, fridge, television, radio and cell-phone), which were then normalised per asset and totalled. All ethical protocols were observed (No. ES18/04)

4.2.3. Dietary diversity score

Information on all the foods consumed, including their ingredients, was coded into the following 12 food groups following FAO (2010): (1) Cereals, (2) White roots and tubers, (3) Vegetables, (4) Fruits, (5) Meat, (6) Eggs, (7) Fish and seafood, (8) Legumes, nuts and seeds, (9) Milk and milk products, (10) Oil and fats, (11) Sweets and (12) Spices, beverages and condiments. Consumption of a particular food group was assigned a score of one, or zero for none. A composite score was then computed by summing across the 12 food groups. This score is termed 'household dietary diversity score' (HDDS), and ranges between zero and twelve. Following FAO (2008), HDDS was categorised into three groups: poor diversity ($\leq$ 5), average diversity (6-7), and good diversity ($\geq$ 8).

4.2.4. Data analysis

Statistical Package for Social Sciences (SPSS) version 21 was used for managing data. Measures of central tendency and dispersion, frequencies and proportions were used for summarising descriptive data. Chi-square tests were used to establish associations between diet composition and perceptions towards wild foods against location of residence and between foragers and non-foragers. One-way analysis of variance (ANOVA) and t-tests were used to assess significant differences in HDDS between and within towns and foraging status. A Generalised Linear Model (GLM) was conducted to determine the predictive ability of households' demographic and socio-economic attributes towards HDDS. The data was subjected to normality test using Shapiro-Wilk test and no violations were observed. Since perceptions were assessed by a set of 15 evaluative statements, they were subjected to an internal consistency reliability test using Cronbach coefficient alpha, which returned a value of 0.84, suggesting a very good internal consistency of the scale items.

4.3. Results

4.3.1. Respondent profile

The sample consisted of 137 respondents with an average age of 45.5±13.8 years, ranging from 22 to 81 years (Table 4.1). Females constituted the majority (70.1%). About 57.9% of the respondents had some secondary education while a few attained primary (24.1%) and tertiary (6.8%) levels. However, 11.3% of the respondents had not received any formal education. Nearly half (46%) of the respondents were unemployed, 22.6% and 13.9% were employed on full and part-time basis, respectively, while 10.2% were retired. Household income was variable, with almost half (49.3%) of the respondents self-reporting low income while a few (14.2%) regarded themselves as better off. The proportion of monthly expenditure on food was highly variable with about 34.1% allocating 51-80% of their monthly income on food purchases, and 33.3% spending 21-50%. A few (13.3%) respondents spent over 80% of their household monthly income on food (Table 4.1). The mean wealth index was 1.5±0.86, ranging from 0.2 to 5.3 across the sample. The average household size comprised of 4.4±2.4 persons, ranging from one to thirteen people. Most of the respondents (71.5%) grew up in rural settings. An overwhelming majority (92%) grew up in a household that used to forage wild foods while only 8% did not.

Table 4.1: Summary of respondents socio-economic and demographic attributes

Variable	Category	Value (%)
Sex	Male	41 (29.9)
	Female	96 (70.1)
Age (Years)	Mean ± SD	45.5±13.8
Education	None	15 (11.3)
	Primary	32 (24.1)
	Secondary	77 (57.9)
	Tertiary	9 (6.8)
Employment	Full-time	31 (22.6)
	Part-time	19 (13.9)
	Self	7 (5.1)
	Unemployed	63 (46.0)
	Retired	14 (10.2)
	Other	3 (2.2)
Household size	Mean ± SD	4.4±2.4
Residence	Informal	54 (39.4)
	RDP	58 (42.3)
	Township	25 (18.2)
Length of residence (years)	Mean ± SD	25.8±14.5
Childhood	Farm	36 (26.3)
	Rural village	62 (45.3)
	Township	37 (27.0)
	Inner town	2 (1.5)
Childhood foraging background	Yes	126 (92.0)
	No	11 (8.0)
Household income	Low	66 (49.3)
	Average	49 (36.6)
	High	19 (14.2)
Proportion of income on food	< 20%	26 (19.3)
	21-50%	45 (33.3)
	51-80%	46 (34.1)
	81-100%	18 (13.3)
Wealth index	Mean ± SD	1.46±0.86

4.3.2. Food consumption composition

Households' diets varied across the 12 food groups. All households consumed food items from the cereal group during the 48 hour recall period (Figure 4.1a). Of this food group, maize-meal and bread were the two most consumed food items. Spices (97.1%), sweets (91.2%), meat (88.3%), oil and fats (81.8%), vegetables (76.6%) and milk (70.1%) were also

prevalent food groups (Figure 4.1a). Under the spices, beverages and condiments food group, salt and tea were the most common food items while sugar for the sweets food group. Chicken was the most frequent type of meat, followed by beef. Onions and tomatoes were the most consumed vegetables. On average, the aforementioned food groups accounted to more than half of the different food groups contributing to the HDDS. Fruits (46%) and white roots and tubers (40.9%) were consumed by nearly half of the households. Apples and bananas were the most frequently consumed fruits. Potatoes were the only food item consumed under white roots and tubers. On the other hand, the least consumed food groups were legumes, nuts and seeds (22.6%), fish and seafoods (21.9%) and eggs (21.9%).

The diet was fairly uniform within the towns, although the incidence of consuming food items from white roots and tubers, fruits, meat and fish and seafoods significantly differed between the towns (Figure 4.1a). Fruits, meat, fish and seafoods were more common in Thabazimbi than in Potchefstroom ($\chi^2_{1, 137} = 5.04$, $p = 0.02$; $\chi^2_{1, 137} = 6.72$, $p = 0.01$; $\chi^2_{1, 137} = 4.05$, $p = 0.04$, respectively). White roots and tubers were more prevalent in Potchefstroom than Thabazimbi ($\chi^2_{1, 137} = 4.75$, $p = 0.02$). There was no significant difference in sweets, eggs, vegetables, milk, oil and fats, spices and legumes, nuts and seeds.

Within the towns, a significant difference was evident only for the proportion of fruits consumed across location of residence (Figure 4.1b). Township residents were more likely to consume fruits compared to RDP and informal residents ($\chi^2_{2, 137} = 8.40$, $p = 0.02$). Similarly, vegetables, milk, eggs and legumes, nuts and seeds were consumed slightly more by township residents, although not significantly different to one another.

Across the sample, all households purchased most of the food consumed in the previous 48 hours. Very few had complemented with foraging wild food (19.7%) and self-production (2.9%). Generally, there was minimum variation in food acquisition between and within the towns, except for foraging. Households in Thabazimbi (22.2%) were more likely to complement their main food source with foraging wild foods than those in Potchefstroom (17.6%). The same applies to informal (22.2%) and RDP (20.7%) households across the sample.

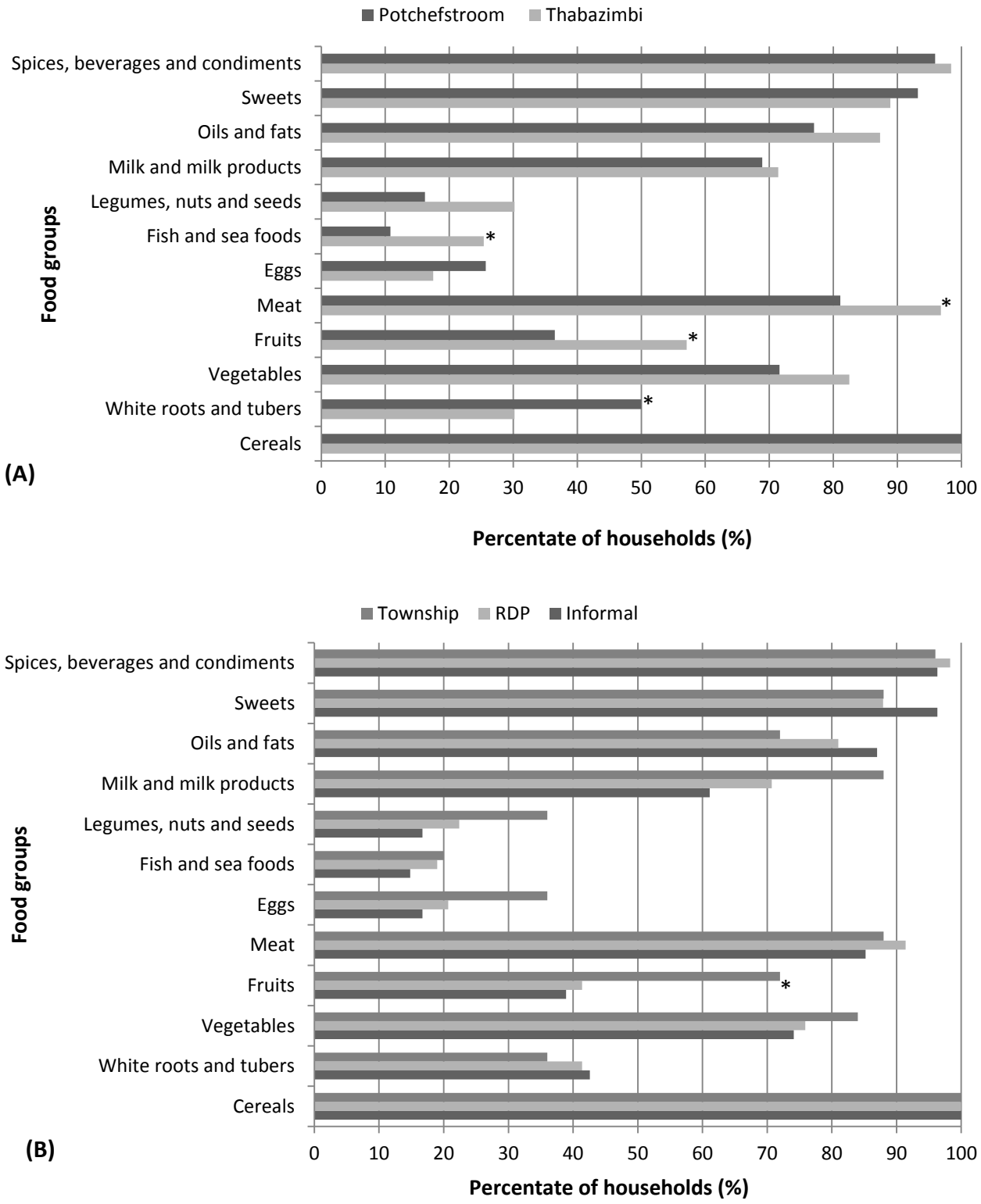
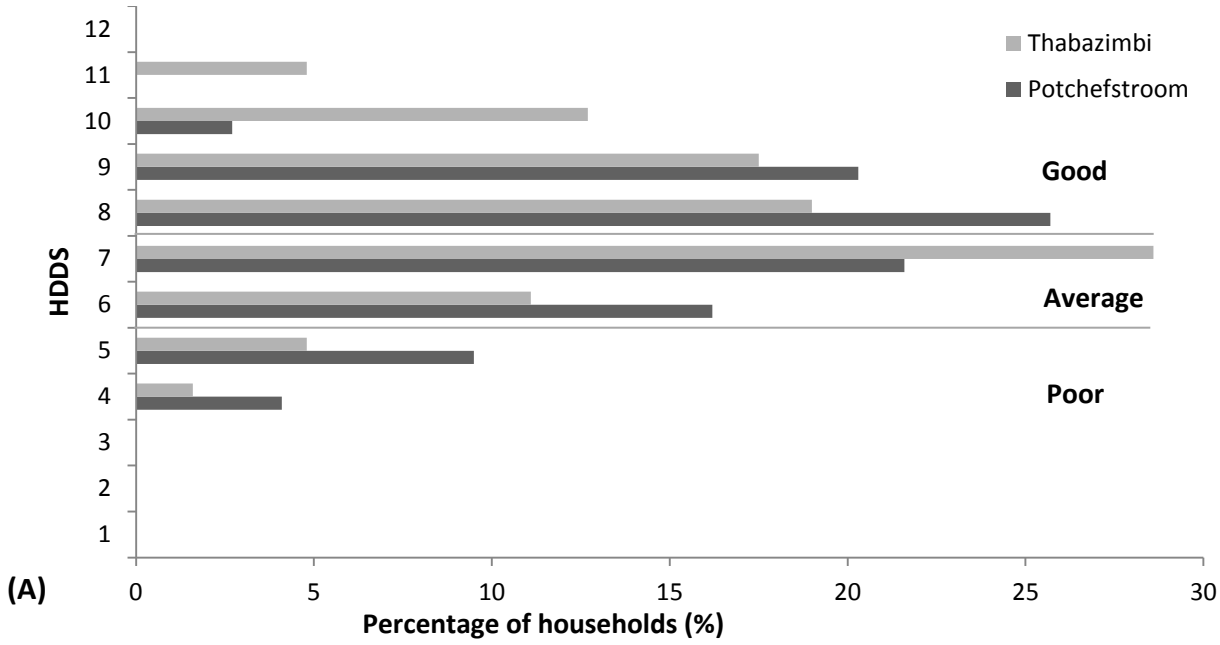


Figure 4.1: The percentage of households consuming different food groups in the previous 48 hours in two towns and across location of residence (Note: * denote significant difference between paired groups)

The HDDS was moderate across the sample, averaging 7.5±1.55 food groups, ranging from 4 to 11. Household dietary diversity score significantly differed between towns ($t_{137} = 2.24$, $p = 0.03$), being slightly higher in Thabazimbi (7.9±1.59) than Potchefstroom (7.3±1.47) (Figure 4.2a). The HDDS did not differ with location of residence ($F_{2, 137} = 2.75$, $p = 0.07$). Nonetheless, the mean HDDS for township residents was higher (8.2±1.49) than for RDP households (7.5±1.49) and informal (7.3±1.60) ones. Figure 4.2b demonstrates that RDP and township household diets were generally quite diverse, with about half (51.7%) and two-thirds (68%) of them, respectively, consuming eight or more food groups. Informal residents recorded moderate dietary diversity, with nearly half (46.3%) consuming 6-7 food groups.



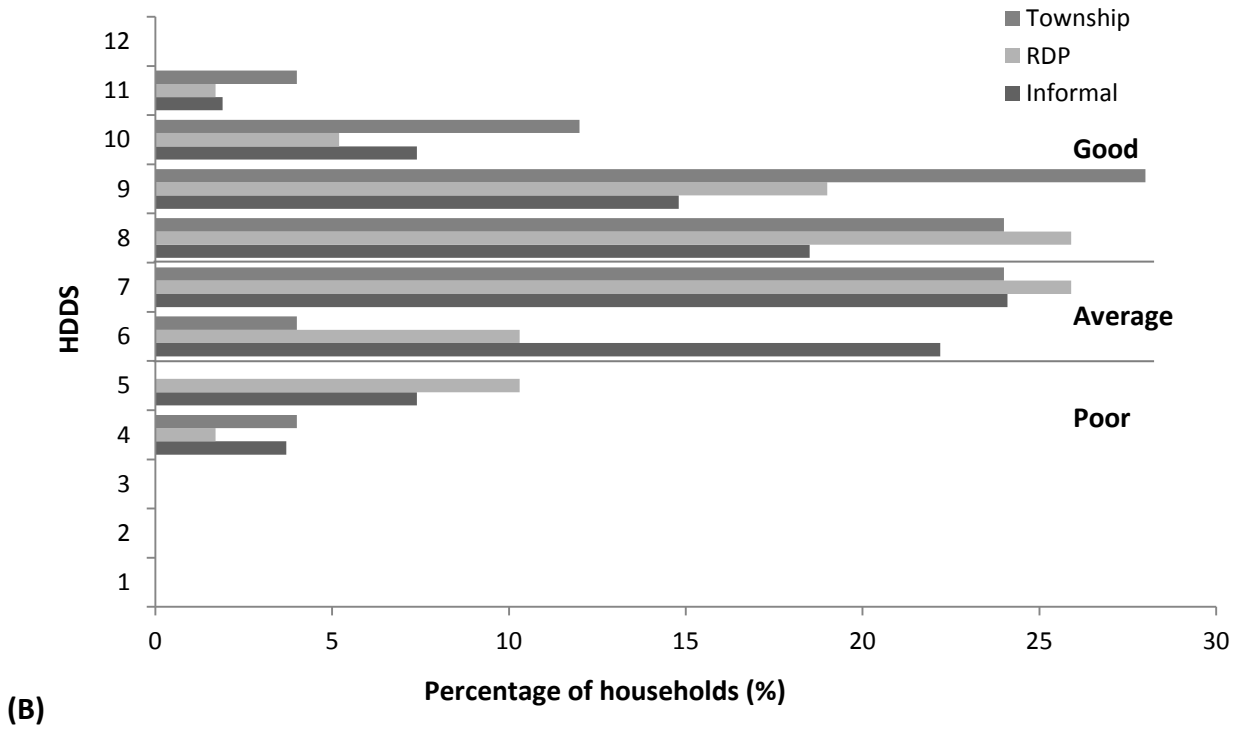


Figure 4.2: Distribution of household dietary diversity scores (HDDS) in two towns and across location of residence, based on 48 hour dietary recall

4.3.2.1. Socio-economic and demographic factors influencing HDDS

The odds of displaying higher HDDS increased with wealth index and education level (Table 4.2). Household dietary diversity scores did not differ against gender, age, employment status, proportion of income on food, social grants, household size and household income.

Table 4.2: GLM regression results of determinants of household dietary diversity scores (Bold values indicate significant difference at $p < 0.05$)

Variables	***Coefficient***	***p***
Sex	0.03	0.80
Age	-0.004	0.53
Household size	-0.05	0.11
Social grants	0.13	0.40
Household Income (Low)	0.17	0.10
Household income (Better)	0.31	0.24
Food income (11-20%)	0.53	0.29
Food income (21-50%)	0.49	0.32
Food income (51-80%)	0.59	0.23
Food income (81-90%)	0.68	0.19
Food income (91-100%)	0.63	0.29
Wealth index	0.20	**0.02**
Education	0.27	**0.01**
Employment (Retired)	0.30	0.55
Employment (Unemployed)	0.27	0.09
Employment (Other)	0.25	0.30
Employment (Self-employed)	0.44	0.14
Employment (Part-time)	0.34	0.08

4.3.3. Wild foods

Over half (62.1%) of the foragers contacted during the main survey reported gathering wild foods at various frequencies. Vegetables and fruits were the most common wild foods, consumed by 95.8% and 79.2% of the respondents, respectively. Fruits were consumed the most by RDP households (43.9%), while vegetables were most prevalent among informal

households (43.5%). Besides, 40.4% of the informal households consumed fruits while 39.2% of the RDP consumed vegetables. In regard to the township, 17.4% and 15.8% consumed vegetables and fruits, respectively. However, the incidence of wild food consumption did not differ between ($\chi^2_{2, 137} = 0.04$, $p = 0.73$) and within towns ($\chi^2_{2, 137} = 0.42$, $p = 0.81$) and relative to household income ($\chi^2_{2, 137} = 5.38$, $p = 0.07$).

4.3.3.1. Patterns of wild food consumption

Wild foods were consumed on a regular basis, but with differences between species. Some wild fruit species were rarely consumed, but most were consumed a few times per year (Figure 4.3). Overall, the modal frequency for wild vegetable consumption was at least one to three times per week. No wild foods were consumed on a daily basis. Wild vegetables were normally served with lunch and on average, accounted for almost half of the particular meal served, in quantity. Wild fruits were eaten as a snack at any time of the day. Although wild foods were generally consumed throughout the year, the intensity of consumption of each type varied seasonally (Figure 4.4). Both vegetables and fruits were mostly consumed during the rainy season as compared to the dry season (Figure 4.4).

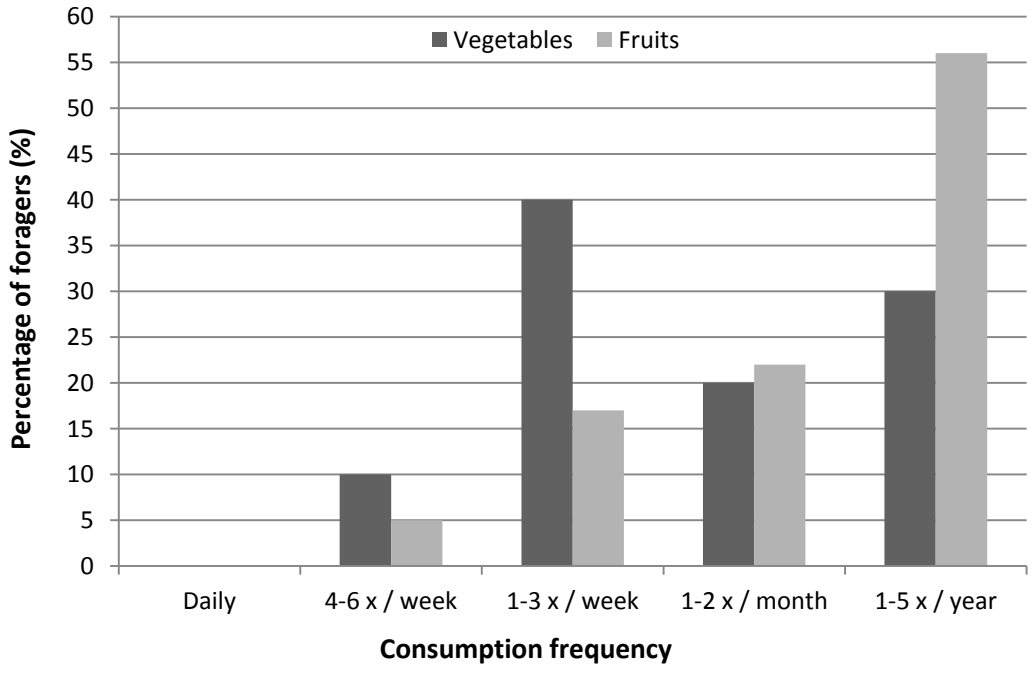


Figure 4.3: Frequency of wild fruits and vegetables consumption

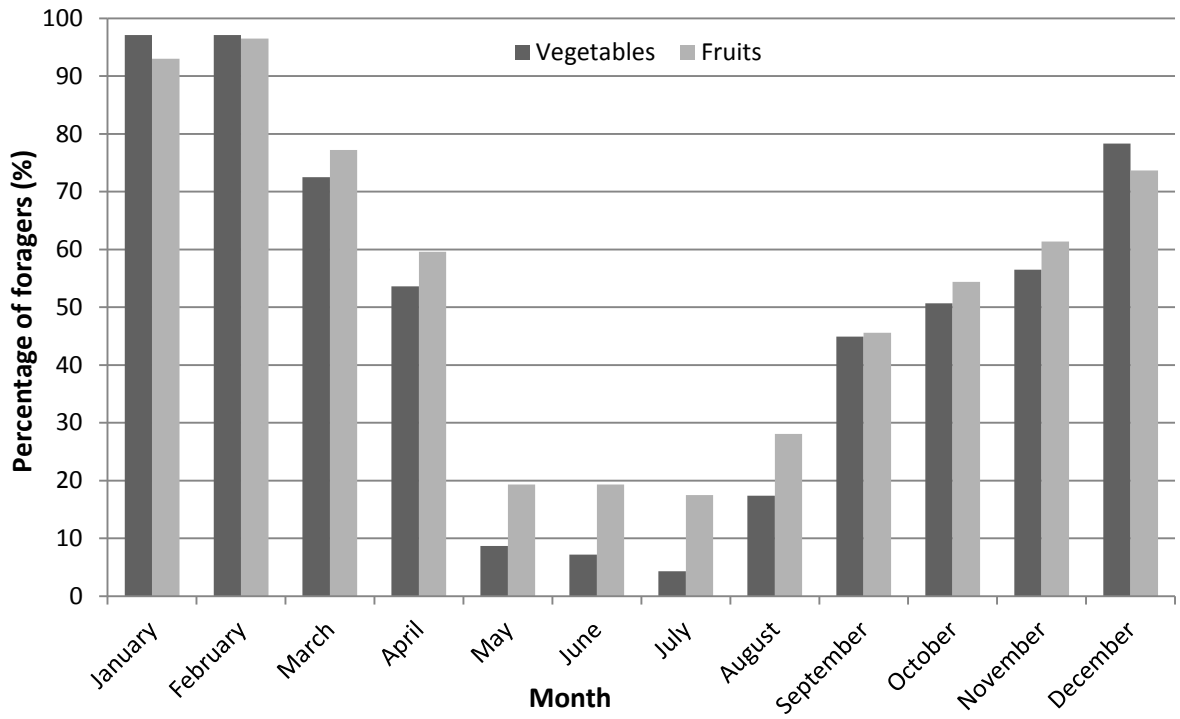


Figure 4.4: Seasonal variation in wild fruits and vegetables consumption across the study sites

Fruits were sourced through self-collection, and vegetables were mostly self-collected (94.2%), purchased from street vendors (4.3%), or solicited from friends (1.4%). Wild foods were sourced from a variety of spaces: domestic gardens, riparian zones and unused spaces. Unused spaces and domestic gardens were mostly visited for foraging both wild food types while riparian zones were solely for vegetables. Peri-urban farms were also visited for collecting vegetables.

4.3.3.2. The contribution of wild foods to household dietary diversity

There was no significant difference in HDDS between foragers and non-foragers across the towns (t_{135} = 0.56, p = 0.58). However, significant differences were observed within the proportions of different food groups (Figure 4.5). The incidence of vegetable consumption significantly differed with foraging status ($\chi^2_{1,\ 137}$ = 6.53, p = 0.01), being more prevalent among foragers (86.1%) than non-foragers (13.9%). Similarly, the frequency for oil and fats was higher amongst foragers (91.7%) than non-foragers (70.8%) ($\chi^2_{1,\ 137}$ = 8.65, p = 0.002).

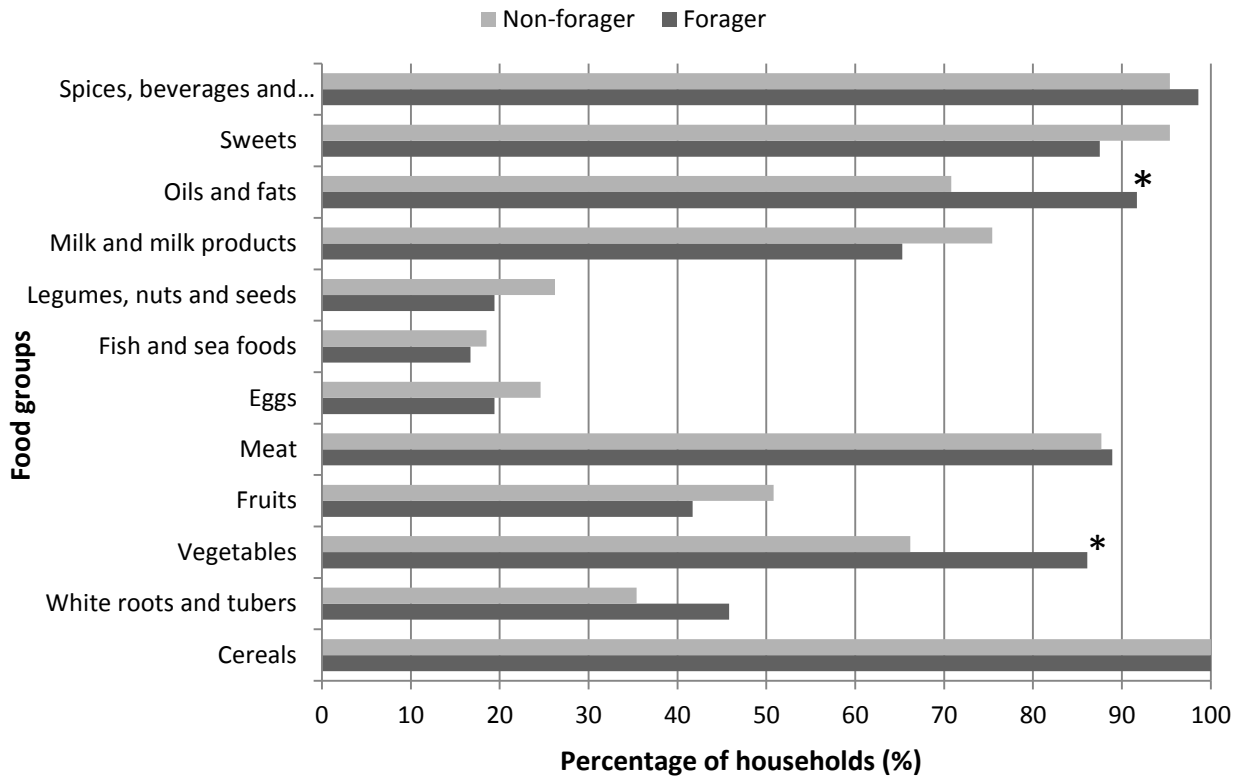


Figure 4.5: The percentage of households consuming different food groups against foraging status (Note: * denote significant difference between paired groups)

4.3.3.3. Perceptions towards wild foods

Most of the respondents (74.5%) harboured positive perceptions towards wild foods, 19% were neutral and 7% were negative (Table 4.3). With regard to the itemised statements, the majority (80.3%) vehemently disagreed with the statement portraying wild foods as food for the poor, with only 11% affirming. Similarly, an overwhelming majority (92.7%) strongly disagreed with the statement depicting consumption of wild foods as a shameful or embarrassing activity, while six people agreed. Many respondents (78.1%) concurred that wild foods were consumed by everyone and they were delicious (84.7%).

Table 4.3: Respondents level of agreement with statements regarding perceptions towards wild foods (%)

Domain	Item	SD	D	N	A	SA	DK
Affective (Feelings, emotive)	Wild foods are delicious	2.2	5.1	4.4	19.7	65.0	3.6
	Wild foods are tasteless	71.5	10.2	6.6	5.8	2.9	2.9
	I feel ashamed to eat wild foods	78.1	14.6	2.9	2.2	2.2	
	Wild foods are contaminated	28.5	13.9	10.9	24.1	12.4	10.2
	Wild foods are collected freely	3.6	7.3	5.8	20.4	54.0	8.8
Cognitive (Beliefs)	Wild foods are nutritious	2.9	2.9	8.8	17.5	65.0	2.9
	Wild foods are important to health	2.2	1.5	8.0	16.8	67.2	4.4
	Wild foods are consumed by everyone	2.9	13.9	2.9	16.1	62.0	2.2
	Wild foods acts as safety net during times of emergency and shocks	1.5	4.4	11.7	16.8	62.0	3.6
	Wild foods are important in diversifying diets	2.2	0.7	11.7	40.9	38.7	5.8
	Wild foods are part of cultural identity	2.9	4.4	7.3	21.2	63.5	0.7
Behavioural (Actions)	Wild foods are easy to find	30.7	16.1	2.9	30.7	16.1	3.6
	Use of wild foods is declining	25.5	11.7	4.4	38.7	16.1	3.6
	Wild foods are foods for children	64.2	20.4	2.2	12.4		0.7
	Wild foods are foods for the poor	67.9	12.4	8.8	8.0		2.9

Note: SD, D, N, A, SA, and DK are Likert type scale options: Strongly disagree, Disagree, Neutral, Agree, Strongly agree and Don't know, respectively

Perceptions towards wild food consumption did not vary with location of residence within the town ($\chi^2_{6, 137} = 4.60$, $p = 0.60$) (Figure 4.6). In contrast, perceptions significantly differed with foraging status ($\chi^2_{3, 137} = 64.75$, $p = 0.001$). Among the non-foragers: 48% expressed favourable perceptions, 40% were neutral while 12% were negative. Almost all (98.6%) foragers exhibited favourable perceptions towards wild foods. Perceptions towards wild foods significantly differed between towns ($\chi^2_{3, 137} = 15.96$, $p = 0.001$), with over three-quarters (88.9%) of the respondents in Thabazimbi being strongly positive towards wild foods, compared to nearly two-thirds (62.2%) in Potchefstroom.

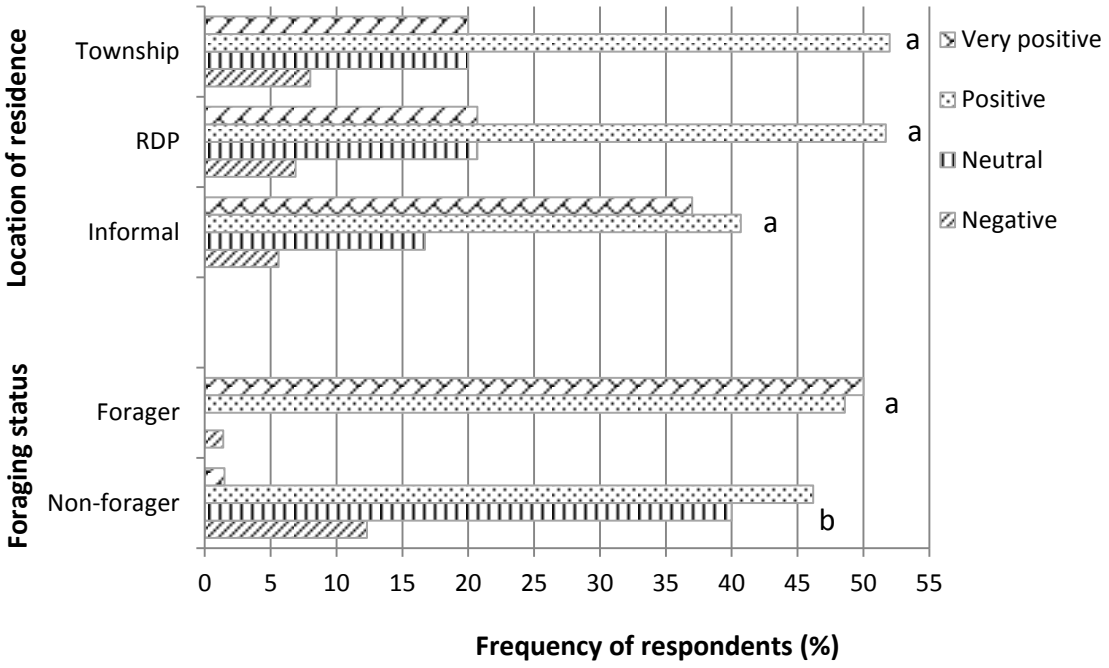


Figure 4.6: Distribution (%) of respondents' perception towards wild foods across location in town and between foraging status (Note: Unlike superscript(s) denote significant difference of perceptions across the groups per variable)

4.4. Discussion

4.4.1. Household dietary composition

Households consumed a variety of items from the 12 different food groups. Cereals were the predominant food group, consumed by all households in the previous 48 hours. Cereals mostly comprised maize ('pap') and wheat (bread) based foods. The dominance of cereals, particularly maize, in diets has been widely acknowledged in South Africa (Faber et al., 2010; Crush & Caesar, 2014; Ronquest-Ross et al., 2015; Chakona & Shackleton, 2017). In these studies, almost all the sampled households reported consuming maize-based foods. Cereals, particularly maize are widely consumed because they are generally cheap to buy and easy to access albeit with low nutritional value. The prevalence of cereals in diets was also observed in a comparative rural-urban study in Botswana (Kasimba et al., 2018), Finote Selam town in Ethiopia (Mekuria et al., 2017) and Ouagadougou rural-urban continuum in Burkina Faso (Chagomoka et al., 2016). Over 95% of the households from these studies consumed cereal food groups.

Spices, sweets, meat, oil and fats, vegetables and milk were also prevalent food groups. Spices were mainly salt and tea, chicken for meat, and onions and tomatoes for vegetables. The dominance of tomatoes and onions as vegetables is of concern, as they are deficient in essential micronutrients compared to leafy vegetables. The prevalence of the aforementioned food groups is consistent with those reported by Crush and Caesar (2014), Mekuria et al. (2017) and Chakona and Shackleton (2018). On average, the aforementioned food groups accounted to more than half of the different food groups contributing to the HDDS. Although the diets were fairly uniform across the sample, the consumption of some food groups differed significantly within and between towns. Fruits, meat, fish and seafoods were consumed more in Thabazimbi than Potchefstroom, and white roots and tubers the opposite.

Despite most food items being sourced through purchasing, the variation in consumption of the aforementioned food groups could be possibly attributed to the prevalence of foraging between the towns. Since the prevalence of foraging was higher in Thabazimbi, they are more likely to consume fruits and vegetables compared to Potchefstroom. Thabazimbi had a diversity of forest resources, hence they could forage to complement their diets. Therefore, varying ecological settings might influence consumption of particular food groups, especially those which can also be sourced from the wild or domesticated. This observation is consistent with Chakona and Shackleton (2018), who observed that the incidence of wild fruit consumption varied along an ecological gradient in South Africa. In their study, fruits were consumed more in areas which had favourable agro-ecological conditions, supporting the findings of Ncube et al. (2016). Within towns, only the incidence of fruit consumption varied with location of residence, being higher in the township than the RDP and informal areas.

The main source of food was through purchasing. This is common to most urban areas worldwide (Kimani-Murage et al., 2014; Sneyd, 2016; Tevera & Simelane, 2016). Moreover, some urban households spend a significant proportion of their monthly expenditure on food purchases. Nearly half (42%) of the household monthly expenditure in Manzini (Swaziland) was devoted to purchasing food (Tevera & Simelane, 2016). While in the cities of Buea, Limbe and Yaoundé in Cameroon, the majority of households spent between half to three-quarters of their monthly expenditure on food (Sneyd, 2016). Distinct from their rural counterparts, urban people are generally net food buyers. This could be largely attributed to undiversified livelihoods in urban areas and limited access to land, as most of their household

income is derived from salaried jobs, wage labour and business (Kimani-Murage et al., 2014; Boonyabancha et al., 2019). Therefore, those with limited income have increased vulnerability to food insecurity and malnutrition, as they might not have enough money to access food from the market (Cohen & Garrett, 2010). Besides purchasing food, less than one-quarter of the households complemented their food with foraging wild foods. This could be a result of modernisation and transitioning to urban lifestyles. Among others, modernisation changes traditional lifestyles practices such as people's eating habits, including consumption of wild foods (Poulain et al., 2015). Moreover, Cohen and Garret (2010) contend that people living in urban areas do not have secured land tenure rights and possession of necessary inputs for self-food production. The finding is consistent with Tevera and Simelane (2016), who noted that food production was not widely practiced in Manzini, Swaziland. Only 10% of the sampled household complemented their main food source with own-production. In contrast, Chakona and Shackleton (2017) found that own-production was the second major food source after purchasing in Richards Bay and Dundee, South Africa, with over half of households producing some food. Favourable climatic conditions in these towns enabled urban agriculture to thrive, hence reducing household dependence on food purchasing.

4.4.1.1. Household dietary diversity

Household diets were moderately diverse, with half (51%) having consumed ≥ 8 food groups, 39% consumed 6 or 7 food groups, and only 10% recorded ≤ 5 food groups in the previous 48 hours. This is within the range reported in the towns of Finote Selam (Mekuria et al., 2017) and Jimma (Tefera & Tilahun, 2007) in Ethiopia, where households exhibited moderate dietary diversity. The HDDS significantly differed between towns, being higher in Thabazimbi than Potchefstroom. This difference could be possibly linked to the level of wealth, as Thabazimbi recorded a slightly higher mean wealth index than Potchefstroom. Hence, Thabazimbi households are likely to possess higher purchasing power which might accord them better access to variety of food from the market. Additionally, foraging wild foods could possibly have contributed to more diverse diets in Thabazimbi. Nearly one-quarter (22.2%) of the households in Thabazimbi complemented their food sources with foraging wild foods compared to 17.6% in Potchefstroom. Although infrequent, foraging wild foods could potentially add 1-3 food groups to urban diets, for example: vegetables, fruits, meat, and fish and seafoods. This is buttressed by Chakona and Shackleton (2017) who

advanced that wild food bears the prospects of diversifying diets and cushioning households from risks and shocks, particularly the urban poor. Although not significantly different from one another, township residents' diets were more diverse than RDP and informal residents. There was no significant difference in HDDS between neighbourhoods within the two towns. The finding contradicts with Drimie et al. (2013) and Chakona and Shackleton (2018), who observed that household diets significantly differed with location of residence in selected towns and cities of South Africa. In these studies, residents in the inner part of towns displayed quite diverse diets compared to those in the outskirts of town.

Wealthier households displayed higher dietary diversity compared to poorer ones. Since the main food source was purchasing, wealthier households are better placed to access a variety of food from the market as well as sustained food supply. This finding is consistent with Gebre (2012) in Ethiopia, Muzah (2015) in Zimbabwe, Powell et al. (2017) in Tanzania and Khed (2018) in India. Not only does wealth enable access to food in the market, it also empowers self-production – as the wealthier can have access to land as well as afford necessary inputs. Of the few households who acknowledged self-production in our study, their wealth indices were higher than that of the overall sample, with all but one belonging to the highest wealth index quartile.

Besides wealth, dietary diversity significantly varied with education level. On average, tertiary education holders consumed 9.0±1.12 food groups while secondary and primary education holders consumed 7.8±1.53 and 7.3±1.23 food groups, respectively. Those without formal education consumed approximately 6.3±1.5 food groups. Generally, attainment of higher education is correlated to higher income, which enables access to a variety of food representing different food groups. Furthermore, those with higher education might be better acquainted on nutritional issues and healthy lifestyles (Ecker & Breisinger, 2012). In addition, they might have greater access to relevant information, education and communication materials (IEC) and activities on health and nutrition. The findings support those of Ecker and Breisinger (2012), Gebre (2012), Muzah (2015) and Khed (2018) that education in general plays a significant role towards attaining better food and nutrition security.

4.4.2. Wild foods consumption

Wild foods use was prevalent, with over half (62%) of the households consuming them to some degree. The overall prevalence of wild foods consumption is higher than reported in comparative studies. Chakona and Shackleton (2019) found that slightly above one-third of the households consumed wild foods in three medium-sized towns in South Africa. While in Kampala (Uganda), nearly half (47%) of the surveyed households affirmed consuming wild foods (Mollee et al., 2017). On the contrary, the prevalence of wild foods consumption was markedly lower than reported in rural areas. Paumgarten et al. (2018) found that almost all households (97%) consumed wild foods in two villages in Limpopo Province, South Africa. Vegetables and fruits were the most common wild foods, typically consumed a few times per week and per year, respectively. This is in accordance with Gido et al.'s (2017) observation, where on average, wild foods were consumed ones or twice per week along the rural-urban continuum of Nairobi, Kenya. The prevalence of wild foods consumption did not differ between and within the study towns, suggesting that wild foods could be an important complementary food sources for all. The prevalence of wild foods consumption varied with seasons, being higher during the rainy season as compared to the dry season, likely correlating with the higher availability at that time.

4.4.2.1. The contribution of wild foods to household dietary diversity

The findings revealed no significant differences in HDDS between foragers and non-foragers, echoing with Chakona and Shackleton (2019). The extent of wild foods contribution to dietary diversity is multifaceted. Among others, it is a function of species availability and seasonality, consumption patterns, species knowledge, food preferences and cultural norms (Faber et al., 2010; Powell et al., 2015). Availability and consumption of wild foods is defined by seasons. Most of the wild foods were abundant during the rainy season and so were higher prevalence rates of consumption, particularly from October to April. Hence, seasonality might impinge on the actual contribution of wild foods to diets. There is a limited reliance on wild foods as a source of food in our study and others from elsewhere (Mollee et al., 2017; Synk et al., 2017). Wild foods didn't constitute the main source of food, but rather served as complementary food sources. Most of the households relied on bought foods, with a limited reliance on wild foods. This calls for a promotion of wild foods in urban diets, in order to increase the frequency of their consumption. Over and above, knowledge is the focal point of wild food consumption and subsequent contribution to diets. The findings contrast

with the established contribution of wild foods in rural contexts, where wild foods are positively associated with diversifying diets. Fungo et al. (2016), drawing upon evidence from 11 villages across the eastern-southern Cameroon, found that households who consumed forest foods displayed higher dietary diversity as compared to those who did not, as did Maseko et al. (2017) amongst children in Malawi. Similarly, Luna-González and Sørensen (2018) observed a direct positive relationship between dietary diversity and wild food from six villages in Baja Verapaz, Guatemala.

Despite the low contribution of wild foods to HDDS, there were significant differences observed within the proportions of particular food groups consumed. The proportion of households consuming items from vegetables groups significantly differed between foragers and non-foragers, being higher among households consuming wild foods than those who did not. Over three-quarters (86%) of the foragers consumed vegetables during the 48 hour recall period compared to 66% of the non-foragers. In regard to wild foods, approximately one-third (35%) of the foragers had eaten wild foods during the 48 hour recall period, and all but two had consumed wild vegetables. This is an important insight since the vegetables group was mostly dominated by onions and tomatoes. Similarly, the incidence of oil and fats consumption was higher among foragers than non-foragers. The findings show that wild foods could contribute towards diversifying urban diets at a micro-level, within particular food groups consumed, such as vegetables, fruits, meat, and fish and seafoods. Hence, wild foods are likely to be important in ameliorating the monotonous diets of some households and in turn promoting dietary diversity.

4.4.2.2. Perceptions towards wild foods

The majority of households harboured favourable perceptions about wild foods. About three-quarters were positive, one-fifth expressed ambivalent views while only nine people were negative. The positive perceptions could be induced by prior exposure and experience with wild foods at childhood, because an overwhelming majority (92%) acknowledged consuming wild foods during childhood. As noted earlier, wild foods are an important source of livelihoods and diets. This is consistent with Chen and Qiu (2012) who found similar favourable perceptions in Noto Peninsula, Japan. In their study, wild foods were considered a delicious, healthy and safe food, forming part of traditional cuisines. Perceptions towards wild foods varied with household foraging status. Foragers were more likely to harbour favourable perceptions of wild foods compared to non-foragers. Almost all foragers

expressed positive perceptions as compared to only half of the non-foragers. Forager's positive perceptions could be associated with the contribution of wild foods to food basket and diets, and the social dimensions of foraging. Perceptions towards wild foods also varied between towns, with Thabazimbi residents' being more positive about wild foods compared to Potchefstroom. This variation could be explained by the prevalence rate of foraging, which was slightly higher in Thabazimbi (55%) than Potchefstroom (45%). In contrast, perceptions did not vary within towns.

4.5. Conclusion

Wild foods are known to be important in rural communities in terms of food and micronutrient provision, diversifying diets, reducing vulnerability to non-communicable diseases and overall health. This study demonstrates that wild food uses is also prevalent in urban areas albeit being consumed less frequently. The majority of respondents perceived wild foods positively. This favourable perception accords an opportunity for promoting wild foods in urban food systems. This could be achieved by incorporating wild foods in local restaurant menus, events celebrating traditional food cuisines in urban areas and school curricula. Moreover, there is need for intensive awareness on the importance of wild foods in diets and nutritional intake among the urban communities. Although wild foods had limited significance on overall dietary diversity, they were important within particular food groups. For example, the consumption of vegetables and oil and fats was more prevalent among households consuming wild foods than those who did not. Wild foods could potentially diversity urban diets at a micro-level, by adding one or a few more food groups to dietary composition. Hence, wild foods are useful in mitigating monotonous diets and in turn promoting dietary diversity.

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Chapter 5

Knowledge of formal and informal regulations affecting wild plant foraging practices in urban spaces in South Africa

Abstract

Foraging of wild plants is an ancient practice commonly perceived to be synonymous with rural areas. Nonetheless, foraging of wild plants has recently gained traction in urban areas as a form of interacting with nature and provision of ecosystem goods. Despite the prevalence of urban foraging, its legitimacy has been marred by uncertainty. The regulations conditioning access to and rights to foraging in urban green spaces have been seldom examined. Consequently, this study explored the formal and informal regulations governing access to and defining rights to forageable plant resources in the towns of Potchefstroom and Thabazimbi, South Africa. A random sample of 374 households was considered for the survey, complemented by in-depth interviews with 26 participants. Foraging occurred in a variety of public and private spaces, with vacant spaces (55%), riparian areas (30%) and domestic gardens (18%) being the most frequently visited spaces. However, the frequency of access to the spaces varied, being slightly higher for vacant spaces and domestic gardens than riparian areas. Over three-quarters of the foragers stated that vacant (87%) and riparian (92.3%) spaces were governed as a public good and hence permission was not required prior to foraging. In contrast, domestic gardens were under private tenure. The majority of the respondents were unaware of both formal and informal regulations governing access to and use of urban landscapes. Of the few who acknowledged awareness, it was mainly related to certain principles but not the actual regulations per se. In regard to formal regulations, they described principles concerned with sustainable harvesting, land-use tenure and protected tree species, while for informal regulations is was more around cultural norms and beliefs. Recognising foraging activities in urban landscapes is a fundamental step towards fostering active community involvement in the management and production of urban spaces.

Keywords: Access; Green spaces; Regulations; Tenure; Urban foraging

5.1. Introduction

Foraging of wild plants is a long-standing practice spanning across generations (Hall, 2013; Svizzero, 2016; Sachdeva et al., 2018). It dates back to the pre-Neolithic period, when hunting and gathering was the primary form of subsistence (Svizzero, 2016). The practice of foraging wild plants is intuitively associated with rural areas (McLain et al., 2014; Negi & Subramani, 2015). Notwithstanding, foraging is now gaining traction in urban areas (Poe et al., 2013; McLain et al., 2014; Mollee et al., 2017). Foraging provides provisioning, cultural and psychological benefits to urban residents (Kaoma & Shackleton, 2014; Poe et al., 2014; Schlesinger et al., 2015; Mosina & Maroyi, 2016). The prevalence of foraging differs across space and over time (Poe et al., 2014; Shackleton et al., 2017). Almost half (49%) of the respondents in the city of Boston (USA) acknowledged foraging (Short-Gianotti & Hurley, 2016) while in Berlin (Germany), 12% of the park visitors reported foraging alongside other park activities (Palliwoda et al., 2017). In Africa, Kaoma and Shackleton (2014) and Schlesinger et al. (2015) reported that most of the urban households foraged at least one plant resource for subsistence. These studies suggest that urban foraging plays a role in livelihoods and human-wellbeing, which may be particularly significant for the urban poor. Urban foraging takes place in a mosaic of spaces, governed by different and sometimes complex tenure regimes. The spaces include both formal and informal green spaces situated in public, private, institutional and communal land (Davenport et al., 2011; McLain et al., 2014).

Until recently, there has being limited understanding on governance of urban green spaces (Zamanifard et al., 2018). The bulk of the literature has focused on issues of access, uses and qualities of urban spaces (Zamanifard et al., 2018). Urban green spaces are governed by various stakeholders with diverse interests and responsibilities (van der Jagt et al., 2016; Zamanifard et al., 2018). These stakeholders include government departments, private entities, non-governmental organisations and the urban community (MacKenzie et al., 2019). Traditionally, urban green spaces were under the jurisdiction of state government, particularly the local authority. This state-oriented approach was marked by a centralised and authoritarian structure in the planning and delivery of urban green spaces and amenities therein (de Magalhães & Carmona, 2009). The approach was top-down, which came at the exclusion of the urban citizens and other key stakeholders (e.g. civic society) in the planning and development of urban green spaces. The state government, through entrusted departments retained the ownership and control of urban green spaces and was the sole

decision-maker in planning and development process. Consequently, this unilateral decision-making process (re)produces uneven urban green spaces which don't take into consideration the needs, desires and aspirations of the urban dwellers. In turn, access to and right to urban green spaces is curtailed for some segment of the urban society, thereby promoting environmental injustices (Heynen 2003).

However, a new paradigm shift was embraced in urban green space management framed on decentralised and participatory principles (Schauppenlehner-Kloyber & Penker, 2016; van der Jagt et al., 2016). This approach was characterised by devolution of power and control of urban green space management from the state to other key stakeholders such as the community, private or civic society groups; albeit at varying degrees of involvement (de Magalhães & Carmona, 2009; MacKenzie et al., 2019). Therefore, it placed the said stakeholders at the centre of planning, development and management of urban green spaces. The participatory approach bears prospects in producing 'just green spaces', which resonates with the diverse needs and aspirations of the urban citizens. The variants of this approach includes privatisation (market-centred), active citizenship (user-centred) and collaboration (de Magalhães & Carmona, 2009). For example, urban citizens were found to be actively engaged in planning and delivery of urban green infrastructure across several European cities (Buijs et al., 2019). They self-organised themselves and took over the responsibilities of maintaining or restoring public urban spaces (parks, open spaces and trail walks), establishing food forest and restoring ecological connectivity of green infrastructure amenities. Still in Europe, the urban citizens in Korneuburg city (Austria) self-organised themselves and designed an ideal development programme for their city independent of government intervention – who were brought in as supporters, together with external experts from the local university (Schauppenlehner-Kloyber & Penker, 2016). The programme set out a mission statement, master plan and a charter for citizen participation, all which the city council affirmed their commitment. Drawing upon the above, it demonstrates the urban community's zeal for (re)producing urban spaces in consideration to their desires and aspirations.

Despite the prevalence of urban foraging worldwide, its legitimacy is often marred by uncertainty (Dyke & Emery, 2010; Shackleton et al., 2017). The practice of foraging plant resources is often obscured within the regulations governing urban spaces and amenities therein. Where it is inscribed, it is generally limited or restricted to certain species and spaces.

Frequently, regulations are designed against the backdrop of urban spaces as providers of supporting, regulating and cultural ecosystem services. This is despite the importance of the regulations in defining access and rights to plant resources in urban spaces (Ginger et al., 2012). Consequently, in many settings the regulations prohibit or discourage foraging practices (McLain et al., 2014; Hurley et al., 2015; Dabady & Stark, 2017). Urban foraging is often viewed as an undesirable activity within the cityscape, especially by those preferring non-consumptive ecosystem benefits. Generally, foraging is often construed as an activity outside the purview of recreational and aesthetic functions of urban green spaces. In the USA, foraging was prohibited in some cities of California, Pennsylvania and Washington states (McLain et al., 2014; Dabady & Stark, 2017). Even foraging from the most abundant species such as *Urtica dioica* and *Verbascum thapsus* was deemed illegal in some cities, such as Philadelphia (McLain et al., 2014). According to the municipal regulations of the respective cities, perpetrators were liable to a fine or imprisonment. Moreover, some regulations forbid planting of fruit trees in certain spaces, such as along streetways (McLain et al., 2012). This was attributed to the potential traffic incidents which might occur if the fruits fell in the road.

Foraging spaces may become sites of contestations, which emanate from contrasting rights over permitted land-use activities within urban green spaces (Hurley et al., 2015). For example, foraging of invasive species in Seattle was prohibited yet the removal of the same species was deemed a management tool (McLain et al., 2012). Still in Seattle, some public park visitors who were not keen about foraging questioned its legal standing amongst visitors who were pro-foraging (Charnley et al., 2018). The privatisation of the urban commons in the peri-urbans of Bengaluru (India) promoted the aesthetic and recreational functions of the urban commons over the provisioning functions which were previously enjoyed by the locals, particularly the urban poor (Mundoli et al., 2015). In South Africa, the practice of foraging in the urban commons in medium-sized towns was competing with other land-use activities such as peri-urban agriculture (Davenport & Gambiza, 2009). The lack of recognising foraging practice in urban spaces exacerbates foragers' vulnerability to unfounded restrictions (Shackleton et al., 2017). This is in struck contrast with the principles of social justice, which envisages equity and justice in society (Salazar 1996; Agrawal & Ostrom 2001; Prasad-Timsina 2003; Poe et al. 2013). Nevertheless, the prevalence of foraging challenges the dominant exclusionary framings and practices common in many, if not most urban space management regimes (McLain et al., 2014). This regime often disparages the utilitarian value of urban spaces but promotes the recreational and aesthetic value (Unnikrishnan et al., 2016).

Despite the ubiquity of regulations against urban foraging in many contexts, there has been a paradigm shift on governance of urban spaces in few cities worldwide. In this context, regulations now portray urban landscapes as productive spaces (Clark & Nicholas, 2013). For example, the city of Seattle has recognised foraging as a legitimate activity to be conducted in the urban landscape and it has been acknowledged in the city's urban forest stewardship plan of 2013 as one of the many functions and benefits of the urban forest (Floberg et al., 2013). Moreover, there is a burgeoning campaign of promoting edible landscapes in cities such as through planting of edible plants in public green spaces in the city of Andernach (Germany) (Kosack, 2016), incorporating food trees in Canadian urban forest regulations (Kowalski & Conway, 2019) and establishing urban food forests in Burlington (USA) (Clark & Nicholas, 2013).

Despite the prevalence of urban foraging worldwide, there is paucity of empirical knowledge on the regulations conditioning access and rights to forageable resources in urban spaces (Shackleton et al., 2017; Charnley et al., 2018). Although there are increasing numbers of studies on urban foraging, very few have considered access to plant resources in urban spaces and associated regulatory frameworks (McLain et al., 2014; Charnley et al., 2018). This is despite access and rights to urban spaces being critical factors influencing the likelihood of and spaces used for foraging. On that note, this study explored the formal and informal regulations governing access and rights to forageable plant resources in Potchefstroom and Thabazimbi, South Africa. Specifically, the study elicited information on access to foraging spaces and land tenure regimes and regulations governing urban spaces where foraging occurs.

5.2. Methods

5.2.1. Study areas

Refer to Chapter 1 for the detailed information on the study areas.

5.2.2. Data collection

The data was collected through a combination of household surveys and in-depth interviews. Refer to Chapter 3 for sampling of the survey participants. The participants were drawn from four socio-economic zones within the town: informal, RDP, township and affluent areas. The household survey was administered to the respondents through face-to-face interviews. The

questionnaire elicited the following issues: (1) location, access to and rights to resources; (2) species allowed or prohibited for foraging; (3) formal and informal regulations, policies and (4) land-use regimes defining access to and rights to resources within urban landscapes. Formal regulations entailed legal frameworks such as act and policies and other local level statutes such as by laws and provisional/district guidelines used for managing urban spaces, whereas informal regulations included norms, customs and beliefs which are mostly unwritten and tacit but are concerned with the use of environmental resources such as cultural values, taboos, traditional belief systems, and neighbourhood associations. The household survey was conducted between May and July 2018.

In regard to in-depth interviews, they were conducted with the following stakeholders: regular foragers, non-governmental organisations (NGOs) dealing with urban greening and landscapes, and municipal officials from the department of parks and recreation, town planning and environmental affairs. The criteria for selecting the interviewees was based on their expertise, knowledge and position on issues dealing with urban greening, planning, and development, and management, collection and consumption of wild plants. A total of 26 participants were purposively sampled for the in-depth interviews, comprising of 20 regular foragers, two NGO members and four municipal officials. The in-depth interviews were used to give depth and insights to the household survey data. An unstructured interview guide was used to elicit data from the interviewees. The interview guide explored the following issues: when, how and why regulations, policies and land-use regimes were developed and how they are implemented; and the position of authorities, managers and policies on foraging practices. Furthermore, the guide explored some of the issues covered in the survey questionnaire and emerging insights during the survey. The in-depth interviews were conducted between September and October 2019. The interviews were tape-recorded (subject to the participant consent) and later transcribed. On average, the interviews lasted between 30 to 50 minutes.

5.2.3. Data analysis

Descriptive data was summarised using frequencies, proportions and measures of central tendency and dispersion. ANOVA tests were used for determining significant differences in the means of frequency of access to foraging spaces against location of residence and household income, and time taken to reach foraging spaces against location of residence. Chi-square tests were used to assess differences in knowledge about regulations between foragers and non-foragers. Qualitative data from the in-depth interviews was captured in NVivo 12

package, and analysed thematically. Thematic analysis technique generates meaning from qualitative data by way of identifying the recurring themes and or patterns within the data (Braun & Clarke, 2006; Kawulich & Holland, 2012). Thematic analysis was executed in a five-step process, namely (1) data familiarisation, (2) data coding, (3) identifying themes, (4) reviewing themes, and (5) defining and naming themes (Braun & Clarke, 2006).

5.3. Results

5.3.1. Access to foraging spaces

Foraging occurred in a variety of both formal and informal green spaces (Chapter 3). Vacant spaces and riparian areas were the most visited foraging spaces, followed by domestic gardens. A small proportion of foragers visited institutional spaces, parks and cemeteries. Foragers also visited other spaces such as peri-urban farms and dumping sites. However, most foragers mostly used more than one type of space and it was conditioned by the availability and type of resources sought. Given the low frequency of visits recorded in some spaces, the subsequent analysis focuses on the three most visited spaces: vacant spaces, riparian areas and domestic gardens.

5.3.1.1. Vacant spaces

Over half (54.7%) of the foragers visited vacant spaces, making it the most preferred foraging site across the sample. Likewise, vacant spaces were the most frequently accessed foraging spaces, as demonstrated by the mean visitation rate of 1.15±1.45 times visits per month, ranging from 0.08 to 12 times. The frequency of access per month did not differ significantly with location of residence within town ($F_{3, 138} = 1.65$, $p = 0.18$) or perceived household income level ($F_{2, 136} = 1.13$, $p = 0.33$). Generally, foragers lived in close proximity to most of the vacant spaces, as evidenced by the time taken to reach the spaces – approximating 21±12 minutes. The average time taken to reach the spaces did not differ with location of residence ($F_{3, 83} = 1.13$, $p = 0.34$). This implies that the spaces were fairly accessible regardless of foragers' location of residence. Consequently, the majority (77.1%) walked, while a few (20.1%) used cars to reach vacant spaces to forage.

Over three-quarters (87%) of the foragers stated that vacant spaces were governed as a public good, which meant that no permission was required prior to foraging. However, a few (10.1%) noted that some vacant spaces were private spaces for which permission was

required. The majority of foragers (73.3%) disagreed with the notion of instigating permits for foraging on vacant spaces, while a few (25.9%) agreed. Of those disagreeing, they advanced a couple of reasons but key among them were land tenure, subsistence needs and resource access rights. A common thread on land tenure was about vacant spaces being public entities, with the goods and services available to every urban citizen without any restrictions. Some of the foragers identified livelihood sustenance as the reason against regulating access to and use of vacant spaces. They regarded the resources as a source of livelihood and they envisaged that their access rights would be curtailed if permits became necessary. However, some foragers contended that permission requirements would not halt their foraging activities should they be implemented. One of the foragers opined that "*people are hungry and they will not even think of asking for permission*". They perceived permits as a constraint against resource use. The foragers were of the view that permit applications might take a long time and or require a fee. One forager said "*it's going to be difficult for people to forage if permission has to be asked because at the end they will say we have to pay to gather now. So no*!"

Regulation, safety and sustainable harvesting were the most recurring reasons provided by those favouring a permit system. These foragers believed that vacant spaces probably belonged to someone; hence permission should be sought to avoid possible litigation for trespassing. Some foragers favoured permits for safety reasons, in terms of knowing who went out foraging as well as the spaces visited. Lastly, some foragers associated permission requirements with sustainable resource harvesting. They argued that permit requirements will curb over-exploitation while at the same time facilitating coordination of foraging activities. One of the foragers noted that: *"... Because if we were to forage anyhow, we would end up depleting the resources. For example, cutting down of live trees in order to dry them at home for firewood usage*".

Although the majority of foragers (87%) did not mention any prohibited species found within the vacant spaces, some species such as *Combretum imberbe*, *Sclerocarya birrea* and *Spirostachys Africana* were deemed protected species and foraging them was limited to non-destructive practices such as picking leaves and fruits. This was proclaimed under formal regulations, particularly those concerned with sustainable utilisation of urban resources. On the other hand, all foragers but one reported there to be no conflicting land-use practices towards foraging. However, one forager expressed that some cultural practices often

contravene with foraging activities. For example, been barred from visiting certain foraging sites where some cultural activities are conducted, such as initiation ceremonies.

5.3.1.2. Riparian areas

Riparian areas were the second-most preferred foraging site (30%) after vacant spaces. The mean visitation rate was 0.76±0.71 time per month, ranging from 0.8 to five times. The frequency of access per month did not differ with foragers' location of residence ($F_{3, 78}$ = 0.87, p = 0.46) or perceived household income level ($F_{2, 76}$ = 1.17, p = 0.32). Riparian areas were within reach to most of the foragers' homesteads, with a one-way trip averaging 26±13 minutes. The average time taken to reach the spaces did not differ with location of residence ($F_{3, 57}$ = 1.77, p = 0.16). Most of the foragers reached the riparian areas by walking (86.8%), while a few used cars (13.2%).

An overwhelming majority of foragers (92.3%) noted that riparian areas were public spaces and consequently permission was not required for foraging. Over half (69.1%) of the foragers disagreed with the idea of managing riparian areas through permission requirements while a quarter (25%) agreed. Similar to vacant spaces, those disputing a possible need for permits advanced reasons revolving around land tenure, subsistence needs and resource access rights. Foragers contended that riparian areas were public spaces, which should be accessed freely by everyone. A common sentiment among foragers was that riparian areas were "… *free spaces not owned by anyone*". For some of the foragers, riparian spaces were a source of livelihood because they provided food and firewood. Hence, they perceived that promulgation of permits would compromise their livelihood sustenance. Other foragers opposed permits on the basis that foraging is one way of affirming their right to the resources found in their proximate environment. One of the foragers' expressed that "…*Everyone has a right to gather God's things*".

To those supporting implementation of permits in managing riparian areas did so for safety, conservation and regulation. Foragers believed that permits would enhance their personal safety, as it enables keeping a track record of who visited a particular space and possible areas of concentration. Similarly, permits were considered pivotal in curbing resource over-exploitation and promoting sustainable harvesting. One of the foragers commented that: "*If all of us were to gather, some of these species will run extinct hence jeopardising the need of the future generation to meet their needs".*

No prohibited species were mentioned as occurring in riparian areas. All but two foragers mentioned no land-use practices contravening with foraging activities. However, elimination of non-native species such as *Opuntia ficus-indica* (the fruits of which are relished by foragers) and disposal of sewage along riparian areas were observed to be deterrents to foraging. However, municipal officials countered that it is within their right to eliminate non-native species, particularly invasive ones that are detrimental to the environment. They contend that the regulations empowering them to eliminate non-native species does not take into consideration the species value to local communities, such as provision of fruits. Some of the officials said:

> "*I think is the bylaws, let's say parks and open spaces or invasive species management bylaws. Within these bylaws, there are certain conditions stipulating that the municipality may eliminate certain species, it makes provision for that. The bylaws don't necessarily specify that if it is a useful plant then it should be spared. So that's where the issue is. If the bylaw is enforcing me to eliminate a certain species because it is alien, then I will do so regardless of whether is useful or not*".

> "Opuntia ficus-indica *is an invasive plant, growing quite rapidly but it originates from elsewhere. When invasive species invades an area, they take dominance and consequently suppress other vegetation therein and thereby destructing the natural environment. So we are trying to regulate that*".

5.3.1.3. Domestic gardens

Domestic gardens were accessed by one-fifth (17.9%) of the foragers, with a mean visitation rate of 0.84±1.02 times per month. The frequency of access ranged between 0.8 to six times per month. The mean frequency of access did not differ significantly with location of residence ($F_{3, 45} = 1.66$, $p = 0.19$) or household income ($F_{2, 43} = 1.02$, $p = 0.37$). Most of the domestic gardens were situated within foragers' homestead, hence no time was spent to access them. However, a few number of foragers gathered from some domestic gardens belonging to relatives, friends and neighbours. In this arrangement, permission was sought verbally and normally only once, during the first time gathering event.

Most of the domestic gardens were under private tenure (82.2%) while a few were governed as a collective space (17.8%). The latter comprised of community gardens designated to a group of people to practice urban agriculture. However, some forageable wild vegetables

self-propagated in them. Permission was required when foraging from other people's gardens (29.5%), normally sought through verbal arrangements from the landowners. Foragers expressed ambivalent viewpoints on the notion of managing domestic gardens through permission requirements. An equal proportion of foragers viewed it as either a good or a bad idea. Those who favoured permits stressed that domestic gardens are situated within private properties, hence the need to seek permission prior to engaging in foraging. Since most of the gardens were situated within foragers' homesteads, prohibited species and conflicting land-use management practices were generally not an impediment. However, for those who foraged from gardens situated elsewhere, they were prohibited from harvesting cultivated crops and at times chemicals applied to the crops affected wild plants growing in the vicinity.

5.3.2. Regulatory frameworks

5.3.2.1. Formal regulations

Most foragers and non-foragers had limited knowledge about the formal regulations governing urban landscapes. About one-quarter (24.9%) of the respondents indicated awareness of some formal regulations used for managing urban landscapes, while the majority (75.1%) were not aware. However, awareness on formal regulations did not differ with foraging status ($\chi^2_{1,\ 374} = 0.08$, $p = 0.93$). Nonetheless, foragers were likely to claim some knowledge of formal regulations compared to non-foragers. About one-quarter (25%) of the foragers acknowledged awareness on formal regulations compared to 24.6% of the non-foragers. Of the few (25%) respondents (foragers and non-foragers) who had some awareness on the regulations, it was mainly related to certain principles but not the actual regulations per se. The most frequently mentioned regulations were those pertaining to sustainable harvesting, land-use tenure and protected tree species, while wild fire management and permission acquisition were the least.

Indiscriminate cutting of live trees was the most recurring theme under sustainable harvesting regulations. The respondents noted that cutting of live trees was prohibited. Some land-use tenure regimes governing certain spaces such as protected and private areas (e.g. mines, nature reserves, army base) prohibited foraging within their confines. In Potchefstroom, most of the respondents who lived near the Highveld Nature Reserve decried lack of access to the reserve for foraging. The manager stated that foraging is prohibited in the reserve, except under certain circumstances when it is allowed to a limited extent, such as collecting

firewood for funerals. But the bereaved family is still expected to seek permission prior to gathering, although this was not always the case. Despite this regulatory measure, some respondents still foraged from the reserve without having obtained permission. The said foragers cited lack of knowledge on the formulation of rules governing the nature reserve. One forager said; "*We are aware that we are not supposed to gather from the adjacent hill but we don't know where that law is coming from*". The respondents noted protected tree species regulations which declare some species as rare or endangered. Consequently, such species were prohibited from foraging. This was a great concern for species foraged for firewood. The municipal officials also shared the same sentiments with the respondents. They indicated that there were no specific regulations dealing with trees in the urban landscapes, but they were using regulations which were too broad in as far as tree resources are concerned in the urban environment. They mentioned National Environmental Management: Biodiversity Act (NEMBA 2004), Conservation of Agriculture Resources Act (1983) and National Forest Act (1998).

About half of the respondents (52.7%) who acknowledged awareness on formal regulations expressed that they allow foraging while 44.1% disagreed. Although at varying degree, the regulations permitted foraging but only for non-destructive practices such as picking leaves and fruits, and salvaging dead woods. On the contrary, regulations concerned with personal safety and preservation of resources prohibited foraging. Nearly half of the respondents (44.1%) believed that the rules were being enforced while 31.2% disagreed. However, a considerable proportion (26.9%) expressed ambivalent views. The stakeholders, particularly municipal officials, acknowledged that enforcement of regulations is limited. They noted a lack of capacity as the major hindrance, particularly of qualified environmentalists within the municipality. One official stated: "*Like I mentioned to you earlier, within our institution we don't have capacity. By capacity I mean a person who knows what and how things should be done. If within the structure or among the pool of personnel in the institution – there is no one who knows the environmental regulations and legislations and how and where they are enforced, then it is a problem. It becomes a problem because we would have a pool of people who do not know what needs to be done. So that is part of the problem*".

On the contrary, an overwhelming majority (91.8%) of the respondents decried a lack of urban citizens' involvement in formulation of regulations governing urban landscapes. An expression like "*I never saw relevant authorities engaging in community outreach to promote*

their policies and laws to us" was reiterated by most of the respondents. Others doubted the existence of any formal regulations, hence the lack of participation during planning and designing of the regulations. Sentiments such as "*I am not aware if any regulations exist*" were common among the respondents. Furthermore, some respondents only get to learn about the existence of regulations after their promulgation, particularly after contravening some of the regulations. Generally, urban citizens' involvement in formulation of formal regulations was through taking part in consultation meetings. However, stakeholders countered that public participation in general in the country is still wanting, as most of the people are not keen to participate in consultative forums convened by the respective officials. They noted that at the helm of people's contentions is service delivery, with issues regarding to the environment not gaining much interest. This is true, as only a small proportion (23.8%) of the respondents expressed a willingness to be involved. They opined that participation in formulation of regulatory instruments will accord them the opportunity to learn about the regulations, voice their views and opinions, infuse traditional ecological knowledge and actively participate in conservation of urban environmental resources. For those who disputed involvement, they contended that they are always taken for granted by the relevant authorities, with their views and opinions never taken into consideration.

5.3.2.2. Informal regulations

Most of the respondents (foragers and non-foragers) exhibited limited knowledge of any informal regulations or practices governing urban landscapes. Two-thirds of the respondents (67.6%) were not aware of any informal regulations or practices while 32.4% acknowledged some. Awareness of informal regulations significantly differed with foraging status ($\chi^2_{1, 374}$ = 15.73, p = 0.00003). Foragers (39.1%) were more likely to exhibit awareness on informal regulations compared to non-foragers (17.8%). Cultural beliefs were the most frequently mentioned informal regulations while religious beliefs and neighbourhood associations were the least. At the heart of cultural beliefs was the use of certain tree species for consumptive or utilitarian purposes. For example, some tree species, such as *Peltophorum africanum*, was forbidden for firewood use since it is believed to change the colour of the food cooked and inducing ailments. Although not recalling species names, certain tree species were associated with bad luck, evil spirits or devastating incidents and hence it was forbidden to grow them at home. The concerned species were believed to incite quarrels or fights among family members or attract lightning strikes if grown within the yard. For example, *Ziziphus*

mucronata was associated with attracting lightning. Cultural beliefs also forbid visiting certain spaces for foraging, especially those considered to be ancestral home. Similarly, cultural beliefs entailed adhering to certain conditions such as good weather prior to embarking on foraging activities. For example, foraging certain species and or seeking refuge underneath them during thunderstorms were forbidden, e.g. *Ziziphus mucronata*. On the other hand, fewer people mentioned pro-environmental and religious values. For example, fruit trees (e.g. *Sclerocarya birrea*) were not supposed to be cut for firewood but rather saved for picking fruits, while certain tree species associated with ancestors were prohibited for foraging. However, foragers were not able to recall the species associated with the latter. For those who were not aware of informal rules, they disputed their existence and deemed them superstitious.

Of the few respondents who were aware of informal rules, nearly half (49.6%) of them expressed that the rules allow foraging while 43% disagreed. With exception of certain tree species, cultural and religious beliefs allow foraging practice. However, informal discussions with some foragers revealed that some people no longer adhere to the informal regulations, mostly cultural beliefs. They contend that the regulations are archaic and mostly applicable to rural areas. Some foragers expressed that the beliefs associated with the particular species never manifest after contravening them. Cultural integration, brought about by the influx of migrants in urban areas has gradually eroded the beliefs associated with the use of certain tree species. This is the case because the same species might be forageable at the migrants' original home. Similarly, resource scarcity led to some foragers gathering any available species regardless of their associated believes. Lack of knowledge also resulted in some people contravening the informal regulations. On the contrary, neighbourhood expectations, conservation priorities and perceived environmental contamination somehow discouraged foraging practice. Foragers residing in the affluent areas narrated that the use of firewood was often times met with confrontation and signs of disapproval from the neighbourhood residents. The respondents expressed mixed reactions regarding enforcement of informal regulations. Over one-third (41.3%) were unaware on whether or not the rules were enforced, while 32.2% suggested no enforcement, with 24.8% of the respondents stating that the rules were enforced. Informal regulations, particularly believes and norms, are developed and reshaped through accumulative processes, with no defined window for participation towards their formulation. Cultural beliefs were established by forefathers and are passed on through generations

5.4. Discussion

Foraging occurred in a variety of public and private spaces, with vacant spaces, riparian areas and domestic gardens been the most frequently visited spaces. The frequency of access to the spaces varied, with vacant spaces being the most frequently accessed, followed by domestic gardens and riparian areas. The frequency of access to vacant spaces and domestic gardens resembles that of Kaoma and Shackleton (2014) in the medium-sized towns of Tzaneen, Bela-Bela and Zeerust in South Africa. Vacant spaces in the form of remnant vegetation and forests at the edges of towns and domestic gardens within households' homesteads were the most visited foraging spaces in their study towns. The spaces were a source of firewood and fruits, with the former mostly collected from vacant spaces while the latter from domestic gardens. In Masvingo City (Zimbabwe), the vacant spaces in the form of peri-urban forests at the edges of the city were a common source of food, energy, construction materials and agricultural inputs (Murwendo, 2011). Similarly, vacant spaces in the form of communal land were the frequented foraging site in the rural-urban continuum of Chobe District, Botswana (Joos-Vandewalle et al., 2018). The predominance of vacant spaces as foraging sites in our study and elsewhere calls for attention in spatial planning and development. This endeavour will promote the social use value of urban spaces and facilitate designing multi-functional land-use types. In regard to domestic gardens, the modal frequency of access is similar to the one observed in the cities of Boston (Short-Gianotti & Hurley, 2016) and Seattle (Charnley et al., 2018) in USA. In these two cities, gardens situated within owners properties and yards were frequently visited for foraging. This was attributed to the availability of forageables and limited competing land-use interests.

The variation in the frequency of access to the aforementioned spaces could be a result of availability of desired forageable resources. For example, firewood was mostly sourced from vacant spaces. Since the foragers were in constant demand for firewood to fulfil household energy needs, they accessed vacant spaces more frequently. Vegetables were mostly foraged from riparian areas, with their demand and availability conditioned by seasons. Hence, the riparian areas were mostly accessed less frequently. In contrast, access to foraging spaces in Masvingo city (Zimbabwe) was largely a function of seasonality (Murwendo, 2011) than desired forageable resources. The peri-urban forests situated at the edges of the city were accessed more during the dry season, particularly between the months of May and October. The mean frequency of access to foraging spaces did not differ against location of residence

and household income. This implies that access to foraging spaces was similar, regardless of foragers' location of residence in town or household income. This could be explained by the close proximity of foraging spaces to most foragers' dwellings, with one-way trip averaging ≤ 30 minutes. This finding is within the ranges of Murwendo (2011), albeit not disaggregated against location of residence. In their study, foraging spaces were within a radius of 4.8 km from residents, with a one-way trip approximating 50 – 60 mins. Synk et al. (2017) also found a similar trend in Baltimore's bounty in USA, where foragers travelled an average distance of 6.9 km for reaching foraging spaces - with different spaces located within and others outside forager's neighbourhood.

The findings provided insights on the types of spaces frequently accessed for foraging within the urban landscape. This insight is critical to urban landscape planning and development, as the urban space managers will know which types of spaces provide ecosystem goods and services to the urban dwellers and how the spaces could be protected from urban transformation. This is relevant to small to medium-sized towns of South Africa and elsewhere, where there is still an opportunity for inclusive planning and development, which promotes different land-use activities. The findings support McLain et al. (2014) and Synk et al. (2017) that a mosaic of spaces within the urban landscape matrix are important not only in supporting but sustaining foraging practice.

The vacant lots and riparian spaces were governed as a public good while domestic gardens were under private tenure. The spaces were accessed freely, with no permission required prior to foraging, except for foraging from other people's gardens. With regard to the latter, permission was granted under tacit arrangements. It was normally sought once during the first foraging outing, with the subsequent ones happening freely. This kind of agreement between foragers and private yard owners was also observed in Seattle (USA) (Charnley et al., 2018). However, the majority of foragers disagreed with the notion of instigating permits for foraging in vacant and riparian spaces but were ambivalent for domestic gardens. The permits were considered a constraint to access and to foragers claiming their right to spaces they use. A permit system was also a course for concern in the transitioning urban area of northern Botswana, where they limited people's ability in benefiting from the plant resources in the proximate environment, particularly for commercial purposes (Joos-Vandewalle et al., 2018). This is against the potential of foraging for income generation, as noted by Chazovachii et al. (2013) and Kaoma and Shackleton (2015). However, respondent's grievances over permit

systems are a cause for concern in both urban and rural areas. In northern Botswana, Chobe enclave villagers castigated the requirement for obtaining permits prior to harvesting *Cymbopogon excavatus*, an abundant thatching grass in the nearby communal area (Garekae et al., 2020). Among others, the harvesting permits were considered a constraint to resource exploitation, as they take a long period of time to be approved. On the contrary, the few foragers in our study who favoured a permit system contend that permits enable keeping a track record of foraging activities and promote sustainable harvesting. The permits designate the harvesting area, specify the quantity and method to be used.

The majority of the respondents (foragers and non-foragers) were unaware of both formal and informal regulations pertaining to urban landscapes. This is in keeping with Charnley et al. (2018) who reported that foragers in Seattle (USA) possessed limited knowledge on regulations used to managing public green spaces. Only one-quarter of our study respondents and mostly foragers acknowledged awareness of some formal regulations. This could be attributed to an array of factors with key ones being inadequate or lack of dissemination of available regulations as well as inadequate or a lack of urban residents' participation in consultative forums. The respondents fell short of identifying exact regulations per se but rather described certain principles such as those concerned with sustainable harvesting, land-use tenure and protected tree species. The respondents opined that the regulations generally allow foraging. In contrast, foraging was largely prohibited or limited in both formal and informal public spaces in the cities of Baltimore, Philadelphia and Seattle (USA) (McLain et al., 2014; Charnley et al., 2018). In these cities, foraging was generally associated with species destruction and often viewed as an undesirable activity in the urban landscape. However, rule enforcement was not consistent in the different public spaces within and between the aforementioned cities. This resulted in foraging occurring under tacit arrangements, where it may be allowed during a particular management authority but prohibited by the next one. Although not prohibited, foraging was limited for subsistence consumption in the transitioning urban area of northern Botswana (Joos-Vandewalle et al., 2018).

The limited knowledge on formal regulations governing urban spaces calls for urban space manager's attention. Apart from raising awareness and educating the urban community about the existing regulations, there is need to infuse some of the informal regulations, particularly cultural norms and beliefs within the existing formal regulatory frameworks. Since the

informal regulations resonate well with their proponents, its incorporation within the formal structure will possibly foster peoples support over formal regulations and in turn increasing awareness and adherence to the regulations. Moreover, the key traditional ecological knowledge possessed by some people could be of vital importance in conservation of the resources in the urban spaces. Generally, people are better placed in monitoring resource use and compliance with regulations which they participated in their planning and formulation.

Despite the unfavourable regulations over foraging, it is still widespread worldwide. Poe et al. (2013) argued that prohibiting foraging constrains people's right to interacting with their immediate environment for benefits such as food sovereignty, cultural affirmation, health and well-being improvement. This calls for a swift shift of the locus of urban regulations from prohibiting to recognising foraging as a legitimate part of urban land-uses. Until recently, urban green spaces were planned and designed mostly for the provision of regulating and cultural ecosystem services (Hurley et al., 2015). The potential provisioning benefits accorded by urban green spaces were considered to be outside the scope of the management authorities (Clark & Nicholas, 2013). Lack of urban residents' participation during rules formulation was a cause for concern for most of the respondents. This is despite that the majority of them were not willing to be involved, only less than one-quarter vowed willingness. This might lead to formulation of regulations which don't take into account the needs, views and aspirations of the urban community over the production of urban spaces. Consequently, the social use value of the urban space will be obscured in the regulations.

About one-third of the respondents affirmed awareness of some informal regulations. The majority of them were foragers. Cultural beliefs were the most frequently mentioned informal regulations. For centuries, cultural beliefs and values have been at the centre of natural resource use and governance (Byers et al., 2001; Rim-Rukeh et al., 2013; Sasaoka, 2017). This governance system is based on the principles of norms and rules subscribed to by a particular community. For example, cultural beliefs could instigate a ban on access to certain spaces, forbid use of certain resources, restrict the amount of harvest and specify harvesting techniques (Sasaoka, 2017). However, some of the respondents considered cultural beliefs to be archaic and superstitious. Moreover, the knowledge about various cultural beliefs was normally vested with the elderly people. Despite the elderly's attempts in knowledge production and sharing, they opine that the youth generally shun cultural beliefs and associate them with rural contexts. This corroborates Wehi and Wehi (2010) who opine that traditional

knowledge among young people is declining. This calls for intensive awareness and orientation of views among the youth as well as using relevant mediums in reaching out to them. In this study, cultural beliefs conditioned foraging practice in terms of species selection, uses, domestication and choice of foraging sites. In Seattle (USA), the prominent informal regulation determining access to potential foraging spaces was foragers' moral judgement (Charnley et al., 2018). Foragers' moral judgements determined the species, spaces, amount and harvesting methods and time framings.

Informal regulations allowed foraging, with the exception of those species associated with certain beliefs. However, the respondents were equivocal on the enforcement of informal rules. A considerable proportion was uncertain, a few agreed while others disagreed.

From a political ecology standpoint, the prevalence of foraging albeit unsanctioned counters the capitalistic dominion over production of urban spaces (Paddeu, 2019), which commodifies and valorises the urban spaces. Commodification and valorisation of urban spaces proliferate property rights and the boom of gated communities, which displaces the locals from the areas they were formally subsisting on (Grabbatin et al., 2011), such as through foraging and further perpetuating prohibition of foraging within the city spaces. Consequently, this transforms the urban green spaces supporting foraging in terms of their form, nature and quality. This threatens the prevalence of foraging within the urban landscape and reconfigures access and rights to the remnant spaces with forageable resources. For example, urban sprawling transformed some of the green space patches consisting of valuable forageable resources in South Carolina (USA) (Hurley et al., 2013). The spaces were converted from communal to private land tenure. Although some plant resources of value and importance to foragers were retained in the properties, access and rights to the spaces and resources therein was curtailed by the new land-use type. The proliferation of low density housing suburbs and the boom of affluent areas in the peri-urban areas of Bengaluru city (India) transformed the nearby commons into spaces of aesthetic and recreational functions, which disparaged the provisioning functions which were previously enjoyed by the urban poor (Mundoli et al., 2015). Based on the foregoing, the urban transformation disrupts the provisioning and cultural ecosystem services of urban green spaces and commons which were previously enjoyed by the local communities (Unnikrishnan et al., 2016). Consequently, this alienates the local community from the spaces they were once depended upon for meeting their subsistence and livelihoods needs. Nonetheless, the prevalence of foraging challenges

the notions of access and rights to urban spaces and regulations governing such spaces amidst this changing dynamics.

Given the widespread rates of foraging in this study (Chapter 3) and others from elsewhere, foraging wild plants could be important in pursuit of food justice and sovereignty (Paddeu, 2019). Food justice and sovereignty strives for equity and equality in the food systems supply chain and production (Poe et al., 2013; Cadieux & Slocum, 2015). At the heart of food sovereignty is the right of people to "… healthy and culturally appropriate food produced through ecologically sound and sustainable methods, and their right to define their own food and agriculture systems" (Via Campesina, 2009: 673). This framings advocate for self-food production which takes into consideration the different socio-cultural contexts in food and people relations (Alkon & Mares, 2012; Poe et al., 2013; Paddeu, 2019). They portray people's ability and right to self-food production as an integral aspect in attaining food security as compared to the globalised food systems. In the context of foraging, the diverse forageable resources in the urban spaces could be an important supply of wild foods for preparation of traditional cuisines, thereby connecting people with their social, cultural and ecological environment. Hence, foraging becomes critical in continuation of long-standing traditional practices in urban contexts. Moreover, foraging becomes even more interesting in the wake of consumerism society, where urban residents food source is mostly market-based as compared to self-production and foraging (Tevera & Simelane, 2016; Boonyabancha et al., 2019). Therefore, foraging could be an important complementary food source, particularly to those with inadequate access to available food in the market.

5.5. Conclusion

Foraging occurred in a range of spaces situated in both public and private areas. However, it was most prevalent in vacant spaces, domestic gardens and riparian areas. The prevalence of foraging in public spaces in this study, and elsewhere, calls for the recognition and appreciation of foraging as a legitimate urban land-use activity. The study insights on the types of spaces visited for foraging and frequency of access to the spaces is critical in spatial planning and development. It enables planners and developers to design urban spaces that support and sustain multi-functional land-uses, foraging included. On the other hand, the majority of the respondents were unaware or had limited knowledge on both formal and informal regulations governing foraging in urban landscapes. This calls for intensive education and awareness on the regulations used for governing urban landscapes. The

prevalence of foraging, albeit unsanctioned calls, for the review of regulations governing urban landscapes. The regulations need to recognise foraging as a legitimate practice and ensure sustained access to urban green spaces. This will ensure continued access to urban spaces for foraging even in the event of change. Moreover, the recognition of foraging is a fundamental step towards fostering active community involvement in the management and production of urban spaces.

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Chapter 6

Socio-spatial dynamics in wild plant foraging practices in two medium-sized South African towns: How do foragers adapt and respond to change?

Abstract

There is growing interest in urban foraging of wild plants worldwide. But rapid urban transformation potentially poses a threat to foraging sites and practices. Yet, little is known about how urban transformation shapes foraging practices over time. This study assessed the perceived socio-spatial dynamics influencing wild plant foraging practices in two medium-sized South African towns and how foragers adapt and respond to transformation. Eighty-one semi-structured interviews were conducted with regular foragers, complemented by 20 unstructured in-depth interviews. Descriptive and inferential statistics were used for analysing quantitative data and thematic analysis for qualitative data. The results showed that the practice of foraging wild plants is constantly changing over time, with respect to spaces, foragers and regulations. Foragers attested to a gradual decline in the number and size of foraging spaces over the past ten years. Moreover, urban developments engulfing green spaces brought along various regulations which often prohibited or restricted access and activities outside the purview of such developments. Besides, change was also noted among foragers' themselves. There was a decreasing trend in the number of people participating in foraging, coupled with changes in foragers' profiles. The aforementioned changes, particularly on the spaces and land-use management, prompted foragers to devise adaptation strategies. The principal adaptation strategies were locating new foraging sites, foraging in more distant areas, and negotiating access. Overall, the results demonstrated that urban transformation continually reconfigures foraging practices.

Keywords: Access; Foraging; Green spaces; Urbanisation; Urban transformation; Wild plants

6.1. Introduction

The world is rapidly urbanising. About half (55%) of the global population currently resides in urban areas and the proportion is projected to reach 68% by the year 2050 (UN, 2019). Although urbanisation is commonly associated with developed regions, the greater proportion of the foreseeable urban population growth is anticipated to be concentrated in developing regions (Montgomery, 2008; Yeh & Huang, 2012). Asia and sub-Saharan Africa (SSA) are anticipated to host approximately 90% of the foreseeable urban population increase (UN, 2019). Contrary to the patterns of urbanisation in developed regions, normally characterised by economic growth; much urbanisation in the developing regions is taking place amid poor economic development (Cohen, 2006; Fotso, 2007; Satterthwaite et al., 2010). The current rapid urbanisation in many developing regions therefore often presents challenges to the urban inhabitants, landscapes and general sustainability (Cohen, 2006; Chen, 2007). This includes environmental, economic, social and health issues, among others. In regard to the environment, urbanisation modifies habitats and drives biodiversity loss, increases resource consumption, and generates pollution (Simms, 2008; Yeh & Huang, 2012; Pauleit et al., 2018). Unemployment, poverty, food insecurity, and inadequate housing constitute core socio-economic challenges, along with poor health conditions and sanitation (Ichimura, 2003; Nsiah-Gyabaah, 2004). Central to this study are the socio-environmental challenges, particularly on how they produce and shape ecosystem services, such as the provisioning of wild plants which may be foraged by local communities.

Rapid urban population growth sparks greater demands for natural resources such as land, water, forests, energy and minerals (Lal, 2012; Yeh & Huang, 2012; Unnikrishnan et al., 2016). This shifting of the global population is likely to increase the prevalence of foraging wild plants in urban areas (Cocks, 2006; Drury, 2009; Schlesinger et al., 2015). Simultaneously, the rapid urban transformation threatens the practice of foraging wild plants in urban landscapes because it is accompanied by land-use and cover change, which transforms land which was set aside for other purposes besides urban development (Lal, 2012; Pauleit et al., 2018). Approximately three million hectares of land per annum is engulfed by urban expansion worldwide (Lal, 2012). However, part of this land might include natural landscapes with the potential of providing ecosystem goods and services to urban inhabitants. For example, in South Carolina (USA), urban development has encroached on some of the remnant woodland patches which were previously used for foraging sweetgrass

(*Muhlenbergia sericea*), a valuable species used for weaving baskets in the area (Hurley et al., 2013). Similarly, the proliferating low density suburbs in Kingston (Jamaica) have engulfed some of the key ecological hotspots in the city, such as watersheds that support a diversity of flora and fauna (Simms, 2008). In India, dense urban sprawl has transformed some urban commons into built environments in the peri-urban areas of Bengaluru (D'Souza & Nagendra, 2011; Mundoli et al., 2017). On that note, over 40 of the city's lakes formerly managed for the public good have disappeared due to urban expansion, with the remaining ones modified in their shape and function. The lakes were a source of water for drinking, irrigation, food (fish and vegetables), and religious and cultural affirmation. Similarly, there was a gradual increase in the built environment in six medium-sized cities of SSA between 2003 and 2013 (Schlesinger et al., 2015), driving a decline in the area of land under cultivation. Urban expansion has also been linked with declines in vegetation cover (Alongi, 2002; DeFries et al., 2010; Mundoli et al., 2015). Consequently, such transformations modify the composition, structure and function of some urban ecosystem goods and services (McKinney, 2002; Tratalos et al., 2007; Lal, 2012), such as the availability of species of value to foragers.

Moreover, the expansion of property and infrastructure development in urban spaces often comes along with complex or changing tenure regimes which shape access to the spaces therein. This development produces 'gated' neighbourhoods or spaces, which may curtail access to the spaces therein for other activities such as foraging plant resources (Hurley et al., 2013). This is despite that some remnant vegetation may be retained during developments, which might be valuable to foragers. Consequently, this disrupts access to the spaces and alienates foragers from the spaces which they formerly used for provisioning and cultural ecosystem services (D'Souza & Nagendra, 2011; Grabbatin et al., 2011). For example, the proliferation of residential suburbs in the peri-urban areas of Bengaluru (India) disrupted the poorer residents' access and right to the communal lakes in the city for livelihood subsistence, while the affluent prioritised recreational activities. This was echoed in Charleston (USA), where the property developments encompassed some of the woodland areas frequented by African-Americans for collecting sweetgrass (Grabbatin et al., 2011).

The above dynamics may reconfigure foraging practices in terms of form and nature, and the right and access to green spaces for foraging (Synk et al., 2017). This underscores the importance of understanding how urbanisation influences land management and access

practices such as foraging wild plants. This is integral to planning and developing multi-functional landscapes, which support diverse land-use activities and livelihoods. Against this backdrop, this study aimed to assess the socio-spatial dynamics influencing wild plant foraging practices in two medium-sized South African towns and if and how foragers adapt and respond to the changes. Specifically, the study elicited information on how foraging spaces, regulations and land management changed over time, adaptation strategies employed, and changes in who forages.

6.2. Methods

6.2.1. Study areas

Refer to Chapter 1 for the detailed information on the study areas.

6.2.2. Data collection

The participants were drawn from a sub-population of regular foragers from the main household survey (Chapter 3). The procedure for identification and selection of regular foragers is described in Chapter 5. A total of 81 participants were considered in this study. A semi-structured questionnaire was administered to the participants through face-to-face interviews. The questionnaire was composed of both open-and closed-ended questions, revolving around the following issues: changes in species availability and abundance, locations, regulations and land-use practices and how they shape and reproduce foraging practices; impacts of urban expansion (infrastructure development, land-use practices) on access to foraging spaces and how foragers adapt, respond and cope with such dynamics. The interviews were conducted during August and September 2018. The questionnaire was administered in the local language (Setswana). The interviews lasted approximately 30 minutes.

Additionally, the aforementioned issues were interrogated more through complementary, in-depth interviews, with 20 regular foragers (See Chapter 5 for detailed information on the selection of the interviewees). An unstructured interview guide was used to elicit data from the interviewees, which was administered in Setswana. The interviews lasted between 30 to 50 minutes and they were tape-recorded (subject to participant consent) and later transcribed. The interviews were conducted during September and October 2019. Observations were made to note changes on the urban landscape.

6.2.3. Data analysis

Descriptive data was summarised using frequencies, proportions, measures of central tendency and dispersion. Inferential statistics were conducted to establish significant differences or associations between nominal, categorical and continuous data. Specifically, ANOVA tests were used to determine significant differences in the means of length of residency and foraging experience against change in foraging spaces, and the number and profile of people involved in foraging. Chi-square tests were used to assess significant associations between change in foraging spaces, and the number and profile of people involved in foraging against location of residence and forager's age. Thematic analysis was used for analysing qualitative data (See Chapter 5 for the details on thematic analysis procedure).

6.3. Results

6.3.1. Respondent profile

Of the 81 sampled foragers, 59% were females. Most of the foragers were middle-aged, with a mean age of 48.6±15.6 years, ranging from 18 to 80 years. Almost half (47%) had some secondary education, 34% had attained primary levels, while only two had tertiary levels. However, 16% of the foragers had not received any formal education. About 44% of the foragers were unemployed, 14% and 12% were employed on a part-time or full-time basis, respectively, while only seven identified as being self-employed. However, 20% were retired. Over half (56%) of the foragers reported a low household income relative to others living within the same neighbourhood. Almost one-third (31%) contended their income was similar to that of their neighbours, while 13% felt better off. The mean household size was 4.3±2.3 persons, ranging from one to twelve people. Nearly three-quarters of the foragers grew up in rural settings (72%) and approximately one-quarter in urban areas (28%). An overwhelming majority (95%) grew up in a household that used to forage wild plants.

6.3.2. Change in foraging practice

The respondents affirmed that the practice of foraging wild plants is constantly (re)shaped by changing dynamics occurring over time. This dynamics are driven by an array of factors with key ones being population increase, economic factors (gentrification, wealth), social factors (poverty, societal values), regulations, land-use and land cover. However, these drivers are

multifaceted and may operate simultaneously. Consequently, this changes foraging practices in terms of form and nature and prompt foragers to respond and adapt to the changing dynamics. The subsequent analysis focuses on the effect of selected drivers on foraging practices, in terms of their effect on the spaces, regulations and people.

6.3.2.1. Spaces

In the context of rapid urban expansion, many undeveloped urban landscapes used for foraging are at risk of transformation. Establishment of developments on open spaces within the urban landscape poses a threat to the availability of foraging sites. Over half of the foragers (57%) stated that the number of foraging spaces had decreased over the past 10 years, while 22% disagreed, and 21% maintained that the number of spaces had remained the same. Similarly, 62% reported that many spaces had shrunk in size, 9% disagreed, and 28% maintained that the spaces remained the same. Only one forager was uncertain. The observation about the number and size of foraging spaces did not differ with length of residence in town ($F_{2, 79} = 0.15$, $p = 0.86$; $F_{2, 79} = 1.42$, $p = 0.25$), foraging experience ($F_{2, 79} = 1.12$, $p = 0.33$; $F_{2, 79} = 0.16$, $p = 0.86$), location of residence ($\chi^2_{6, 81} = 3.60$, $p = 0.73$; $\chi^2_{6, 81} = 3.44$, $p = 0.75$) and foragers' age ($\chi^2_{4, 73} = 4.08$, $p = 0.4$; $\chi^2_{4, 81} = 4.92$, $p = 0.3$).

Most of the foragers (80%) reported that physical infrastructure, industrial sites, peri-urban farms and protected areas were developed in some spaces they had used as foraging sites. Physical infrastructure was the commonest form of development, comprising of residential areas, line infrastructure (roads, power and sewage lines), hospitals, schools, shopping malls, churches, dams and offices. Development of residential areas was a cause for concern for the majority of foragers. Foragers decried that open spaces were rapidly engulfed by residential areas and also private areas such as game lodges on the fringes of town. They said that developments are normally accompanied by land clearing, therefore some form of deforestation was inevitable. This decreased the number and size of available foraging spaces. For example, one forager expressed: "… *the spaces are shrinking due to the urban expansion. Where we are now used to be a bushy area and we use to gather from here but now it is all built-up*".

Industrial sites, particularly the establishment of mines on the fringes of towns threatened the availability of some foraging spaces. This observation was prevalent in Thabazimbi, which is surrounded by iron mines. Demarcation of land for establishment of protected areas, such as

parks and nature reserves, was also a cause for concern about the availability of foraging spaces, especially in Potchefstroom where foragers decried of a large portion of land having been set aside for the establishment of the Highveld Nature Reserve. Foragers noted that a large piece of land was fenced off for establishment of the reserve, which then restricted access rights. Although establishment of protected areas is a fundamental step towards management and conservation of resources, it might come with disenfranchisement of some locals' access rights to the spaces, often the poor. Also, some portions of land within and adjacent to towns were used for urban agriculture. On the other hand, those who disputed such change maintained that the number and area of the spaces had remained the same all along.

Besides the decline in number and size of spaces, many developments also constrained access to the spaces. The common narrative was limited access to some of the spaces which were previously accessed easily before developments took over, e.g. protected areas. For example, one forager said: "… *we used to freely access the adjacent hill for foraging, but now it is fenced off and we are obliged to ask for permission of entry. So this has restricted our access, we are no longer able to access the hill as we used to back in time*" (The referred hill has being proclaimed a protected area). This presented a formidable challenge to foragers, as they were compelled to transverse longer distances to new areas not affected by exclusionary management regimes. Some foragers opined that the aforementioned dynamics ultimately led to a reduction in the frequency of foraging events, as they no longer gather as much as they used to do, as compared to when foraging spaces were not engulfed by developments. A forager narrated: "… *we are now struggling with finding foraging spaces nearby but rather we have to travel to distant areas where there are no fences to situate them. So this has reduced our frequency of foraging outings*". Despite foragers' grievances, they felt powerless to contest developments enacted in the spaces they used for foraging. They expressed that the spaces were not theirs. Some expressed sympathy, particularly when it comes to establishment of residential areas. Sentiments such as "*we don't have a choice since people need a place to live*" were common responses. However, a few were agitated as some of the developments curtailed their access to the spaces. Although they had narrated their ordeal to the local authorities such as ward councillors, they argued that their 'voices' were never taken into consideration. Consequently, they reduced the frequency of foraging or resorted to the use of alternative products and planting the required species in home gardens.

6.3.2.2. Regulations

6.3.2.2.1. *Formal regulations*

Most of the respondents (64%) had limited knowledge of any formal regulations governing urban landscapes, although one-third (36%) acknowledged awareness on some formal regulations. For those who were aware, they identified only certain excerpts of some regulations but fell short of articulating either the names or responsible agencies of the said regulations. Land tenure, sustainable harvesting and protected tree species were the commonly mentioned regulations. In regard to land tenure, foraging was prohibited in certain spaces, such as protected and private areas. This was widely cited in Potchefstroom, with regard to the governance of Highveld Nature Reserve which restricts access to the resources within its confines. Sustainable harvesting regulations prohibited any kind of destructive practices which might injure or damage the entire plant. For example, cutting down of live or young trees for firewood and uprooting of herbs for vegetables was perceived as forbidden. Foragers felt that they were only permitted to salvage dead trees for firewood and picking of leaves for vegetables. They said that protected tree species regulations prohibited foraging of certain species deemed rare or endangered. *Combretum imberbe* and *Sclerocarya birrea* were the only tree species mentioned as protected by the foragers. For such trees, foraging was limited to non-destructive practices such as picking of fruits or leaves.

Of the few foragers who were aware of formal regulations, 24% noted changes in the regulations over the past 10 years, 14% disagreed while the majority (63%) were uncertain. However, those who affirmed changes could not articulate which regulations had changed and how it occurred. Nonetheless, some contended that promulgation of some regulations came with a ban on foraging activities, particularly land tenure ones. Sentiments such as conversion of public spaces to private tenure resulting in regulations prohibiting and or limiting access were common among the respondents. On the other hand, some foragers expressed increasing non-adherence to the aforementioned regulations. They opined that people engage in indiscriminate foraging practices, without considering regulations. This deviation was attributed to inadequate knowledge of regulations governing urban landscapes.

6.3.2.2.2. *Informal regulations*

Contrary to the pattern established with formal regulations, most of the foragers (68%) acknowledged some informal regulations or practices governing urban landscapes, while

32% did not. Cultural beliefs were the most mentioned informal regulations, while only one forager mentioned property guidelines. Cultural beliefs were concerned with the use of certain tree species for consumptive or non-consumptive purposes. For example, species forbidden for firewood use as they were believed to attract lightening (*Grewia flava*, *Salix mucronata* and *Ziziphus mucronata*), change the colour of the food cooked (*Peltophorum africanum*) or invite evil spirits. Cultural beliefs forbid growing of certain tree species associated with inducing bad luck or inciting quarrels among family members. Similarly, the beliefs prohibited foraging of certain tree species during particular seasons, such as the wet season. However, foragers were not able to recall the species associated with the aforementioned beliefs. In contrast, some foragers disputed cultural beliefs and argued that they forage any species they encounter. With regard to property guidelines, they compel foragers to seek permission prior to embarking on foraging.

Nearly half of the foragers (42%) concurred that informal regulations experienced changes over the past 10 years, while equal proportions (29%) disagreed or were uncertain. Most viewed the change as increasing non-adherence to the informal regulations. Foragers indicated that people no longer adhere to the regulations, as they just gather whatever plant species they encounter. Limited abundance, inadequate knowledge, economic hardships and increasingly multicultural backgrounds were mentioned as drivers of such change. They stated that urban areas are home to people of different backgrounds and hence, what is forageable in one's native area might be forbidden in another area. One forager said: "… *from my observation, it seems like there are no taboos here in Thabazimbi, whatever which is wood - they just gather it. This could be attributed to the mixture of people in town and camps*".

6.3.2.3. Land-use

Over half of the foragers (61%) felt there had been changes in land-use in foraging areas over the past 10 years. However, a considerable proportion (40%) disagreed. Conversion of land from public to private tenure was a widely cited change over time. This included zoning of land for residential areas, organisational amenities, private areas and protected areas. To a lesser extent, some changes in land-use were informal – such as a group of people occupying a particular space for activities such as sports or worship. One forager expressed: "… *some people from our neighbourhood have turned one of the open green space in our vicinity into a football playground, now we can't forage from there anymore*". Although it can still be

accessed, the informal use might override other uses such as foraging, or restrict when foraging could occur.

6.3.2.4. People

Apart from spaces and regulations, change was also noted amongst foragers themselves. The change was in terms of the number and profile of people involved in foraging. All but three foragers (96%) affirmed changes in the number of people engaged in foraging. For those who noticed a change, over half (57%) reported a decrease in the number of foragers while 42% noted an increase. This observation was not associated with foragers' length of residence in town ($t_{52.05,\ 76} = 0.47$, $p = 0.64$), foraging experience ($t_{74,\ 76} = 0.83$, $p = 0.41$), location of residence ($\chi^2_{6,\ 79} = 5.58$, $p = 0.47$) and foragers' age ($\chi^2_{4,\ 79} = 9.22$, $p = 0.06$).

Several reasons were advanced for perceptions of decreasing numbers of foragers, including increasing availability of alternative products, change of lifestyle, lack of interest, decreasing spaces, and perceptions about foraging. The availability of alternatives was the most recurring response for the decreasing number of foragers. For example, they indicated that most of the people now use electricity and gas for heating and cooking instead of firewood, and cultivated vegetables and fruits for food instead of those sourced from green spaces. Consequently, this reduces the number of people engaged in foraging. Change in lifestyle was the second most common reason for the decreasing number of foragers. Foragers contended that increasingly people have generally adopted a more westernised lifestyle, marked with changes in people's eating habits. This dynamic shift some people's interests away from foraging as well as developing ambivalent perceptions towards the practice. Decreasing foraging spaces also lessened the number of foragers. Foragers decried travelling greater distances to reach foraging spaces when those within their proximity had been developed. However, some foragers noted an increase on the number of people engaging in foraging. This was attributed to the benefits of foraging, such as provision of energy, food, medicine and cultural affirmation. For example, foragers noted that wild foods, especially vegetables are healthier and an important relish for traditional cuisines.

Some foragers also noticed changes in the profile of people involved, with almost two-thirds (63%) affirming change, while 37% did not. However, this observation did not vary with length of residence in town ($t_{77,\ 79} = 1.36$, $p = 0.18$), foraging experience ($t_{77,\ 79} = 0.24$, $p = 0.81$), location of residence ($\chi^2_{3,\ 81} = 3.34$, $p = 0.34$) and foragers' age ($\chi^2_{2,\ 81} = 2.07$, $p =$

0.36). Although foraging was performed by both males and females, the latter were most likely to be engaged – a phenomenon which also prevailed in the past. Widespread participation in foraging by females is culturally rooted, as they were in charge of household chores in the past, foraging included. However, the economic hardships experienced in urban areas prompted some males to also take an active part in foraging. Firewood was mostly gathered by males, and wild foods by females. Currently, foraging is mostly done by the elderly as compared to the youth. This observation was in contrast to the past, where the youth were the ones mostly engaged in foraging. Foragers contended that the current young generation considers foraging an archaic practice, which generally embarrasses them. One forager said; "*The youth don't want to gather, they say foraging sites are very far and they are free not to do so*". However, a few foragers maintained that both the elderly and the youth equally engage in foraging. Informal settlers gathered the most as compared to those residing in the inner parts of town. However, foragers couldn't establish whether or not this trend prevailed in the past. Most of the foragers were unemployed, with foraging been one of the many ways of livelihood diversification. However, foragers couldn't establish whether or not this trend prevailed in the past.

6.3.3. Adaptation to changing urban dynamics

Generally, most foraging occurred in places governed as public spaces – with no permission required prior to foraging. About 58% indicated that the spaces were accessed freely while a considerable proportion (42%) claimed to negotiate entry. For those who negotiated access, it was mostly to private areas, protected areas and institutional spaces. Private areas comprised of residential areas and peri-urban farms, parks and nature reserves for protected areas and school yards, play grounds and dumping sites for institutional land. Across the spaces, access was negotiated through requesting permission from the property owners or managers. It was mostly done verbally, with tacit agreements reached. Moreover, some foragers went beyond requesting permission and established network ties with either property owners or other people who might be associated with the owners.

Most of the foragers (62%) had rarely experienced changes in accessing foraging spaces over the past 10 years while 38% acknowledged change. For those who had experienced change, it was mostly in relation to the introduction of regulations requiring permission. All but one of the foragers who experienced change had negotiated access by requesting for permission prior to embarking on foraging. In the past, permission was not mandatory in some spaces as

compared to now. Secondly, 37% negotiated access by establishing relationships with either property owners or those working therein while two had entered into contractual agreements with the space owners. However, some foragers contravened "the rules" as they accessed spaces without acquiring permission from the owners. Others resorted to foraging elsewhere, where permission was not a prerequisite. In contrast, some foragers had experienced a change from having to negotiate access to free entry in some spaces. For example, abandonment of peri-urban farms rendered the particular spaces to be accessed freely.

Foragers were asked to explain how they have or will adapt to a possible decrease in species population size, number of foraging spaces and change in access to spaces and land management practices. The most common adaptation strategies for decreasing species population size and number or area of foraging spaces was extending foraging to more distant sites, purchasing the same product from the market and cultivating the species in gardens (Table 6.1). In regard to change in access and land management, most of the foragers vowed to requesting permission and establishing social ties and networks for negotiating access through family, friends and the community (Table 6.1).

Table 6.1: Distribution of foragers' responses (%) on how they have or will adapt to possible changes in forageables, spaces and land-use management

Change	1	2	3	4	5	6	7	8	9
Decrease in species population size	38.8	8.8	10.0	28.8	40.0	2.5	-	2.5	1.3
Decrease in number or area of foraging spaces	41.8	1.3	11.4	16.5	38.0	2.5	1.3	3.8	5.1
Change in access to foraging spaces	9.3	-	8.0	6.7	6.7	20.0	1.3	14.7	40.0
Change in land management	14.5	-	9.2	2.6	10.5	18.4	3.9	11.8	36.8

Note: 1: Extend foraging to distant places, 2: Use alternative products, 3: Abandon foraging, 4: Cultivate the species in gardens, 5: Purchase the same product from the market, 6: Establish social ties and networks to negotiate access, 7: Establish associations to negotiate access, 8: Develop agreements with private space owners, 9: Request permission

6.4. Discussion

6.4.1. Changing foraging practices

The findings demonstrate that foraging practice is constantly changing over time. The change is noticeable in the spaces, foragers and regulations managing urban spaces. The majority of foragers perceived a decrease in foraging spaces both in numbers and area over the past 10 years. This was attributed to urban expansion, particularly the establishment of developments in informal public green spaces which were previously used as foraging sites. This resulted in land been set aside for the purposes of such developments, which might impinge on the number and size of available spaces for foraging. The observation on public green spaces being engulfed by urban developments is prevalent regionally (Schlesinger et al., 2015) and worldwide (Hurley et al., 2013; Unnikrishnan et al., 2016). Schlesinger et al. (2015) showed that urban developments engulfed land for peri-urban agriculture and habitat for wild natural resources in sub-Saharan African cities. For example, cultivable land decreased from 25.57 to 10.29 ha between 2003 and 2013 in the peri-urban zones of Moshi, Tanzania. Consequently, this decreases the extent of productive land in urban areas and likely to lessen the abundance of wild natural resources. In Bengaluru (India), urban development gradually transformed the urban commons into built-up areas, recreational and aesthetic spaces, which greatly diminished their social and ecological functions (D'Souza & Nagendra, 2011; Mundoli et al., 2015; Unnikrishnan et al., 2016). The rapid urban expansion was linked to the disappearance of over 40 lakes in the city, with the remaining ones modified in their form and function. These lakes are a source of provisioning and cultural ecosystem services. The resultant transformation alienated the people who were dependent on the commons for their livelihood sustenance. This culminated in displacement and shifts in livelihood strategies, as people migrated elsewhere and those remaining sought alternative products. Still in India, the privatisation of the coastal commons in the city of Mumbai reduced the number and size of coastal areas, a phenomenon which lessened the reliance on wild natural resources (Parthasarathy, 2011). Similar observations were also made in South Carolina (USA), where urban development modified the composition and structure of remnant woodlands habitat in the area, which were endowed with sweetgrass - a valuable crafting resource (Hurley et al., 2013).

Not only do developments affect the extent of public green spaces, they also instigate new regulations governing the area. Depending on the type of development, foragers noted that

the regulations may prohibit or restrict access to the particular spaces for activities outside the purview of the development, such as that of foraging wild resources. This negatively affects foragers, as their formal or informal access rights to the spaces might be curtailed. In contrast, remnant patches with valuable flora and fauna might be spared during developmental phase. This is in keeping with Hurley et al. (2013) who observed that sweetgrass was retained within some built-up areas in Mt. Pleasant, South Carolina (USA) but access was not guaranteed. Urban developments also disparage the utilitarian value of urban spaces but exalt the recreational and aesthetic value (Unnikrishnan et al., 2016). This disenfranchises some people over the extractive uses of urban spaces. Moreover, land-use changes often come along with practices impinging foraging, such as the use of agrochemicals in land management. Although this was not a concern in this study, foragers in several cities in USA decried the use of herbicides and pesticides on both public and private green spaces (McLain et al., 2014).

Change was also noted among foragers themselves. The majority of foragers perceived a decreasing number of people engaged in foraging over time. The reasons advanced revolved around issues of modernisation and urban transformation. For example, modernisation changes traditional lifestyle practices such as that of foraging wild resources (Poulain et al., 2015). This change manifest in people's diets, from those dominated by wild foods to store-bought foods. This might result in a gradual decline on the number of people subsisting on wild foods. As reiterated earlier, urban transformation gradually reduces the number and size of foraging spaces. Some foragers narrated that they travel longer distances to reach foraging spaces as those within reach have been enclosed by urban developments. Hence, some people might forgo foraging because of the arduous efforts in locating forageable spaces and species. This is consistent with Mundoli et al.'s (2015) study in Bengaluru (India), where the declining number of people foraging vegetables in the peri-urban commons was associated with the disappearing spaces and resultant diminishing species abundance. In contrast, inadequate knowledge and skills on preparation of foraged products such as for food, crafting and carving was associated with the declining use of wild natural resources in the rural-urban continuum of northern Botswana (Joos-Vandewalle et al., 2018).

In contrast to the distant past, foragers noted that both men and women now engage in foraging. This change was linked to the economic hardships befalling some urban residents, with foraging emerging as an important source of livelihood to some. However, this finding

differs with the observation in rural areas, where foraging is largely conducted by women, particularly for edible products important for household food needs (Cavendish, 2000; Timko et al., 2010; Norbert et al., 2014). Nonetheless, men often forage high-value products for income generation, through selling in the market (Sunderland et al., 2014). Foragers also noted a shift in demographic trends, with the elderly mostly involved in foraging as compared to the youth. Some elderly foragers contended that the youth consider foraging an archaic practice. This could be attributed to inadequate exposure and experience with foraging during childhood years (Chapter 3). This transition might diminish the longstanding practice of foraging wild plants if it remains unabated. Overall, foragers' perceptions about changes in foraging practice did not differ significantly with selected attributes, such as length of residence in town, foraging experience, location of residence and forager's age. This suggests that the perceived changes were widespread among foragers, regardless of their socio-demographic and contextual factors.

On the other hand, a few foragers opined that regulations managing urban spaces also changed over time. However, they were not able to articulate on the specificity of changes in the regulations. Nonetheless, some foragers expressed that the instigation of some regulation such as those dealing with land-tenure prohibited foraging activities. However, it was unclear whether or not the previous formal regulations allowed foraging, if there were any. Some foragers associated changes with the increasing non-adherence to rules, particularly the informal regulations. Many foragers contended that people no longer adhere to the informal regulations, an observation in contrast to the past. However, this may not be non-adherence per se but differences in norms and beliefs, given the influx of immigrants in urban areas from different backgrounds. This is consistent with Poe et al. (2014) who reported that migrants in Seattle (USA) foraged some of the forbidden species in the city as they were a common forageable species in their native countries. This dynamic reproduce and shapes foraging practice, as the locals may have to infuse this differences into their beliefs systems.

However, the diminishing value of informal regulations in natural resource use and governance is not unique to urban areas. Studies conducted in rural areas have also noted the increasing erosion of informal regulations, particularly cultural and traditional religious belief systems (Ntiamoa-Baidu, 1991; Jones et al., 2008; Ayaa & Waswa, 2016; Osei-Tutu, 2017). In Ghana, Osei-Tutu (2017) noted local communities' non-adherence to informal regulations restricting access to particular spaces such as sacred forests and engaging in land-based

activities during certain days declared as resting period in three villages of Boabeng-Fiema, Tafi Atome and Assin Akropong. In Africa, the non-compliance with informal regulations is linked to the burgeoning western religion, adoption of formal education and changes in societal values induced by modernisation, among others (Anoliefo et al., 2003; Golden & Comaroff, 2015). The advent of western religion in Africa disrupted the long-standing traditional institutions governing natural resources, such as taboos, cultural and traditional religious belief systems, and traditional leadership (Anoliefo et al., 2003; Mavhura & Mushure, 2019). The western religion eroded the reverence accorded to traditional institutions, with some belief systems conceived as pagan, hence prompting disobedience and the gradual deterioration of the institutions. In regard to modernisation, it transformed the social structure of most African societies which were primarily anchored on collectivism but to proliferation of individualistic structures (Kasongo, 2010). This affected the success of traditional institutions which were mostly founded on the basis of a homogenous community, characterised by shared norms and customs (Jimoh et al., 2012). Against this backdrop, it is evident that the declining adherence of informal regulations is not unique to urban areas nor is it primarily driven by urbanisation, but possibly mediated by changes in culture and respect of norms, which is promoted by among others cultural differences, western religious doctrines and modernisation. Consequently, this reconfigures the commonly held societal values and belief systems.

It is evident that foraging practice is not only dynamic in space and over time but it is also a complex entity. This complexity is mediated by the diverse actors involved in the different facets of the practice (Shackleton et al. 2017), who may not necessarily share the same mandate goals. Moreover, foraging is driven by multifaceted but interrelated drivers, affecting different facets of the system's practice. These drivers include but are not limited to urban population growth, socio-economic conditions, regulations and land-use and cover change (Figure 6.1). The drivers may be interactive and often operate simultaneously, with their overall effect to the outcome quite different. Consequently, a wide range of response options are brought into play to cope with the changing dynamics. For example, improved socio-economic conditions within a particular neighbourhood, together which unfavourable regulations governing urban spaces may promote aesthetic values of public green spaces over extractive uses, prompting foragers to either explore new foraging sites, negotiate access where restricted and consider the use of alternative products (Figure 6.1). However, addressing contrasting values over use of green spaces alone or together with unfavourable

regulations is not sufficient to ameliorate the imminent pressure facing foraging practice. This complexity represents a formidable challenge to the persistence of foraging practice amidst urban transformation (Poteete & Welch, 2004). Therefore, unilateral solutions aimed at circumventing the changing dynamics are likely to be unsuccessful. As argued by Cilliers et al. (2013), simplification of a complex system by way of disentangling its individual parts has a bearing on its overall integrity. Indeed, "… a system is more than the sum of its parts" (Meadows, 2008: 12). Hence, innovative measures that recognise and accommodate this complexity are required, especially from planners and authorities dealing with urban green spaces. Moreover, it is important to take cognisance of the stocks, flows and feedbacks among the various facets of the complex system (Sterman, 2000). In the context of foraging, this will provide an understanding on how changes in certain components within the broader urban system affect foraging practice and influence the system as a whole.

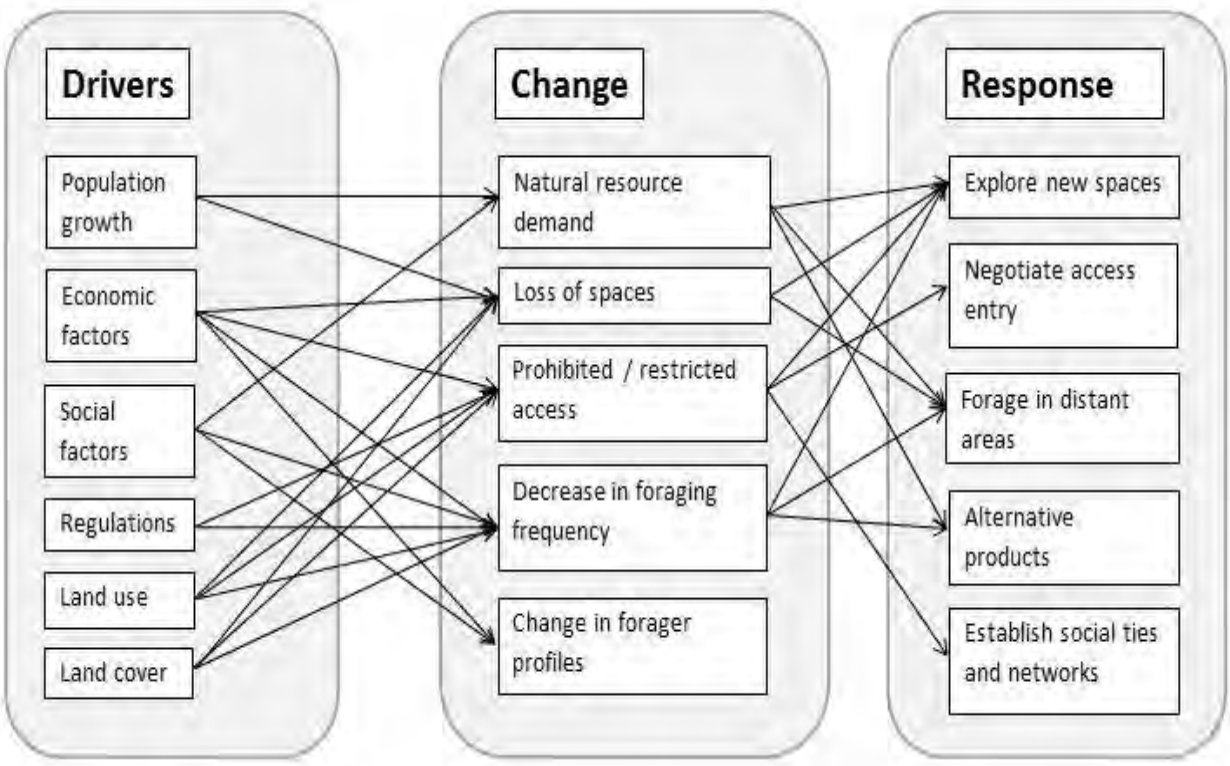

Figure 6.1: Drivers effecting change in foraging practices and possible responses or adaption measures

6.4.2. Adapting to changing dynamics

The reported changes in the number and size of foraging spaces, and land-use access prompt foragers to devise adaptation strategies. Foragers adapted to the decreasing number and size of foraging spaces by exploring new spaces as well as extending foraging to distant areas. This is consistent with Hurley et al. (2013), where foragers adapted to the disappearing foraging spaces by travelling longer distances to neighbouring counties and other states in their quest for sweetgrass stocks. Also, some foragers' explored sweetgrass planted in landscaping within homesteads and along the roads albeit, being of poor quality in crafting as well as issues of access. However, these adaptation measures are not distinctive to urban areas. Studies conducted by Marshall et al. (2006), Ahenkan and Boon (2011) and Guta (2014) also mentioned collecting from distant locations and species domestication as the most common strategies towards circumventing resource supply change in rural communities. On the other hand, some foragers vowed to purchase the same product from the market. In regard to change in land-use access, foragers noted that they negotiate access entry through seeking permission from the managers or property owners. In this study, permission was sought verbally and in some instances tacit agreements reached. For example, requesting permission was only done once, during the first visit, with the subsequent ones being free. This is a desirable form of governance, as foragers will be spared the hurdles of requesting permission every time they embark on foraging. Besides, some foragers adapted by befriending either the property owners or people who might be associated with the owners. This was the commonest way of negotiating entry in homesteads and peri-urban farms. This could be a vital action under the context of declining foraging spaces. The finding is similar to Hurley et al. (2013), who indicated that foragers in South Carolina (USA) adapted to the conversion of urban commons from being public to private tenure by renegotiating access and establishing network ties with the new owners. Likewise, Grabbatin et al. (2011) noted that foragers negotiated access entry through establishing formal and informal arrangements with property owners. Formal arrangements entailed contractual agreements between foragers and property owners, which specified where and when foraging is permitted. Informal arrangements included kinships and associations, where friends or customers of a particular forager who have planted sweetgrass in their compounds invited foragers for harvesting or at times harvest the grass and give it to the said foragers. This becomes an additional resources supply. However, this kind of arrangement may exclude some foragers outside the kinship and association circles.

6.5. Conclusion

This study demonstrates that the practice of foraging wild plants in urban spaces is constantly changing over time. The change occurred in the spaces, foragers and regulations. The decline in the number and sizes of foraging spaces calls for attention in land-use planning. There is need for planning and developing urban spaces against the backdrop of productive spaces, promoting their social and ecological functions. This will protect remnant spaces with wild resources from being subsumed by urban developments. Furthermore, land-use conversions should take into account the historical context of particular spaces so that developments conducted therein are potentially compatible with previous land-use functions. The decline in the number of people participating in foraging erodes its value and the collective agency of foragers. This is exacerbated by the shifting demographic trends, where foraging is increasingly conducted by the elderly compared to the youth. This calls for public education about foraging practice and its provisioning, cultural and psychological benefits. The prevailing socio-spatial dynamics in urban areas shape foraging practice in terms of its form and nature. Hence, this prompts foragers to adapt to the changing dynamics.

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Chapter 7

Synthesis and recommendations

7.1. Introduction

The world's population is rapidly urbanising, with approximately half (54%) already residing in urban areas (UN, 2019). This proportion is expected to increase to two-thirds (66%) by the year 2050 (UN, 2019). Ninety percent of the foreseeable urban population growth is projected to be largely concentrated in developing regions, particularly in Asia and sub-Saharan Africa (UN, 2019). Despite the projected population growth, these continents currently struggle with poor socio-economic development (Satterthwaite et al., 2010). Hence, the continuing population increase is likely to constrain urban liveability and general well-being in these regions. Urbanisation presents a myriad of environmental, economic, social and health challenges in urban areas, such as food insecurity and poverty (Kimani-Murage et al. 2014). In some countries, such as South Africa, food insecurity is exacerbated by high income inequalities, which may inhibit people from accessing food in the market despite its availability (van Wyk & Dlamini, 2018), especially those who are dependent on the market-based economy and often undiversified livelihoods (Boonyabancha et al. 2019). Therefore, many people living in urban areas particularly the poor are vulnerable to deprivation. This calls for exploration of potential livelihood activities aimed at ameliorating living conditions and in turn promoting liveable and sustainable neighbourhoods in urban areas.

Against this backdrop, this study portrays foraging wild plants as one potential strategy for cushioning livelihoods of the urban poor and in turn enhancing livelihood resilience and sustainability. Foraging is an old-aged practice, spanning across generations (Svizzero, 2016; Sachdeva et al., 2018). Although it was commonly perceived to be synonymous with rural areas (Negi & Subramani, 2015; Joos-Vandewalle et al., 2018), it is now gaining recognition in urban areas. Foraging provides provisioning, cultural, health and psychological benefits to foraging practitioners (Kaoma & Shackleton, 2014a; Schlesinger et al., 2015; Ward & Shackleton, 2016; Synk et al., 2017). Although foraging is a widespread practice, it is seldom examined and hence understood in urban contexts (Poe et al., 2013; Short-Gianotti & Hurley, 2016; Mollee et al., 2017). Moreover, the available literature is dominated by works from the Global North (Shackleton et al., 2017). This prompts for further research about urban foraging to provide an understanding on its prevalence and patterns and how it is

reconfigured by the rapid urbanisation, especially in the Global South. Hence, the aim of this study was to examine urban foraging practices, their potential contribution to household dietary diversity and how they are shaped by and respond to urbanisation. Specifically, the study sought to understand the (1) prevalence and distribution of forageable plant species, (2) prevalence and pattern of wild plant foraging and uses, (3) contribution of wild foods to dietary diversity, (4) formal and informal regulations governing access and rights to forageable plant resources and (5) socio-spatial dynamics influencing wild plant foraging practices. The study aim and specific objectives were executed through a set of mixed method approaches, comprising of vegetation surveys for inventorying plant species found in different urban spaces, household surveys for assessing the prevalence of foraging and dietary recalls, and semi-structured interviews for exploring regulations governing urban spaces and changes in foraging practices, which were complemented by in-depth interviews with selected stakeholders. Drawing upon the detailed results and discussion of each individual results chapter, this chapter provides an integrated synthesis of the key findings and suggested recommendations.

7.2. Synthesis of key findings

7.2.1. Forageable plant species in urban spaces

The findings showed that mosaics of spaces within the urban landscape were endowed with a variety of plant species, which are a critical source of ecosystem goods and services. This finding is consistent with other studies which reported high species richness across different spaces in urban landscapes (Kaoma & Shackleton, 2014b; Gopal & Nagendra, 2014; Jaganmohan et al., 2018; Caliskan & Aktağ, 2019). In these studies, urban vegetation provides a suite of ecosystem services such as provisioning and cultural services. Of note, about half of the species encountered in different urban green spaces were forageable in the present study, with the majority having more than one use. This finding is in accordance with Gopal and Nagendra (2014) and Hurley and Emery (2018), who reported that various spaces within the urban landscape matrix host key plant species with various uses. Most species uses were for medicine, food and fuel energy, in order of frequency. Despite a sizeable proportion of species bearing medicinal uses, medicines were rarely foraged in this study (Chapter 3). Medicines were foraged on an irregular basis, with most sourced at least one to five times per year. This is not surprising since medicinal remedies are normally sourced when the need arises. Moreover, some people might be greatly reliant on allopathic medicine, with

traditional medicine acting as a complimentary source of health care. Therefore, traditional medicine can be promoted as a potential complementary source to allopathic medicine, which can be afforded by many people. This endeavour could possibly ameliorate scepticism about the use of traditional medicine amongst some people (Abdullahi, 2011; Habtom, 2018), and in turn promote its acceptance and acknowledgement within the institutionalised health care system. In contrast, vegetables and firewood were collected on a regular basis, often a few times per week or per month (Chapter 3).

Species abundance, richness and diversity were markedly higher for forageable compared to non-forageable species. Protected areas, domestic gardens and vacant spaces displayed a higher diversity of forageable species compared to other spaces. The finding implies that the three spaces could act as a potential supply of provisioning ecosystem services to urban foragers. Despite the high diversity of valuable and useful plant species in protected areas and domestic gardens, they were the least preferred foraging spaces. As indicated in Chapter 3, vacant spaces (55%) and riparian areas (30%) were the most visited foraging spaces. This counterintuitive finding could be possibly explained by land-use tenure in protected areas and domestic gardens, as they were governed under private tenure. As narrated in Chapter 6, access to private spaces was constrained for the majority of foragers, with the activities outside the space mandate likely to be restricted or prohibited, such as foraging. The same was also noted in South Carolina, USA (Hurley et al., 2013), and Bengaluru, India (Unnikrishnan et al., 2016). In regard to protected areas, this study calls for a shift away from exclusionary management regimes to participatory ones, which embrace the role of urban residents in management and conservation of urban resources. This will accord some urban people to benefit from resources found in their environment but at the same time managing them sustainably. As posited by McLain et al. (2017), the involvement of interested urban stakeholders may promote resource stewardship and efficacy in monitoring resource use and compliance with regulations. As demonstrated in rural contexts, the paradigm shift embraced in natural resource management came into being after the recognition that conservation of natural resources without the human face is unattainable (Ostrom, 1990; Agrawal, 2003). Therefore, the same could be extrapolated to urban areas by involving urban residents in management and conservation of urban resources while at the same time deriving benefits from the resources. This is particularly relevant to this study, since the boundaries between one of the protected areas and the adjacent community appeared blurry.

The study findings provided a nuanced understanding on the multifunctionality and diversity of urban landscapes. The rich and diverse plant species present in the various spaces are useful in complementing livelihoods and general well-being. They provided among others food, fuel energy and medicine, particularly to the urban poor. The findings provide insights on the type of spaces harbouring valuable species within the urban landscape. This insight can be used in urban planning and development, as managers and planners will become aware of the various species hotspots with the potential of supplying provisioning and cultural ecosystem services, hence worth protection from transformation (Chapter 5 and 6). This study is among the few which quantified the composition of forageable plant species across various spaces within the urban landscapes. Hence, it expanded the body of knowledge on urban ecology which is mostly dominated by studies on the structure and composition of urban vegetation, with little understanding on its multifunctional uses (Hurley & Emery, 2018). However, the present study focused on spaces where foraging occurred and this neglected other productive spaces across the urban landscape. Therefore, this calls for a comprehensive study to examine the distribution and composition of forageable species across the wider urban landscape, regardless of whether or not foraging is being conducted therein.

7.2.2. Prevalence and pattern of urban foraging practice

Urban foraging was prevalent across the study towns, with about two-thirds of the respondents reporting foraging. This study asserts that urban foraging is a common practice, albeit being seldom understood in planning, policy and research (Shackleton et al., 2017). This finding corroborates other studies from elsewhere which also reported widespread rates of urban foraging (Poe et al., 2013; Short-Gianotti & Hurley, 2016; Mollee et al., 2017; Palliwoda et al., 2017; Fischer & Kowarik, 2020), although the overall prevalence of foraging in the present study was markedly higher than reported in the latter studies. This demonstrates that urban foraging differs across space, over time and context. As evidenced from Chapter 6, the practice of foraging is constantly evolving over time. Hence, this underscores the importance of site-specific studies across different contexts elucidating the dynamics of urban foraging practices. Although the findings suggest that foraging was not the primary source of subsistence, it was important in complementing livelihoods. As demonstrated in Chapter 4, foraging wild foods could potentially diversify household diets, by adding one or a few more food groups to urban diets. However, the low significance of

foraging in livelihoods is buttressed by the underlying motives, with cultural affirmation being the greatest impetus behind foraging. Therefore, foraging is not necessarily driven by necessity or lack thereof but is "... a deeply relational practice connecting humans with nature, other humans, and their inner selves" (McLain et al., 2014: 231).

The prevalence of foraging amid unfavourable regulations governing green spaces depicts foragers' zeal in claiming access and rights to the environments they inhabit. This conforms the propositions of the 'right to the city' (RTC) concept (Chapter 1). The RTC concept contends that urban residents have the right to production of urban spaces. Through the RTC lens, urban residents are bestowed with the right to physical access, occupy, and use the urban space (Purcell, 2002). Therefore, the RTC enfranchises the urban residents with the right to access green spaces for foraging activities. This challenges urban planners and policy makers to take into account the needs, desires and aspirations of the urban residents in the production and co-production of urban spaces. This is a crucial step in the formulation of holistic approaches which facilitate foragers to claim their right over the production of urban landscapes, but most importantly shaping it according to their desires and aspirations (Friendly, 2013).

Although urban foraging transcends demographic and socio-economic backgrounds, the likelihood of foraging was greatly influenced by childhood experiences of foraging, perceptions towards the practice, location of residence in town and household affluence. This finding is consistent with other studies elsewhere (Kaoma & Shackleton, 2014a; Hosaka et al., 2017; Mollee et al., 2017; Landor-Yamagata et al., 2018). Therefore, to sustain foraging practices across generations, it is important to take conginanse of these underlying factors – although they may differ across space, over time and context. For example, to engender pro-foraging behaviour among people, it would be necessary to increase their exposure to and experience with biodiversity, particularly at an early stage in life. Moreover, it is important to ensure access to green spaces with a variety of valuable species across different neighbourhoods within the urban landscapes. Overall, the study findings provided valuable insights on the pattern and prevalence of foraging practice, which will inform urban planning and development, and policy formulation. Moreover, the study elucidated information on the sources of forageable resources, which could enlighten urban managers in creating productive and multifunctional spaces, which promote diverse land-based activities, including foraging. This study expanded the body of knowledge on urban foraging, which was mostly dominated

by works from the Global North (Poe et al., 2013; Short-Gianotti & Hurley, 2016; Synk et al., 2017).

7.2.3. Wild foods and dietary diversity in urban context

The findings showed that household diets were moderately diverse, being significantly more so in Thabazimbi than Potchefstroom. Thabazimbi residents were more affluent compared to those in Potchefstroom, which enabled them access to a variety of food in the market and sustained a stable food supply. As shown in Chapter 3, the prevalence of foraging was significantly higher in Thabazimbi than Potchefstroom, which complemented food sources and potentially contributed a few more food groups to household diets. About 22% of the households in Thabazimbi complemented their food sources with foraging wild foods compared to 18% in Potchefstroom. Besides, household dietary diversity was a function of wealth and education level. As explained earlier, wealthier households have greater chances of access to food as well as self-production since they are able to afford the necessary inputs. This finding corroborates Gebre (2012) in Ethiopia, Powell et al. (2017) in Tanzania and Khed (2018) in India. Tertiary education holders displayed higher dietary diversity compared to those with basic education. Higher education is commonly associated with higher income, hence increasing one's purchasing power and enabling access to a variety of food from the market (Semba et al., 2008; Nwokolo, 2015; Mutisya et al., 2016). Accordingly, these factors and others which might be influencing household diets such as household size, access to credit services, and employment (Gebre, 2012; Huluka & Wondimagegnhu, 2019) should be taken into consideration when designing interventions aimed at improving diets and food security.

The findings revealed no significant difference in household dietary diversity between foragers and non-foragers. This could be explained by the role of foraging in livelihoods, i.e. it was not the main source of subsistence but rather a complementary source (Chapter 3). Moreover, the underlying motives driving foraging could explain, in part, the limited significance of wild foods in overall diets. As demonstrated in Chapter 3, the principal motivation driving foraging was culture, with an overwhelming majority (92%) opining that foraging is part of their tradition. Therefore, this might constrain the availability and supply of wild foods within household food baskets, as some people may collect them in limited quantities and at irregular times just for fulfilling cultural desires. Moreover, the decreasing number and size of foraging spaces could potentially affect the availability of wild foods and

in turn limit their contribution to diets. As noted in Chapter 6, some foragers opined that the declining foraging spaces and changes in land-use regimes has led to a reduction in the frequency of foraging outings, ultimately decreasing the frequency of wild foods within household diets. The findings on the low contribution of wild foods to diets are consistent with Chakona and Shackleton (2019) in three medium-sized South African towns but in contrast with the observations made in rural contexts (Fungo et al., 2016; Maseko et al.., 2017; Luna-González & Sørensen, 2018).

Although wild foods did not increase mean dietary diversity scores, they displayed a meaningful contribution within particular food groups. For instance, the incidence of vegetable consumption was significantly higher for foragers than non-foragers. This implies that wild foods can be important in diversifying urban diets within particular food groups consumed, hence helping alleviating monotonous diets. This finding is buttressed by the frequency of foraging reported in Chapter 3, being generally high for vegetables. The modal frequency of collecting wild vegetables was 1-3 times per week. This is critical in the present study since diet compositions were dominated by cereal group items which are low in micronutrients. Poverty is rife in the study areas, with 70% and 64% of people in Limpopo and North West provinces respectively living below the poverty datum line (STATS SA, 2017). Hence, wild foods are likely to be an important food source to the poor. For example, the consumption of wild foods in three medium-sized South African towns significantly reduced the amount of money spent on food purchases compared to those who did not (Chakona & Shackleton, 2019). Furthermore, Shackleton et al. (2007) argue that forest products are important livelihood safety nets in the event of socio-economic and natural shocks. For example, rural households often resort to foraging wild foods to circumvent seasonal deficiencies such as food scarcity and poor agricultural produce (Garekae et al., 2020). Therefore, wild foods bear prospects of offering resilience in the face of adversity in urban areas. Hence, this study calls for promotion of wild foods within urban food systems to increase their cultural significance and consumption. As noted by Bharucha and Pretty (2010), the importance of wild foods to urban diets has been generally overlooked in urban food systems. The study findings have expanded the body of knowledge on urban foraging, by assessing the role of foraging in food security and dietary diversity in urban food systems, a phenomenon which has being largely overlooked.

7.2.4. Formal and informal regulations affecting foraging practice

Foraging occurred in a variety of both formal and informal green spaces. The most preferred spaces were vacant spaces, riparian areas and domestic gardens, in order of importance (Chapter 3). This finding correlates with the composition and diversity of forageable species available in the three spaces, which were generally higher than for non-forageable species (Chapter 2). However, more than one space was visited for foraging, depending on the availability and resource sought. These three types of foraging spaces were within reach of most of the foragers, with a one-way trip approximating half an hour, which didn't differ significantly with location of residence. This suggests that the spaces were fairly accessible regardless of forager's location of residence. Proximity to spaces composed of rich biodiversity increases the likelihood of foraging, as evidenced from the residents on the outskirts of town who foraged the most since they were closer to areas with dense vegetation, harbouring diverse forageable resources (Chapter 3). As such, proximity shortened the distance required to reach foraging spaces, thereby enabling foraging whilst in pursuit of other daily activities, echoing Baiyegunhi et al. (2016), Mukul et al. (2016) and Garekae et al. (2017). Therefore, it is important for planners and developers to spare remnant spaces with valuable species within reach of the urban people for supplying of provisioning and cultural ecosystem services, including foraging. The finding on the proximity to foraging spaces probably contributes to the widespread presence of foraging in the study towns (Chapter 3), which is markedly higher than reported from studies elsewhere (Short-Gianotti & Hurley, 2016; Mollee et al., 2017; Fischer & Kowarik, 2020).

The frequently visited foraging spaces were managed as public spaces, with no permission required for access, except for domestic gardens. Nonetheless, access to many foraging spaces is threatened by urban transformation, which changes space existence or land-use tenure which may culminate in limited or prohibited access to the respective spaces for activities outside their mandate, such as foraging (Chapter 6). An overwhelming majority of foragers disputed the notion of managing public spaces through permission requirements. Central to their contentions was that access and rights to foraging spaces would be curtailed after the promulgation of permits. The majority perceived permits as a constraint against resource use. Similar sentiments were also noted in northern Botswana (Joos-Vandewalle et al., 2018; Garekae et al., 2020). This signifies the importance of providing multifunctional urban spaces, which recognises and allows various land-based activities conducted therein.

An emerging literature shows that urban citizens are making strides in producing urban spaces which accommodate their diverse needs, desires and aspirations (Schauppenlehner-Kloyber & Penker, 2016; Buijs et al., 2019).

The findings show that most of the respondents had limited knowledge about the formal and informal regulations used in managing urban landscapes. About three-quarters and two-thirds of them were unware of any formal and informal regulations, respectively. This finding corroborates Charnley et al. (2018) who also reported that foragers had limited knowledge on the rules governing public green spaces in Seattle (USA). The limited knowledge on rules could be mediated by inadequate participation of the urban citizens during formulation of the rules as well as their dissemination to the general public. Indeed, an overwhelming majority (92%) of the respondents had never been exposed to or heard of urban citizens' involvement in rules formulation. This may result into formulation of regulations which don't take into account the views and visions of the urban people regarding the spaces they inhabit. Hence, the regulations are likely to infringe on foragers' access and common rights to spaces endowed with valuable plant resources. Therefore, this study calls for relevant stakeholders to intensify community involvement and dissemination of the available regulations to the general public, using effective communication channels relevant to diverse audience.

Although unclear in the present study, foraging is formally limited or prohibited in several cities and towns worldwide (McLain et al., 2014; Dabady & Stark, 2017; Charnley et al., 2018). Nonetheless, foraging is still widespread worldwide. The prevalece of foraging albeit under unfavourable regulations ties with one of the RTC propositions, the right to appropriation. This proposition accords urban citizens to take control and claim ownership of the spaces they inhabit, including access to the resources therein. Therefore, it bestows urban citizens with the rights to physcially access, occupy, and use urban spaces for various livelihood activities (Purcell, 2002), including foraging. The right to appropriation enables inhabitants to use urban space for their survival (Purcell, 2008) or other needs. Based on this notion, city dwellers are enfranchised with rights over the environment they inhabit, they could forage on wild plant resources endowed in their environment and initiate developments which will not infringe on urban foraging nor on the locations or spaces where the resources are found. Moreover, the right to appropriation challenges the burgeoning commodification and privatisation of urban spaces but rather promotes the social use value of such spaces. As demostrated in Chapter 6, the valorisation of urban commons disrupted foragers access and

rights to spaces endowed with valuable species, which they used for sustaining their livelihoods. This was also a cause for concern in Bengaluru (India) and Charleston (USA) (D'Souza & Nagendra, 2011; Grabbatin et al., 2011). This dynamic reconfigured the use and functions of the urban commons and promoted their aesthetic and recreational value over their provisioning functions. In contrast, the social use value accords access and rights to spaces to a wider segment of the urban community. Overall, the findings on the limited knowledge about regulations calls for civic education about various regulations governing urban landscapes. But adoption of participatory processes is a fundamental step towards formulation of holistic and incluvise regulations.

7.2.5. Changing foraging practice

The findings revealed that foraging practice is constantly changing over time, in terms of spaces, regulations and participants. Many foraging spaces are declining, both in terms of numbers and size. Establishment of developments in informal public green spaces was the commonest causal factor noted by the majority of foragers. The developments engulfed some of the spaces which were previously used as foraging sites. Moreover, some developments also brought along new set of land-use tenure regimes, which restricted or prohibited access to the particular spaces for foraging activities and displaced foragers from the spaces they relied upon for subsistence. This finding conforms with the sentiments on barriers to foraging presented in Chapter 3, where inadequate foraging spaces and unfavourable regulations governing urban spaces were the most frequently mentioned barriers. The findings are consistent with Hurley et al. (2013), Schlesinger et al. (2015) and Unnikrishnan et al. (2016). The rapid urban expansion significantly decreased the area of productive spaces in Moshi (Tanzania), thereby altering habitats with valuable plant resources (Schlesinger et al., 2015). In Bengaluru (India), urban expansion modified the structure, composition and functions of urban commons (D'Souza & Nagendra, 2011; Unnikrishnan et al., 2016). This transformation diminished the provisioning functions of the commons in favour of their recreational and aesthetic values. This negatively affected the people who were dependent on the commons for subsistence, as their access and rights to the spaces was curtailed. Hence, this study calls for consideration of historical context of spaces during planning and development, in efforts towards designing compatible and multifunctional land-uses. Drawing from the results in this study and elsewhere, it is evident that urban expansion can inhibit access and rights to productive spaces, thereby countering the propositions of the RTC. Generally, this study

finds that the production of urban spaces typically happens at the exclusion of the urban community, with their needs and aspirations rarely taken into consideration.

The findings also indicated perceptions of a decreasing number of people engaging in foraging over time. This was largely attributed to urban transformation and modernisation. As explained earlier, urban transformation modifies the structure and composition of remanant spaces with potentially valuable plant resources and also reconfigures access and rights to the said spaces (D'Souza & Nagendra, 2011; Lal, 2012; Hurley et al., 2013). This decreases the availability of foraging spaces within the vicinity of foragers, thereby requiring them to travel further afield to reach spaces not yet engulfed by the developments. This might become a challenge to some foragers, hence the decreasing number of participants. In regard to modernisation, it presents alternative products which might be readily available to people as compared to forageable products which require a certain amount of time and effort to locate them. This is buttressed by responses on barriers to foraging presented in Chapter 3, where nearly half of the respondents decried the lack of time as a major hindarance to foraging. In contrast, over one-third of the respondents in Chapter 3 expressed limited knowledge on foraging practice as one of the barriers to engaging in foraging, thereby decreasing the number of people foraging. This was also echoed in the transtioning urban centers of northern Botswana (Joos-Vandewalle et al., 2018). Hence, this underscores the importance of sharing knowledge about foraging species and practices, which is vital to assimilating the practice across generations.

Change was also noticed among foragers' profiles. Although foraging is traditionally a female oriented practice, both men and women equally engages in foraging, with men likely to take a leading role. This striking change was attributed to the socio-economic conditions prevalent in urban areas, such as poverty, unemployment and food insecurity. Therefore, foraging may become an important source of livelihood for some people. The findings corroborate those of Chapter 3, where the likelihood of foraging was significantly higher for males than females. In contrast to the distant past, foraging was mostly performed by the elderly as compared to the youth. This finding is buttressed by the insights on foragers' profiles in Chapter 3, where the likelihood of foraging significantly differed with age, with the elderly most likely to forage compared to the youth. The plausible explaination to this shifting demographic trends was the ambivalent perceptions towards foraging held by the youth (Agea et al., 2011). The youth considered the practice archaic and mostly associated it

with the elderley. Besides, this could be explained by childhood exposure and experience with nature interactions, which is believed to be limited among the youth (Ladio & Lozada, 2004; Soga & Gaston, 2016). As postulated by Wehi and Wehi (2010), traditional knowledge among the youth is eroding, a phenomonon which could lead to their declining participation in foraging.

The aforementioned changes in the spaces and land-use prompted foragers to devise adaptation strategies. Exploring new spaces within the neighbourhood and extending foraging to distant areas were the most frequently mentioned adaptation strategies for the decreasing number and size of foraging spaces. This was also common in South Carolina (USA), where foragers responded to changes in sweetgrass supply by travelling longer distance to reach other spaces which were accessed freely (Hurley et al., 2013). The same adaptation measures were also common in rural areas (Ahenkan & Boon, 2011; Guta, 2014). In regard to change in land-use access, foragers negotiated for permission entry where required and also established friendships with property owners as one way of circumventing restricted access. This finding is consistent with Grabbatin et al. (2011) and Hurley et al. (2013).

7.3. Conclusion and recommendations

The aim of this study was to examine urban foraging practices, their potential contribution to household dietary diversity and how they are shaped by and respond to urbanisation. The study provided a profound understanding on the dynamics of urban foraging practices amidst rapid urban transformation in South Africa. Moreover, the study has expanded the body of knowledge about urban foraging which has being largely dominated by works from the Global North (Poe et al., 2013; Short-Gianotti & Hurley, 2016; Synk et al., 2017). The results demonstrated that mosaics of spaces within the urban landscape harbour a rich diversity of plant species, capable of providing provisioning ecosystem services to the urban people. About half of the plant species were known to be forageable, with the majority having at least one use. Therefore, urban space managers and developers need to be mindful of the remnant spaces harbouring valuable species during spatial planning and development. Such spaces could be zoned in the town and city plans to ensure their protection from urban transformation. Moreover, there is a need for increasing the stocks of forageable resources within urban landscapes for sustaining foraging practices. This could be achieved by promoting indigenous but useful plants in urban greening and landscaping activities.

Urban foraging was widespread across the study towns. Foraging provided fuel energy, diversified diets, improved health, and maintained cultural practices, among others. In regard to dietary diversity, foraging was important in ameliorating monotonous diets for some households.

The findings on the preferred foraging spaces are important to managers and planners, as they will be enlightened on the various productive spaces harbouring useful and valuable species within the urban landscapes. The ecological hotspots could be zoned in the town and city plans, thereby enabling the design of multifunctional spaces which promotes a suite of land-based activities within the urban landscape. This will widen access to green spaces for various activities, including foraging. The recognition and appreciation of foraging will promote the social use value of urban spaces, which could be accorded to diverse urban citizens. Furthermore, foraging will be recognised as a legitimate part of the urban landscape. Foraging could be promoted through formal and informal education initiatives tailored to local contexts, which recognises traditional and other valuable species within local environments. Besides, urban transformation has reconfigured foraging practices. Urban transformation has brought about some changes in the structure and composition of green spaces and also constrained access and right to the spaces. This calls for inclusive urban landscape planning and development, which promotes different land-use activities.

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Appendices

Appendix 1: Vegetation survey sheet (Chapter 2)

Date:_____ Town:_____

Site number:_____ Site coordinates:_____

a. Site description

Plot no.	**Coordinates**	**Photo no.**	**Space type**	**Land use zone**

Slope	Level	Slight	Moderate	Steep	Very steep	**Slope angle:**	
Comments							
Slope position	Crest	Scarp	Mid	Base	Flat	Depression	
Comments							
Rock/Soil (%)	Rocks		Bare ground		Litter cover	**Soil compaction:**	

b. Vegetation percentage cover

	Trees	**Herbaceous**	
Notes			

c. Species description

Specimen / Photo no.	**Species**	**% cover abundance**	**Notes**

Appendix 2: Household survey questionnaire (Chapter 3 & 5)

R/A _____ Date _____ Start time _____ End time _____ Sample no _____

Town _____ Suburb _____ Street name _____ House no _____

SECTION A: WILD PLANT COLLECTION AND USES IN URBAN SETTING

In this study, wild plants refer to plants growing without being purposively planted and growing independent of or with very minimal human management. It includes those wild plants growing within domestic gardens, parks, institutional grounds, unbuilt spaces or unused land, riparian zones and cemeteries. It includes firewood, construction materials, thatching grass, fruits, foods, medicinal plants, etc.

Gathering practice

1. Did you or any member of your household gather wild plants during the past three years in and around the town or your own garden or fields? [ ] yes | [ ] no
2. If no, why?

   _____

   _____

   _____
3. How long have you been gathering wild plants? _____ (years)
4. Generally how often do you go to gather wild plants during the following seasons?

Season	Weekly	Monthly	Yearly
Rainy			
Dry			

5. Which spaces do you normally gather from? [ ] cemetery | [ ] domestic gardens | [ ] institutional grounds | [ ] parks | [ ] riparian zones | [ ] unbuilt/unused land | [ ] other: _____
6. Which of the following do you consider when selecting a space to gather from? [ ] access to resources | [ ] distance | [ ] land management practices | [ ] land use history | [ ] personal safety | [ ] quality of resources | [ ] others:

   _____
7. Which wild plants do you normally gather from the aforementioned spaces (starting with the most gathered species)? (complete the table on the next page)

DOMESTIC GARDENS

Plant species (local name)	Part collected (Code A)	Use (Code B)	Frequency (Code C)	Quantity	Purpose (Code D)	Months (Code E)	Change in abundance over past 5 years (Code F)
1.							
2.							
3.							

Code A	Code B	Code C	Code D	Code E	Code F
1. Bark 2. Branch 3. Flower 4. Fruit 5. Leaf 6. Root 7. Seed 8. Stem 9. Tuber 10. Other (specify)	1. Building poles 2. Craft 3. Decoration 4. Fencing/kraal poles 5. Food 6. Fruits 7. Firewood 8. Furniture 9. Medicinal 10. Thatching 11. Utensils and tools 12. Vegetables 13. Weaving material 14. Other (specify)	1. Most frequently (daily) 2. Frequently (4-6 days a week) 3. Occasionally (1-3 days a week) 4. Rarely (once or twice per month) 5. Sometimes (1-5 timer per year) 6. Never	1. Personal use 2. Household use 3. Selling 4. All of the above 5. Other (specify)	1. January 2. February 3. March 4. April 5. May 6. June 7. July 8. August 9. September 10. October 11. November 12. December	1. No 2. It increased 3. It decreased

Access to and right to wild plant resources

8. How often do you gather in domestic gardens? _____per [ ] week | [ ] month | [ ] year
9. Approximately how long does it take to reach this space? _____[ ] minutes | [ ] hours
10. Which mode of transport do you use to reach the gathering space?

    _____

11. What is the land use tenure of this space? [ ] organisational | [ ] private | [ ] public
12. Is permission required to gather from this space? [ ] yes | [ ] no | [ ] don't know
13. If yes, from who? _____

14. Is the requirement for seeking permission prior to gathering enforced? [ ] yes | [ ] no
15. If yes, how?

    _____

16. Do you normally seek permission prior to gathering? [ ] yes | [ ] no
17. If no, why?

    _____

    _____

18. What happens to gatherer's if they embark on gathering activities without having acquired necessary permission? [ ] nothing is done | [ ] products confiscated | [ ] sanctioned | [ ] don't know
19. Have you ever been sanctioned and or your products confiscated? [ ] yes | [ ] no
20. If yes, when was it and what was your reaction?

    _____

21. Does one have to pay for permission to gather at this space? [ ] yes | [ ] no
22. If yes, how much and to who? _____
23. Do you think it is a good or not good strategy for managing spaces by way of permission requirement? [ ] yes | [ ] no
24. Why?

_____

_____

25. Are there any species which are prohibited from gathering in domestic gardens? [ ] yes | [ ] no
26. If yes, which ones?

_____

_____

27. Are there any land use practices in domestic gardens which conflict with gathering practices? [ ] yes | [ ] no
28. If yes, which ones? [ ] elimination of non-native species | [ ] use of chemicals (herbicides, pesticides) | [ ] other:

_____

29. Are there any warning signs provided about the application of such chemicals at this gathering space? [ ] yes | [ ] no

UNUSED / UNBUILT LAND

Plant species (local name)	Part collected (Code A)	Use (Code B)	Frequency (Code C)	Quantity	Purpose (Code D)	Months (Code E)	Change in abundance over past 5 years (Code F)
1.							
2.							
3.							

Access to and right to wild plant resources

30. How often do you gather in unused/unbuilt land? _____ per [ ] week | [ ] month | [ ] year
31. Approximately how long does it take to reach this space? _____ [ ] minutes | [ ] hours
32. Which mode of transport do you use to reach the gathering space?

_____

33. What is the land use tenure of this space? [ ] organisational | [ ] private | [ ] public
34. Is permission required to gather from this space? [ ] yes | [ ] no | [ ] don't know
35. If yes, from who? _____
36. Is the requirement for seeking permission prior to gathering enforced? [ ] yes | [ ] no
37. If yes, how?

_____

38. Do you normally seek permission prior to gathering? [ ] yes | [ ] no
39. If no, why?

_____

_____

40. What happens to gatherer's if they embark on gathering activities without having acquired necessary permission? [ ] nothing is done | [ ] products confiscated | [ ] sanctioned | [ ] don't know

41. Have you ever been sanctioned and or your products confiscated? [ ] yes | [ ] no
42. If yes, when was it and what was your reaction?

_____

43. Does one have to pay for permission to gather at this space? [ ] yes | [ ] no
44. If yes, how much and to who? _____
45. Do you think it is a good or not good strategy for managing spaces by way of permission requirement? [ ] yes | [ ] no
46. Why?

_____

_____

47. Are there any species which are prohibited from gathering in unused/unbuilt land? [ ] yes | [ ] no
48. If yes, which ones?

_____

_____

49. Are there any land use practices in unused/unbuilt land which conflict with gathering practices? [ ] yes | [ ] no
50. If yes, which ones? [ ] elimination of non-native species | [ ] use of chemicals (herbicides, pesticides) | [ ] other:

_____

51. Are there any warning signs provided about the application of such chemicals at this gathering space? [ ] yes | [ ] no

RIPARIAN ZONES

Plant species (local name)	Part collected (Code A)	Use (Code B)	Frequency (Code C)	Quantity	Purpose (Code D)	Months (Code E)	Change in abundance over past 5 years (Code F)
1.							
2.							
3.							

Access to and right to wild plant resources

52. How often do you gather in riparian zones? _____per [ ] week | [ ] month | [ ] year
53. Approximately how long does it take to reach this space? _____[ ] minutes | [ ] hours
54. Which mode of transport do you use to reach the gathering space?

_____

55. What is the land use tenure of this space? [ ] organisational | [ ] private | [ ] public
56. Is permission required to gather from this space? [ ] yes | [ ] no | [ ] don't know
57. If yes, from who? _____
58. Is the requirement for seeking permission prior to gathering enforced? [ ] yes | [ ] no
59. If yes, how?

_____

60. Do you normally seek permission prior to gathering? [ ] yes | [ ] no

61. If no, why?

_____

_____

62. What happens to gatherer's if they embark on gathering activities without having acquired necessary permission? [ ] nothing is done | [ ] products confiscated | [ ] sanctioned | [ ] don't know
63. Have you ever been sanctioned and or your products confiscated? [ ] yes | [ ] no
64. If yes, when was it and what was your reaction?

_____

65. Does one have to pay for permission to gather at this space? [ ] yes | [ ] no
66. If yes, how much and to who? _____
67. Do you think it is a good or not good strategy for managing spaces by way of permission requirement? [ ] yes | [ ] no
68. Why?

_____

_____

69. Are there any species which are prohibited from gathering in riparian zones? [ ] yes | [ ] no
70. If yes, which ones?

_____

_____

71. Are there any land use practices in riparian zones which conflict with gathering practices? [ ] yes | [ ] no
72. If yes, which ones? [ ] elimination of non-native species | [ ] use of chemicals (herbicides, pesticides) | [ ] other:

_____

73. Are there any warning signs provided about the application of such chemicals at this gathering space? [ ] yes | [ ] no

PARKS

Plant species (local name)	Part collected (Code A)	Use (Code B)	Frequency (Code C)	Quantity	Purpose (Code D)	Months (Code E)	Change in abundance over past 5 years (Code F)
1.							
2.							
3.							

Access to and right to wild plant resources

74. How often do you gather in parks? _____ per [ ] week | [ ] month | [ ] year
75. Approximately how long does it take to reach this space? _____ [ ] minutes | [ ] hours
76. Which mode of transport do you use to reach the gathering space?

_____

77. What is the land use tenure of this space? [ ] organisational | [ ] private | [ ] public
78. Is permission required to gather from this space? [ ] yes | [ ] no | [ ] don't know
79. If yes, from who? _____
80. Is the requirement for seeking permission prior to gathering enforced? [ ] yes | [ ] no

81. If yes, how?

_____

82. Do you normally seek permission prior to gathering? [ ] yes | [ ] no
83. If no, why?

_____

_____

84. What happens to gatherer's if they embark on gathering activities without having acquired necessary permission? [ ] nothing is done | [ ] products confiscated | [ ] sanctioned | [ ] don't know
85. Have you ever been sanctioned and or your products confiscated? [ ] yes | [ ] no
86. If yes, when was it and what was your reaction?

_____

87. Does one have to pay for permission to gather at this space? [ ] yes | [ ] no
88. If yes, how much and to who? _____
89. Do you think it is a good or not good strategy for managing spaces by way of permission requirement? [ ] yes | [ ] no
90. Why?

_____

_____

91. Are there any species which are prohibited from gathering in parks? [ ] yes | [ ] no
92. If yes, which ones?

_____

_____

93. Are there any land use practices in parks which conflict with gathering practices? [ ] yes | [ ] no
94. If yes, which ones? [ ] elimination of non-native species | [ ] use of chemicals (herbicides, pesticides) | [ ] other:

_____

95. Are there any warning signs provided about the application of such chemicals at this gathering space? [ ] yes | [ ] no

INSTITUTIONAL GROUNDS

Plant species (local name)	Part collected (Code A)	Use (Code B)	Frequency (Code C)	Quantity	Purpose (Code D)	Months (Code E)	Change in abundance over past 5 years (Code F)
1.							
2.							
3.							

Access to and right to wild plant resources

96. How often do you gather in institutional grounds? _____ per [ ] week | [ ] month | [ ] year
97. Approximately how long does it take to reach this space? _____[ ] minutes | [ ] hours

98. Which mode of transport do you use to reach the gathering space?

_____

99. What is the land use tenure of this space? [ ] organisational | [ ] private | [ ] public

100. Is permission required to gather from this space? [ ] yes | [ ] no | [ ] don't know

101. If yes, from who? _____

102. Is the requirement for seeking permission prior to gathering enforced? [ ] yes | [ ] no

103. If yes, how?

_____

104. Do you normally seek permission prior to gathering? [ ] yes | [ ] no

105. If no, why?

_____

_____

106. What happens to gatherer's if they embark on gathering activities without having acquired necessary permission? [ ] nothing is done | [ ] products confiscated | [ ] sanctioned | [ ] don't know

107. Have you ever been sanctioned and or your products confiscated? [ ] yes | [ ] no

108. If yes, when was it and what was your reaction?

_____

109. Does one have to pay for permission to gather at this space? [ ] yes | [ ] no

110. If yes, how much and to who? _____

111. Do you think it is a good or not good strategy for managing spaces by way of permission requirement? [ ] yes | [ ] no

112. Why?

_____

_____

113. Are there any species which are prohibited from gathering in institutional grounds? [ ] yes | [ ] no

114. If yes, which ones?

_____

_____

115. Are there any land use practices in institutional grounds which conflict with gathering practices? [ ] yes | [ ] no

116. If yes, which ones? [ ] elimination of non-native species | [ ] use of chemicals (herbicides, pesticides) | [ ] other:

_____

117. Are there any warning signs provided about the application of such chemicals at this gathering space? [ ] yes | [ ] no

CEMETERY

Plant species (local name)	Part collected (Code A)	Use (Code B)	Frequency (Code C)	Quantity	Purpose (Code D)	Months (Code E)	Change in abundance over past 5 years (Code F)
1.							
2.							
3.							

Access to and right to wild plant resources

118. How often do you gather in cemetery? _____ per [ ] week | [ ] month | [ ] year
119. Approximately how long does it take to reach this space? _____[ ] minutes | [ ] hours
120. Which mode of transport do you use to reach the gathering space?

_____

121. What is the land use tenure of this space? [ ] organisational | [ ] private | [ ] public
122. Is permission required to gather from this space? [ ] yes | [ ] no | [ ] don't know
123. If yes, from who? _____
124. Is the requirement for seeking permission prior to gathering enforced? [ ] yes | [ ] no
125. If yes, how?

_____

126. Do you normally seek permission prior to gathering? [ ] yes | [ ] no
127. If no, why?

_____

_____

128. What happens to gatherer's if they embark on gathering activities without having acquired necessary permission? [ ] nothing is done | [ ] products confiscated | [ ] sanctioned | [ ] don't know
129. Have you ever been sanctioned and or your products confiscated? [ ] yes | [ ] no
130. If yes, when was it and what was your reaction?

_____

131. Does one have to pay for permission to gather at this space? [ ] yes | [ ] no
132. If yes, how much and to who? _____

133. Do you think it is a good or not good strategy for managing spaces by way of permission requirement? [ ] yes | [ ] no
134. Why?

_____

_____

135. Are there any species which are prohibited from gathering in cemeteries? [ ] yes | [ ] no
136. If yes, which ones?

_____

_____

137. Are there any land use practices in cemeteries which conflict with gathering practices? [ ] yes | [ ] no
138. If yes, which ones? [ ] elimination of non-native species | [ ] use of chemicals (herbicides, pesticides) | [ ] other:

_____

139. Are there any warning signs provided about the application of such chemicals at the gathering spaces? [ ] yes | [ ] no

Less preferred spaces

140. Which spaces are less preferred for gathering? [ ] areas with soil contamination | [ ] cemetery | [ ] domestic gardens | [ ] institutional grounds | [ ] industrial sites | [ ] parks | [ ] railway | [ ] riparian zones | [ ] roadsides | [ ] unused/unbuilt land | [ ] other: _____

Benefits and motivation of gathering

141. What do you like about gathering?

_____

_____

_____

142. What do you dislike about gathering

_____

_____

_____

143. What are the motivations for gathering?

Items	Level of agreement					
	SD	D	N	A	SA	D/K
Is our tradition						
Is a form of recreation						
Is a pleasurable activity						
It connects us with our environment						
Wild plants (food) are beneficial for health						
Wild plants offer quality products						
Wild plants are essential in meeting our subsistence needs						
It is a form of income generation						
It saves money						

Note: SD: strongly disagree, D: disagree, N: Neutral, A: agree, SA: strongly agree, D/K: don't know

Perceptions towards gathering

144. What are your perceptions towards gathering wild plants?

Items	Level of agreement					
	SD	D	N	A	SA	D/K
I feel ashamed when people see me gathering wild plants						
I have been gathering wild plants for a long period of time						
It is part of our lifestyle						
It is the practice for the poor						
I like gathering wild plants						
It revives culture						
Is an activity supposed to be undertaken in rural areas						
It enhances social ties among urban citizens						
Gathering is a tiresome activity						
Wild plants are readily and freely available						

Gathering constraints

145. What are the constraints to gathering?

Items	level of agreement				
	SD	D	N	A	SA
It is time consuming					
Gathering locations are engulfed by private properties					
Inadequate gathering locations					
Gathering locations too far					
Limited species availability					
Inadequate knowledge on species identification					
Inadequate knowledge on gathering locations					
I don't know how to prepare gathered products					
Inadequate information on locations and species available therein					
Gathering is considered illegal					
Regulations prohibiting gathering					
Contaminated gathering spaces					
Other:					

Knowledge sharing and sources of information on gathering

146. How did you learn about gathering? [ ] books | [ ] brochures | [ ] family | [ ] field guides | [ ] friends | [ ] gathering tours/workshops | [ ] gatherers within the area | [ ] internet | [ ] neighbours | [ ] newspapers/magazines | [ ] own observations | [ ] professional societies | [ ] radio | [ ] television programs | [ ] other: _____
147. How do you learn about species identification? [ ] books | [ ] botanist | [ ] family | [ ] field guides | [ ] gathering tours/outings | [ ] other gatherers | [ ] resource managers
148. How do you learn about plant uses? [ ] family | [ ] friends | [ ] other gatherers | [ ] school
149. How do you learn about new gathering locations? [ ] family | [ ] gathering tours/outings | [ ] other gatherers | [ ] own observations
150. Is knowledge on gathering passed through generations? [ ] yes | [ ] no
151. If yes, how? [ ] family participation | [ ] gathering tours | [ ] oral tradition | [ ] organised trainings/workshops | [ ] public gatherings
152. If no, why?

_____

153. Do you normally teach people about gathering? [ ] yes | [ ] no
154. If yes, how? [ ] organising gathering tours | [ ] giving public lecturers | [ ] producing gathering information materials

SECTION B: REGULATORY FRAMEWORKS

155. Are you aware of any official documents such as acts, policies, bylaws strategies and guidelines used to govern/manage wild plants found in and around your town? [ ] yes | [ ] no
156. If yes, which ones do you know?

_____

_____

157. Do these official documents allow gathering of wild plants within the urban landscape? [ ] yes | [ ] no
158. If yes, which ones specifically?

_____

159. If no, why is it disallowed?

_____

_____

160. Are the official documents used to govern/manage wild plants enforced in this area? [ ] yes | [ ] no | [ ] don't know
161. Are the urban citizens involved in the formulation of the official documents used to govern/manage wild plants found in and around your town? [ ] yes | [ ] no
162. If yes, how?

_____

_____

163. If no, why?

_____

_____

164. Would you like to be involved?

_____

_____

165. Are you aware of any unofficial practices such as neighbourhood associations, cultural values, beliefs and other group of people responsible for governing/managing wild plants found in and around your town? [ ] yes | [ ] no
166. If yes, which ones do you know?

_____

167. Do these unofficial practices allow gathering of wild plants within the urban landscapes? [ ] yes | [ ] no
168. If yes, which ones specifically?

_____

169. If no, why is it disallowed?

_____

_____

170. Are the unofficial practices used to govern/manage wild plants enforced in this area? [ ] yes | [ ] no | [ ] don't know
171. Are the urban citizens involved in the formulation of some of the unofficial practices such as cooperatives, pressure groups, neighbourhood groups and non-governmental organisations used to govern/manage wild plants found in and around your town? [ ] yes | [ ] no
172. If yes, how?

_____

_____

173. If no, why?

_____

_____

174. Would you like to be involved (abovementioned groups)?

SECTION D: RESPONDENT PROFILE

175. Sex [ ] female | [ ] male
176. Age (years): _____
177. Language: [ ] Afrikaans | [ ] English | [ ] isiXhosa | [ ] Sepedi | [ ] Sesotho | [ ] Setswana | [ ] Tshivenda | [ ] Xitsonga
178. Highest education level: _____
179. Employment status [ ] full-time employed | [ ] part-time employed | [ ] self-employed | [ ] student | [ ] unemployed | [ ] retired | [ ] other: _____
180. How many people live in this household? _____

Sex	Adults (≥18 years)	Children (6-17 years)	Younger children (≤5 years)
Male			
Female			

181. How many adults in this household are on cash based employment?

Sex	Full-time	Part-time/casual	Self-employed
Male			
Female			

182. Does this household receive any government grants? [ ] yes | [ ] no
183. If yes, which ones and how many? [ ] child grant | [ ] disability grant | [ ] old age pension | [ ] other: _____
184. How long have you lived in this town: _____ years
185. How would you describe the setting of your childhood years (0-17 years old)? [ ] farm | [ ] inner town/city | [ ] rural village | [ ] township
186. Did your household practiced gathering during your childhood? [ ] yes | [ ] no
187. How would you rate your household income relative to others in this neighbourhood? [ ] less | [ ] about the same | [ ] better off
188. Does your household own this house or rent it? [ ] own | [ ] rent | [ ] other: _____
189. How many bedrooms are in this house? _____
190. Approximately how much of your budget is spent on food? R _____ per [ ] week | [ ] month
191. Which of the following items are owned by your household and how many are they?

Car		Motorbike		Cattle		Fridge		Radio	
Tractor		Bicycle		Goats		TV		Cell phone	

Appendix 3: Dietary recall questionnaire (Chapter 4)

R/A _____ Date _____ Start time _____ End time _____ Sample no _____

Town _____ Suburb _____ Street name _____ House no _____

SECTION A: WILD FOOD AND DIETARY DIVERSITY

In this study, wild food refers to any kind of edible plant product sourced from plants growing out of purposive planting and growing independent of or with very minimal human management. It includes those wild plants growing within domestic gardens, parks, institutional grounds, unbuilt spaces or unused land, riparian zones and cemeteries. Wild food could include leaves, fruits, roots, bulbs and tubers, seeds, nuts, berries, fungi, mushrooms (wild) etc.

Household dietary recall (Only for food preparer aged 18 years and above)

1. Did you eat anything (meal or snack) outside of the home during the last 48 hours? [ ] yes | [ ] no
2. Did the food you ate during the last 48 hours differ from your usual diet due to certain circumstances (e.g. funeral, wedding ceremony, party/session)? [ ] yes | [ ] no
3. If yes, how?

   _____

   _____
4. Please describe the types of foods (meals and snacks) and drinks that you consumed during the past two days (day and night), at home or outside home and including those purchased (include local foods and ingredient for meal compositions)

   a. Food and drinks consumed yesterday

Meal	Name of the dish	Ingredients	Source of ingredients	Comments
Before breakfast				
Breakfast				
Snack before lunch				
Lunch				
Snack before dinner				
Dinner				
Snack after dinner				

Drinks				

b. Food and drinks consumed the day before yesterday

Meal	Name of the dish	Ingredients	Source of ingredients	Comments
Before breakfast				
Breakfast				
Snack before lunch				
Lunch				
Snack before dinner				
Dinner				
Snack after dinner				
Drinks				

SECTION B: WILD FOODS

Consumption patterns

5. Do you eat wild foods? [ ] yes | [ ] no
6. If no, why? [ ] dislike them | [ ] don't know them | [ ] don't know how to cook them | [ ] not available | [ ] other
7. For other, specify

   _____

   _____

   _____

8. If no, who does eat wild foods in your household?

   _____

9. If yes, which wild foods do you eat the most (starting from the frequently consumed one)? (complete the table on the next page)

Wild food	Part (Code A)	Frequency (Code B)	Meal (Code C)	Proportion of meal (Code D)	Form eaten (Code E)	Months (Code F)	Mode of acquiring (Code G)	Location of own collection (Code H)	Point of purchase (Code I)
1.									
2.									
3.									

Code A	**Code B**	**Code C**	**Code D**	**Code E**
1. Bark 2. Branch 3. Fruit 4. Leaf 5. Root 6. Seed 7. Stem 8. Tuber 9. Other (specify)	1. Most frequently (daily) 2. Frequently (4-6 days a week) 3. Occasionally (1-3 days a week) 4. Sometimes (once or twice per month) 5. Rarely (1-5 timer per year) 6. Never	1. Breakfast 2. Lunch 3. Dinner 4. Snack	1. Less than half 2. Almost half 3. More than half 4. All	1. Brewed 2. Cooked 3. Dried 4. Peeled 5. Raw 6. Washed 7. Other (specify)
Code F	**Code G**	**Code H**	**Code I**	
1. January 2. February 3. March 4. April 5. May 6. June 7. July 8. August 9. September 10. October 11. November 12. December	1. Buy 2. Given by family 3. Given by friends 4. Own collection 5. Other (specify)	1. Cemetery 2. Domestic garden 3. Institutional grounds 4. Parks 5. Riparian zones 6. Unbuilt/unused land 7. Other (specify)	1. Informal market 2. Neighbours 3. Supermarket 4. Vendors 5. Other (specify)	

8. For how long have you been consuming wild foods? _____
9. Do you process and or store wild food for future use? [ ] yes | [ ] no
10. If yes, how? [ ] dry (uncooked) | [ ] dry (cooked) | [ ] refrigerate | [ ] other: _____

Perception on wild food consumption

11. What are you perceptions on wild foods?

Items	Level of agreement				
	SD	D	N	A	SA
I feel ashamed to eat wild food					
Wild foods are consumed by everyone					
Wild food are delicious					
Wild foods are tasteless					
Wild foods are collected freely					
Wild foods are important in diversifying diets					
Wild foods are foods for the poor					
Wild foods act as a safety net during times of emergency and shocks					
Wild foods are important to health					
Wild foods are foods for children					
Wild foods are nutritious					
Wild foods are contaminated					
Wild foods are part of our cultural identity					
Wild foods are easy to find					
Use of wild foods is declining					

SECTION C: RESPONDENT PROFILE

12. Sex [ ] female | [ ] male
13. Age (years): _____
14. Language: [ ] Afrikaans | [ ] English | [ ] isiXhosa | [ ] Sepedi | [ ] Sesotho | [ ] Setswana | [ ] Tshivenda | [ ] Xitsonga
15. Highest education level: _____
16. Employment status [ ] full-time employed | [ ] part-time employed | [ ] self-employed | [ ] student | [ ] unemployed | [ ] retired | [ ] other: _____
17. How many people live in this household? _____

Sex	Adults (≥18 years)	Children (6-17 years)	Younger children (≤5 years)
Male			
Female			

18. How many adults in this household are on cash based employment?

Sex	Full-time	Part-time/casual	Self-employed
Male			
Female			

19. Does this household receive any government grants? [ ] yes | [ ] no
20. If yes, which ones and how many? [ ] child grant | [ ] disability grant | [ ] old age pension | [ ] other: _____
21. How long have you lived in this town: _____ years
22. How would you describe the setting of your childhood years (0-17 years old)? [ ] farm | [ ] inner town/city | [ ] rural village | [ ] township
23. Did you eat wild foods as a child? [ ] yes | [ ] no
24. How would you rate your household income relative to others in this neighbourhood? [ ] less | [ ] about the same | [ ] better off
25. Does your household own this house or rent it? [ ] own | [ ] rent | [ ] other: _____
26. How many bedrooms are in this house? _____
27. On average, what is the proportion of the money spent on procuring food relative to the total household expenditure? [ ] < 10% | [ ] 11-20% | [ ] 21-50% | [ ] 51-80% | [ ] 81-90% | [ ] 91-100%

28. Which of the following items are owned by your household and how many are they?

Car		Motorbike		Cattle		Fridge		Radio	
Tractor		Bicycle		Goats		TV		Cell phone	

Appendix 4: Foragers questionnaire (Chapter 6)

R/A _____ Date _____ Start time _____ End time _____ Sample no _____

Town _____ Suburb _____ Street name _____ House no _____

SECTION A: CHANGING URBAN DYNAMICS

1. Is it easier to locate the following wild plants in this town now as compared to the past 10 years ago?

Wild plant	Easy of location			Explain why
	Yes	No	D/K	
Thepe				
Leshwe				
Thelele				
Mmilo				
Kgwaga				
Morula				
Mmopudu				
Moretologa/Sechidi				
Moselesele				
Mosu				
Motswere				
Mogodiri/Mohwiliri				

2. Have gathering spaces increased or decreased in terms of their numbers over past 10 years? [ ] increased | [ ] decreased | [ ] no change
3. Explain why

_____

_____

_____

4. Have gathering spaces increased or decreased in terms of their area or size of coverage over the past 10 years? [ ] increased | [ ] decreased | no change
5. Explain why

_____

_____

_____

6. Are there any developments such as residential houses, farms, private areas, mines, shopping centres/malls or roads which were constructed in some of the gathering spaces in the past 10 years? [ ] yes | [ ] no
7. If yes
    a. Which ones and how did they affect gathering?

_____

_____

_____

    b. How did you react to this change in gathering?

_____

_____

_____

8. Has there been a change in the number of people involved in gathering wild plants in your town? [ ] yes | [ ] no
9. If yes, explain how (increase, decrease) and why?

_____

_____

_____

10. Has there been a change in terms of the type of people gathering wild plants in your town (gender, age, employment status, location in town (informal, RDP, township, affluent), etc.)? [ ] yes | [ ] no
11. If yes, explain how and why?

_____

_____

_____

12. Are you aware of any formal documents such as acts, policies, bylaws, strategies and guidelines used to govern/manage wild plants found in and around your town? [ ] yes | [ ] no
13. If yes, which ones do you know?

_____

_____

14. Has there been a change in this formal document(s) over the past 10 years? [ ] yes | [ ] no
15. If yes, which ones and explain how?

_____

_____

_____

16. Are you aware of any informal practices such as neighbourhood associations, cultural values, and beliefs used to govern/manage wild plants found in and around your town over the past 10 years [ ] yes | [ ] no
17. If yes, which ones do you know?

_____

_____

_____

18. Has there been a change in this informal practice(s) over the past 10 years? [ ] yes | [ ] no
19. If yes, which ones and explain how?

_____

_____

_____

20. Has there been a change in land use management practices of some gathering spaces over the past 10 years? [ ] yes | [ ] no
21. If yes, which spaces and explain how

_____

_____

_____

Response to and adaptation to changing dynamics

22. Does one have to negotiate access to the gathering space prior to embarking on gathering activity? [ ] yes | [ ] no
23. If yes, which spaces and explain how?

_____

_____

_____

24. Have you ever experienced any changes in regard to access to gathering spaces over the past 10 years? [ ] yes | [ ] no
25. If yes, explain

_____

_____

_____

26. If experienced changes, how did you negotiate access to the gathering spaces after the changes? [ ] sought permission | [ ] formulated contractual agreements | [ ] established gathering networks | [ ] established social groups | [ ] other: _____

27. How would you overcome (adapt to) a possible change in the following aspects?

Aspect	**Answer** (Code A)
Decrease in species (Refer to table on page 1 for most used wild plants)	
Decrease in number of gathering spaces	
Change in access to gathering spaces	
Changes in land-use management in your town (e.g. rules/regulations)	

Code A

1. Extend gathering to distant areas | **2**. Use alternative products | **3.** Abandon gathering **4.** Grow same plants in our gardens | **5.** Purchase the same from the market| **6.** Establish social ties and networks to negotiate access (family, friends, community) | **7.** Establish associations to negotiate access | **8.** Develop agreements with private space owners | **9.** Other (specify)

SECTION D: RESPONDENT PROFILE

28. Sex [ ] female | [ ] male
29. Age (years): _____
30. Language: [ ] Afrikaans | [ ] English | [ ] isiXhosa | [ ] Sepedi | [ ] Sesotho | [ ] Setswana | [ ] Tshivenda | [ ] Xitsonga
31. Highest education level: _____
32. Employment status [ ] full-time employed | [ ] part-time employed | [ ] self-employed | [ ] student | [ ] unemployed | [ ] retired | [ ] other: _____
33. How many people live in this household? _____

Sex	**Adults (≥18 years)**	**Children (6-17 years)**	**Younger children (≤5 years)**
Male			
Female			

34. How many adults in this household are on cash based employment?

Sex	**Full-time**	**Part-time/casual**	**Self-employed**
Male			
Female			

35. Does this household receive any government grants? [ ] yes | [ ] no
36. If yes, which ones and how many? [ ] child grant | [ ] disability grant | [ ] old age pension | [ ] other: _____
37. How long have you lived in this town: _____ years
38. How would you describe the setting of your childhood years (0-17 years old)? [ ] farm | [ ] inner town/city | [ ] rural village | [ ] township
39. Did your household practiced gathering during your childhood? [ ] yes | [ ] no
40. How would you rate your household income relative to others in this neighbourhood? [ ] less | [ ] about the same | [ ] better off
41. Does your household own this house or rent it? [ ] own | [ ] rent | [ ] other: _____
42. How many bedrooms are in this house? _____
43. Which of the following items are owned by your household and how many are they?

Car		Motorbike		Cattle		Fridge		Radio	
Tractor		Bicycle		Goats		TV		Cell phone	

Appendix 5: Key informant interview prompts (Chapter 5)

Formal and informal regulations governing wild plant resources in urban landscapes

1. What are the formal regulations governing access to wild plant resources found in urban landscapes?
   - Policies
   - By laws
   - Land acts
   - City masterplans
2. What are the informal regulations governing access to wild plant resources?
   - Cooperatives
   - Pressure groups
   - Non-governmental organisations guidelines
   - Belief systems
   - Cultural values
   - Traditional knowledge
   - Neighbourhood groups
3. When, how and why were these regulations developed?
4. Were the urban citizens involved during formulation of the regulations?
   - How were they involved
5. How are these regulations implemented?
6. What is the position of authorities, managers and regulations (formal and informal) towards gathering?
7. What are the perceptions of authorities and managers towards gathering?

Respondent profile

8. Sex [ ] males | [ ] female
9. Age:_____ years
10. For how long have you lived in this town?_____Years
11. Years in position: _____
12. Professional background:_____
13. Highest education level: _____

Appendix 6: Selected foragers interview prompts (Chapter 6)

1. How has species abundance and availability changed in your area in the past five years?
   - What has caused such changes?
2. How does this change affect gathering activities?
3. How has gathering activities changed over the past 15 years?
4. Have gathering locations changed over the past 15 years?
5. Have you experienced any changes on the formal and informal regulations governing urban landscapes and their position towards gathering since you lived here?
6. How does property development and urban expansion affect access to gathering spaces/locations?
7. How did you respond to and cope with the aforementioned changes?
8. How do you adjust to these changes?
9. Did you participate in any associations or groups aimed at overcoming this changing dynamics?

Respondent profile

10. Sex [ ] males | [ ] female
11. Age:_____ years
12. For how long have you lived in this town?_____ Years
13. Years in position: _____
14. Professional background:_____
15. Highest education level: _____