URBAN GREEN IN DEPRIVED AREAS: THE MATCH BETWEEN SUPPLY OF AND DEMAND FOR ECOSYSTEM SERVICES OF URBAN GREEN SPACES – THE CASE OF KUMASI, GHANA

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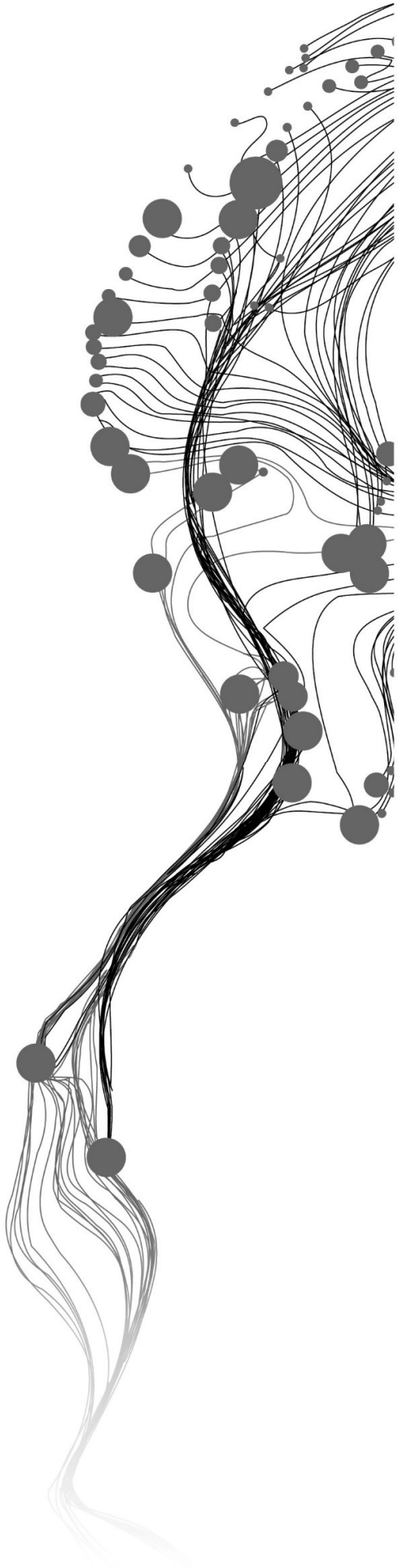

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ABSTRACT

Urban green spaces (UGS) are an important contributor to human wellbeing and health. Several studies have been done on these UGS with particular emphasis on the Global North. Little is being done and known about cities in the Global South. The few studies in the Global South usually focus on citywide scale with very little known about deprived areas. These deprived urban areas are described as areas with poor and worsened environmental conditions. As such, access to UGS in these areas could be beneficial for the provision of ecosystem services (ES) such as temperature and air quality regulation, and a place for social cohesion which are relevant to the wellbeing of the residents. Moreover, with the few studies done on these deprived urban areas, little is known about the relationship between what UGS and associated benefits are available to the residents and what they actually demand for. Hence, this study adopts a mixed-method approach incorporating geographic information system (GIS) methods, household survey, and key informants interviews using two deprived areas – Dakodwom and Ayigya Zongo – in Kumasi, Ghana as case studies: 1) to assess the level of supply of ES of UGS in the selected deprived urban areas of Kumasi; 2) to assess the level of demand for ES of UGS in the selected deprived urban areas of Kumasi; 3) to assess the potential gap(s) between the level of supply of and demand for ES of UGS in the selected deprived urban areas of Kumasi; and 4) to determine how the identified gap(s) can be used to inform decision-making. The results of the study show that UGS are generally non-existent in these deprived urban areas, which is influenced by encroachment as a result of limited land space while there are relatively more UGS available in surrounding areas identified as well-off. Regardless, the residents in the areas perceived to be benefiting from the few available UGS which are within shorter travel distances with a higher recognition for regulating and cultural services. In addition, the residents tend to be satisfied with the few available UGS, with which they are of the view that there is no space for the creation of more green spaces. However, a larger share of the respondents also sees the need for additional UGS. In this regard, there is a higher demand for socio-cultural benefits of UGS than the environmental and economic with recreational activities being more distinct. The high demand by the residents in the areas, which exceeds the available supply presents a huge gap that requires spatial planning and management decisions involving all stakeholders with effective legislative support.

Keywords: demand; deprived urban areas; ecosystem services; Global South; Kumasi; supply; urban green spaces

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TABLE OF CONTENTS

LIST OF FIGURES v
LIST OF TABLES vi
LIST OF APPENDICES vii
LIST OF ABBREVIATIONS viii
1. INTRODUCTION 1
1.1. Background and justification 1
1.2. Research problem 2
1.3. Research objectives 4
1.4. Thesis structure 4
2. LITERATURE REVIEW 5
2.1. UGS 5
2.2. ES 5
2.2.1. ES of UGS 6
2.3. Supply of and demand for ES of UGS 6
2.3.1. Supply of ES of UGS 6
2.3.2. Demand for ES of UGS 6
2.4. Supply of and demand for ES of UGS in deprived urban areas 7
2.5. Conceptual framework of the study 7
3. RESEARCH DESIGN AND RESEARCH METHODS 9
3.1. Research design 9
3.2. Study area and case studies 9
3.2.1. Study area, Kumasi 9
3.2.2. Case study selection 11
3.3. Indicators selection for assessing the supply of and demand for ES of UGS 12
3.4. Data sources and methods for data collection 12
3.5. Pre-fieldwork phase 13
3.6. Fieldwork phase 13
3.6.1. Recruitment and training of field assistants 14
3.6.2. Sampling strategy 14
3.6.3. Reconnaissance and pilot surveys 14
3.6.4. Household survey 15
3.6.5. Key informants interviews 15
3.7. Post-fieldwork phase 15
3.7.1. Statistical analysis 16
3.7.2. Spatial analysis 16
3.8. Ethical considerations, risk, and contingencies 18
4. RESULTS 20
4.1. Demographic characteristics of respondents 20
4.2. Supply of ES of UGS in Dakodwom and Ayigya Zongo 21
4.2.1. Available UGS – type and size 21
4.2.2. Estimated distance from residential houses to the nearest UGS 27
4.2.3. Available ES of UGS perceived by respondents 30
4.2.4. Perception on the current state of UGS for ES provision by respondents 33
4.2.5. Perception on the adequacy of UGS for ES provision by respondents 35
4.3. Demand for ES of UGS in Dakodwom and Ayigya Zongo 36
4.3.1. Satisfaction with UGS availability and location for ES provision by respondents 36

4.3.2. Demand for additional UGS for ES provision by respondents....38
4.3.3. Type of UGS demanded for by respondents....40
4.3.4. Estimated size of UGS demanded for by respondents....42
4.3.5. Preferred location for UGS by respondents....43
4.3.6. Preferred distance to the nearest UGS from residential houses by respondents....43
4.3.7. ES of UGS demanded for by respondents....44
4.3.8. Value of the state of UGS for ES provision by respondents....46
4.4. Potential Gap(s) between the supply of and demand for ES of UGS in Dakodwom and Ayigya Zongo....48
4.4.1. Match between available UGS and population....48
4.4.2. Match between the type of UGS perceived to be supplied and demanded for by respondents50
4.4.3. Match between the estimated and the preferred distances to nearest UGS by respondents....51
4.4.4. Match between the perceived ES supplied by available UGS and demanded for by respondents....51
4.4.5. Match between the perceived current state of available UGS and their value by respondents for ES provision....54
4.5. Making informed decisions based on the identified gaps....54
4.5.1. Spatial planning decisions for UGS in Dakodwom and Ayigya Zongo....55
4.5.2. Management decisions for UGS in Dakodwom and Ayigya Zongo....56
4.6. Summary....57
5. DISCUSSION....58
5.1. Land scarcity affecting the availability of UGS....58
5.2. Factors influencing the satisfaction level of the respondents on UGS availability and location....59
5.3. Influence of shorter travel distances on available UGS....59
5.4. Available types of UGS influencing ES supply and demand....59
5.5. Relationship between the perceived current state of available UGS and their value by respondents for ES provision....61
5.6. Implications of the informed decisions to address the identified gaps....61
5.7. Guide based on the conceptual framework of the study for similar and further studies....61
5.8. Limitations of the study....63
6. CONCLUSION....64
6.1. Summary of key findings and conclusion....64
6.2. Areas for further research....65
LIST OF REFERENCES....67
APPENDICES....73

LIST OF FIGURES

Figure 2.1: Conceptual framework of the study 8
Figure 3.1: Location of the study area in Ghana (A), Location of the case study areas in Kumasi (B), Case study area 1 – Dakodwom (C), Case study area 2 – Ayigya Zongo (D) 10
Figure 3.2: Map of 300 m buffer from the boundary of Dakodwom 17
Figure 3.3: Map of 300 m buffer from the boundary of Ayigya Zongo 18
Figure 3.4: Summary of the overall research workflow 19
Figure 4.1: UGS map of Dakodwom 24
Figure 4.2: UGS map of Ayigya Zongo 24
Figure 4.3: UGS map of Dakodwom considering 300 m buffer from boundary 25
Figure 4.4: UGS map of Ayigya Zongo considering 300 m buffer from boundary 25
Figure 4.5: Available UGS by respondents 26
Figure 4.6: Pictorial evidence of available UGS in the case study areas. Street trees 27
Figure 4.7: Distance to available UGS in Dakodwom 28
Figure 4.8: Distance to available UGS in Ayigya Zongo 29
Figure 4.9: Available UGS and provided ES: Blue colour represents provisioning services; 32
Figure 4.10: Perception on the current state of UGS for ES provision by respondents in terms of Freedom from garbage (FFG), Freedom from crime (FFC), Availability of vegetation cover (AVC) 33
Figure 4.11: Perception on the adequacy of UGS for ES provision by respondents 36
Figure 4.12: Level of satisfaction with UGS Availability (SUGS_A) and Location (SUGS_L) for ES provision by respondents 37
Figure 4.13: Demand for additional UGS by respondents 39
Figure 4.14: Preferred location for UGS by respondents 43
Figure 4.15: Value of the state of UGS for ES provision by respondents in terms of Freedom from garbage (FFG), Freedom from crime (FFC), Availability of vegetation cover (AVC) 47
Figure 4.16: Variation in the state of vegetation cover availability and value attached to it by respondents (Current state of UGS: Very bad – 1, Bad – 2, Neutral – 3, Good – 4, Very good – 5; Value of UGS state: Very low – 1, Low – 2, Neutral – 3, High – 4, Very high – 5) 54
Figure 5.1: Guide based on the conceptual framework of the study for similar and further studies 62

LIST OF TABLES

Table 2.1: Examples of ES that are provided by UGS....6
Table 3.1: Selected indicators and descriptions....12
Table 3.2: Summary of data, their format, and sources....13
Table 3.3: Key informants interviewed....15
Table 4.1: Demographic characteristics of respondents....21
Table 4.2: Available UGS from satellite images....23
Table 4.3: Residents' distances for accessing nearest UGS....29
Table 4.4: Estimated distance from residential houses to the nearest UGS by respondents....30
Table 4.5: Available ES of UGS perceived by respondents....31
Table 4.6: Perception on the current state of UGS for ES provision by respondents....35
Table 4.7: Level of satisfaction with UGS availability and location for ES provision by respondents....38
Table 4.8: Demand for additional UGS considering demographic characteristics of respondents....40
Table 4.9: Type of UGS demanded for by respondents....41
Table 4.10: Estimated size of UGS demanded for by respondents....42
Table 4.11: Preferred distance to the nearest UGS from residential houses by respondents....44
Table 4.12: ES of UGS Demanded for by Respondents....45
Table 4.13: Value of the state of UGS for ES provision by respondents....47
Table 4.14: Size of available UGS and population....49
Table 4.15: Type of UGS perceived to be supplied and demanded for by respondents....50
Table 4.16: Variation in Supply of and Demand for Type of UGS by respondents....50
Table 4.17: Perceived ES supplied by available UGS and demanded for by respondents....52
Table 4.18: Variation in perceived ES supplied by available UGS and demanded for by respondents....53

LIST OF APPENDICES

Appendix 1: Creation, preparation, and execution of household survey questionnaire using KoBoToolbox 73
Appendix 2: Primary data collection instruments 76
Appendix 3: Research matrix of the study 85
Appendix 4: Locations of the respondents 87
Appendix 5: Quotations generated from the transcripts in ATLAS.ti 88
Appendix 6: Results of the Chi-square test 89
Appendix 7: Relationship between demographic characteristics of respondents and demand aspects 90
Appendix 8: Variation in the state of vegetation cover availability and value attached to it by respondents 96

LIST OF ABBREVIATIONS

ANGSt	Accessible Natural Greenspace Standards
CBD	Central business district
CoV	Coefficient of variation
DoP	Department of Planning
ES	Ecosystem services
GIS	Geographic information system
GSS	Ghana Statistical Services
KMA	Kumasi Metropolitan Assembly
KNUST	Kwame Nkrumah University of Science and Technology
MEA	Millennium Ecosystem Assessment
OMA	Oforikrom Municipal Assembly
PPD	Physical Planning Department
SPSS	Statistical Package for Social Sciences
SDGs	Sustainable Development Goals
TEEB	The Economics of Ecosystems and Biodiversity
UGS	Urban green spaces
WHO	World Health Organization

1. INTRODUCTION

According to the United Nations Department of Economic and Social Affairs [UNDESA] (2019), the world's population will continue to grow with more than half of the population dwelling in urban areas. This trend in developing countries especially poses a threat to the natural environment such as urban green spaces (UGS) as these are being invaded by activities including commercial and residential (Quagraine, 2011; Cobbinah & Darkwah, 2016; Essel, 2017). Kong and Nakagoshi (2006) emphasized that there is a continuous increase in the negative impacts of urbanization on UGS in cities. Thus, UGS are rapidly depleting regardless of their enormous benefits to the health and wellbeing of people (Barbosa et al., 2007). Also, environmental impacts resulting from the reduction of UGS due to urbanization are very prominent - e.g noise pollution, increasing carbon dioxide concentration, and urban heat island (Haq, 2011; Oliveira, Andrade, & Vaz, 2011; Zhou & Wang, 2011). In the Global South, especially in Africa, the rapid rate of urbanization is greatly associated with physical urban expansion which leads to the destruction of UGS and their ecosystem services (ES) (Asabere et al., 2020). Hence, there is an increased concern about the separation of urban residents from nature, which is capable for the enhancement of their health and wellbeing (Adjei-Mensah, 2014). This is therefore a serious issue within cities in the Global South where little is being done to tackle the situation (Oduro-Ofori, Braimah, & Osei, 2014).

1.1. Background and justification

UGS consist of a wide variety of parks, urban trees, urban agriculture, lawns, and roof gardens (Breuste, Haase, & Elmqvist, 2013; Kabisch & Haase, 2014). These can be termed as one of the required infrastructures of cities that provide essential benefits to urban dwellers (Yao, Liu, Wang, Yin, & Han, 2014). Furthermore, these benefits vary from environmental (temperature regulation, noise reduction, air quality improvement, and climate change adaptation strategy) to social (mental and physical health improvement, leisure, relaxation, and recreation) (De Ridder et al., 2004; Kabisch & Haase, 2014). All these benefits are therefore referred to as ES (Burkhard, Kroll, Nedkov, & Müller, 2012; Richards et al., 2019).

Next to the reduction of UGS is the increasing levels of inequality and deprivation particularly in the Global South (Wan & Su, 2017). Hence, there is an increase in the number of deprived urban areas which are often described as areas within cities known to be the hub of poverty with low socio-economic status (Roy, Shemdoe, Hulme, Mwageni, & Gough, 2018; Cruz-Sandoval, Ortego, & Roca, 2020). The lack of green areas is one of the many dimensions of deprivation but not the only one, as deprivation has been described as multidimensional which can include lack of education and training, inadequate income, lack of access to basic facilities and services, and low level of social cohesion (Baud, Sridharan, & Pfeffer, 2008; Wan & Su, 2017). These situations usually compromise people's ability to enjoy higher levels of wellbeing (Baud et al., 2008).

Deprived urban areas, especially in the Global South usually have few available green spaces with worsened environmental conditions (Roy et al., 2018). Thus, there is a lower concentration of green spaces in these areas compared to well-off areas (Cruz-Sandoval et al., 2020). However, residents of these deprived urban areas depend more on the ES of UGS and are largely affected by a decrease in coverage, quality, and accessibility to such services (Derkzen, Nagendra, Van Teeffelen, Purushotham, & Verburg, 2017). This therefore presents a mismatch between the supply of and demand for ES of UGS in such

areas (Burkhard et al., 2012). Supply here refers to the ES provided by UGS and demand also refers to the need for ES of UGS by residents (Syrbe, Schröter, Grunewald, Walz, & Burkhard, 2017). The benefits of UGS in deprived areas should not be overlooked, as they can greatly serve as a source of livelihood and a general improvement to the quality of life of residents of these deprived areas (Derkzen, Nagendra, Van Teeffelen, Purushotham, & Verburg, 2017; Adegun, 2018).

In the quest for sustainable development, the study of urban green in deprived urban areas will help in realizing the Sustainable Development Goals (SGDs) (3 – good health and wellbeing, 10 – reduced inequality, 11- sustainable cities and communities, and 13 – climate action) (United Nations, 2019). This is mainly because UGS are highly associated with nature, health, and wellbeing improvement. Also, the SDG 11, target 11.7 particularly emphasizes the provision of universal access to safe, inclusive, and accessible, green, and public spaces, in particular for women and children, older persons, and persons with disabilities by 2030. The study will therefore help to inform decision-making by limiting the inequality concerning UGS and associated ES distribution, especially in the Global South.

Making urban spaces available for the growing population remains a key challenge for urban planning in the sustainable management of cities for improved liveability (Haase et al., 2017). Hence, an important part of the sustainable development of cities is associated with UGS management (Haq, 2011). Moreover, getting maximum benefits from UGS requires the concentration of integrative and local approaches in tackling the various challenges that cities in different countries face, such as allocation of land for green spaces and the determination of the number and size of green spaces per urban resident (Haq, 2011).

The study will therefore help in informing policymakers in planning sustainable cities by emphasizing the significance of UGS especially with regard to the management of these deprived areas. UGS have also proven to be very important in combating climate change which is an essential issue. Therefore, the study will help in assessing the current state of UGS in deprived urban areas by looking at the relationship between the supply and demand as well as the way forward for the sustainable development of cities in the Global South.

1.2. Research problem

Several studies have been done on urban green globally. Comparatively, less is being done and known about cities in the Global South (Richards et al., 2019). The few studies conducted in the Global South have largely focused on a citywide scale. However, within a specific city, there might be large differences in the types of services that are needed by various user groups such as the urban poor, and different impacts of changing UGS (Derkzen et al., 2017). Studies such as Mpofu (2013); Cobbinah and Darkwah (2016) emphasized the implications of rapid urbanization on UGS. The studies confirmed the negative impacts of urbanization on UGS in the Global South which limit the relevance of green spaces in urban areas. Also, studies by Quagraine (2011); Adjei-Mensah (2016) examined the state of UGS in Ghana which was seen to be in a deterioration state. Furthermore, Adjei-Mensah, Andres, Baidoo, Eshun, and Antwi (2017) also associated the bad state of UGS in developing countries especially in Africa with poor management practices. Nevertheless, the situation in areas of the cities such as that of deprived urban areas could be worsened which needs particular attention (Derkzen et al., 2017). Additionally, the role of UGS in developing countries has been explored in studies such as Kithiia & Lyth (2011); Roy et al. (2018) also largely on a citywide scale. The results of the studies indicated that UGS have the potential in combating climate change, as such, effective measures should be taken to help maintain these green spaces for sustainable development. Also, a study by Shackleton et al. (2018) in small and medium-sized towns in South Africa elaborated on the importance of UGS which included recreational and health benefits. Subsequently, these benefits were highly attributed to wellbeing and quality of life enhancement and were

recommended for the integration of UGS in urban planning (Shackleton, Chinyimba, Hebinck, Shackleton, & Kaoma, 2015). Moreover, in deprived urban areas residents depend more on ES of UGS for their livelihood than other areas but there has been little research into these areas (Derkzen et al., 2017).

Furthermore, studies into the demand and supply of UGS either focus more on the demand aspect leaving the supply aspect and vice versa (Hegetschweiler et al., 2017). Few of such studies in the Global South include Girma, Terefe, Pauleit, and Kindu (2019) who assessed UGS changes and drivers in Sebeta town of Ethiopia. The study findings revealed that UGS have drastically declined over the years with physical expansion and population growth being some major drivers which have a significant impact on the services provided (Girma, Terefe, Pauleit, et al., 2019). Their study is therefore based on the supply aspect of UGS without any information on the demand aspect. Moreover, a study by Girma, Terefe, and Pauleit (2019) also analysed how UGS are used and managed by people in the emerging towns of the Oromia special zone surrounding Finfinne in Ethiopia. Also, their study essentially concerned the demand for UGS where it was revealed that there is low utilization of green spaces due to the availability of few green spaces (Girma, Terefe, & Pauleit, 2019).

Some of the fewer studies in deprived urban areas in the Global South such as Derkzen et al. (2017) analysed how the wellbeing of the urban poor is being affected by urban development with shifts in ES and the responses from people in Bangalore, India. The study findings revealed that changes in ES in these areas result in a shift in the ecosystem supplied and demanded (Derkzen et al., 2017). Therefore, people respond to these shifts by finding alternate sources of income as well as accepting the lower quality or stop the use of particular ES. Also, Adegun (2019) and Roy et al. (2018) emphasized the importance of UGS in deprived urban areas. Roy et al. (2018) specifically explored the relevance of UGS for climate change adaptation in deprived areas in Dar es Salaam, Tanzania.

With all these studies being done on UGS, little is known about the relationship between the supply of and demand for the ES of UGS (Burkhard et al., 2012; Hegetschweiler et al., 2017). Here, residents in these deprived urban areas require more of ES such as temperature and air quality regulation due to the poor environmental conditions in the areas. Burkhard et al. (2012) emphasize the need for a match between the supply of services provided by nature and the demand of society for the achievement of sustainable natural resource use which is self-sustainable. Also, the state of ES is affected by the needs of society and not only the provision (Burkhard et al., 2012). Thus, there is a connection between the supply of and demand for ES which should not be separated (Burkhard et al., 2012).

This study therefore focuses on Kumasi, the second largest city in Ghana, which gained the "Garden City of West Africa" status in the 1960s and has lost so much of its greens due to urbanization coupled with urban expansion and urban sprawl (Quagraine, 2011; Asare, 2013; Adjei-Mensah, 2014). A study by Quagraine (2011) showed that the depletion of Kumasi's greenery has resulted in excessive heat and an increase in air pollution in the city, which is very severe and calls for stakeholders' attention. Also, according to Takyi, Amponsah, Yeboah, and Mantey (2020), there is an increased in the development of deprived urban areas with poor environmental conditions in the city. Hence, the study seeks to analyse the relationship between the supply of and demand for ES of UGS in deprived urban areas of Kumasi. The study will help in determining the potential gap(s) between the supply of and demand for ES of UGS, which can subsequently be used to inform decision-making.

1.3. Research objectives

The overall objective of the study is to analyse the match between the supply of and demand for ES of UGS in selected deprived urban areas of Kumasi, Ghana. Specific research objectives and questions are presented below:

1. **To assess the level of supply of ES of UGS in selected deprived urban areas of Kumasi.**
   - ✓ What type of UGS are available in the selected deprived urban areas of Kumasi?
   - ✓ What ES are provided by these UGS in the selected deprived urban areas of Kumasi?
   - ✓ What is the current state of the available UGS for the provision of ES in the selected deprived urban areas of Kumasi?
2. **To assess the level of demand for ES of UGS in selected deprived urban areas of Kumasi.**
   - ✓ What is the level of satisfaction on the available UGS for ES provision by residents in the selected deprived urban areas of Kumasi?
   - ✓ Who is demanding for ES of UGS in the selected deprived urban areas of Kumasi?
   - ✓ What kind of ES of UGS are being demanded for by residents in the selected deprived urban areas of Kumasi?
   - ✓ How do residents of the selected deprived urban areas of Kumasi value the state of UGS for the provision of ES?
3. **To assess the gap(s) between the level of supply of and demand for ES of UGS in selected deprived urban areas of Kumasi.**
   - ✓ Does the supply of ES of UGS meet the demand in the selected deprived urban areas of Kumasi?
   - ✓ What potential gap(s) can be identified between the level of supply of and demand for ES of UGS in the selected deprived urban areas of Kumasi?
4. **To determine how the identified gap(s) can be used to inform decision-making.**
   - ✓ How can the identified gap(s) be used to inform spatial planning of UGS decisions in the selected deprived urban areas of Kumasi?
   - ✓ How can identified gap(s) be used to inform management of UGS decisions in the selected deprived urban areas of Kumasi?

1.4. Thesis structure

This thesis consists of six chapters. Chapter one provides an introduction, background and justification, research problem, and research objectives of the study. Chapter two presents a literature review on the conceptual issues relating to the study of urban green in deprived urban areas. Chapter three presents a research design for the study, a description of the study area, case studies and indicators selection. It also presents the data sources for the study, methods for data collection, and data preparation and analysis. Chapter four presents the results of the study based on the research objectives and questions. Chapter five provides a discussion on the findings of the study, a guide for similar and future studies based on an improvement in the conceptual framework of the study, and the limitations of the study. Finally, Chapter six concludes the study by summarizing the key findings, reflect on them, and provides areas for further research.

2. LITERATURE REVIEW

This chapter presents a review of conceptual issues relating to urban green in deprived urban areas. It was worthwhile to delve into the already existing literature on the topic which helped serve as a guide in the realization of the research objectives.

2.1. UGS

The term UGS has been defined across different disciplines with varying definitions (Taylor & Hochuli, 2017). The most common definitions considered vegetated areas including forests, trees, and parks (Bastian, Haase, & Grunewald, 2012; Taylor & Hochuli, 2017). In order to articulate the meaning of UGS, Taylor and Hochuli (2017) suggested the use of a definition that applies to the study context. Therefore, multi-criteria such as qualitative and quantitative aspects of UGS can be used in the definition (Taylor & Hochuli, 2017). For instance, the qualitative definition of UGS in the field of urban planning like green space referring to urban parks, such as public parks, street trees, cemeteries, and sports areas can be used (Taylor & Hochuli, 2017). Whereas quantitative definition such as vegetated areas which consist of more than 40% of mature tree cover to help in urban heat mitigation is applicable in urban cooling studies (Kong, Yin, James, Hutyra, & He, 2014; Taylor & Hochuli, 2017).

UGS have gained much attention in several studies because nature is evidenced to help in the improvement of human health and wellbeing (Frumkin, 2013; Taylor & Hochuli, 2015). UGS are also considered as key components for the attainment of environmental sustainability and enhanced quality of life of people in urban areas (H. Madureira, Nunes, Oliveira, & T. Madureira, 2018). Hence, UGS can be regarded as an essential contributor to sustainable development (James et al., 2009; Haq, 2011).

This is mainly true because of the benefits they provide such as helping in combating climate change impact through heat mitigation, carbon storage, and regulation of air and noise pollutions (Kabisch & Haase, 2014; H. Madureira et al., 2018). These benefits are classified as the environmental benefits of UGS (Haq, 2011; Kabisch & Haase, 2014). Also, social benefits including mental and physical health improvement, leisure, relaxation, and recreation are provided by UGS (Haq, 2011; Kabisch & Haase, 2014). The benefits provided by UGS are termed as ES (Burkhard et al., 2012; Richards et al., 2019).

2.2. ES

Ecosystems such as green areas provide various benefits to people which are very significant to their livelihood, wellbeing, and quality of life (Breuste et al., 2013; Haase et al., 2014; Richards et al., 2019). These benefits are largely referred to as ES. The ES provided in urban areas are usually known as urban ES (Breuste et al., 2013). These ES range from environmental to social (Haq, 2011; Kabisch & Haase, 2014).

ES have received several classifications by different authors, bodies, and organizations. Notable among them are the classifications by (Millennium Ecosystem Assessment [MEA], 2005) and (The Economics of Ecosystems and Biodiversity [TEEB], 2011). Generally, four categories of ES have been identified (Breuste et al., 2013; Haase et al., 2014). These include provisioning services, regulating services, cultural services, and habitat and supporting services (MEA, 2005; TEEB, 2011). The MEA (2005) describes the various categories as follows: The provisioning services include the derived products of ecosystems. The regulating services include the benefits provided by the ecosystem processes regulation. The cultural

services include the derived non-material benefits from ecosystems. The habitat and supporting services also include the services needed for the provision of other ecosystem services. Table 2.1 presents examples of ES under the various categories.

2.2.1. ES of UGS

The kind of ES that are provided in an area is influenced by the available type of UGS which vary across cities (Breuste et al., 2013; Lindley, Pauleit, Yeshitela, Cilliers, & Shackleton, 2018; Richards et al., 2019). Some examples of ES that are provided by UGS are presented under the provisioning, regulating, and cultural and cultural services categories below.

Table 2.1: Examples of ES that are provided by UGS

Provisioning Services	Regulating Services	Cultural Services	Supporting Services
5. Medicinal Plants	9. Temperature regulation	15. Recreation	20. Soil protection
6. Food	10. Water flow and runoff regulation	16. Aesthetics	21. Nutrient deposition
7. Wood Fuel	11. Erosion control	17. Social cohesion	
8. Livestock grazing and fodder	12. Air quality regulation	18. Sense of place	
	13. Noise reduction	19. Heritage, cultural and historical values	
	14. Windbreak		

Source: Adapted from du Toit et al. (2018)

2.3. Supply of and demand for ES of UGS

2.3.1. Supply of ES of UGS

Supply in many UGS studies is usually referred to as the available green spaces in a particular area at a specific point in time to provide services (Badiu et al., 2016; Girma, Terefe, Pauleit, et al., 2019). Supply is associated with the ES that are provided by UGS without any reference to the exact usage such as the actual recreational services provided in a specific period (Syrbe et al., 2017). Moreover, the supply of ES of UGS is mostly determined by their physical characteristics such as size and shape as well accessibility (Hegetschweiler et al., 2017). In addition, the supply of ES of UGS is also influenced by several factors including, human-induced activities (land cover/land use changes), planning and management regulations, and awareness of the benefits of UGS (Girma, Terefe, Pauleit, et al., 2019).

The supply of ES of UGS is often captured by using remote sensing and geographic information system (GIS) approaches such as land use/land cover analysis (Kong & Nakagoshi, 2006; Zhou & Wang, 2011; Qian, Zhou, Li, & Han, 2015; Girma, Terefe, Pauleit, et al., 2019). These help in identifying the locations, patterns as well as the dynamics of ES of green spaces at a particular period of time (Zhou & Wang, 2011; Qian et al., 2015; Girma, Terefe, Pauleit, et al., 2019).

2.3.2. Demand for ES of UGS

Demand for ES of UGS is referred to as individuals or groups of people's or society's need for ES of UGS (Burkhard et al., 2012; Syrbe et al., 2017). The demand for ES of UGS is usually determined by the socio-economic attributes of people, preferences, and values attached to the green spaces (Chen, Wang, Ni, Zhang, & Xia, 2020; Hegetschweiler et al., 2017). Furthermore, demand for UGS and the associated ES is also influenced by the availability of alternatives, culture-driven desires as well as the ability to satisfy the needs (Syrbe et al., 2017). Demand connects specific beneficiaries to ES while the beneficiaries have the ability to relate the demand to actual use (Syrbe et al., 2017).

In assessing the demand for UGS and related ES, surveys and interviews have been used in studies such as (Derkzen et al., 2017; Girma, Terefe, & Pauleit, 2019). These help in identifying the socio-economic factors, preferences, and values that influence the demand for the ES of UGS (Girma, Terefe, & Pauleit, 2019).

2.4. Supply of and demand for ES of UGS in deprived urban areas

Deprived urban areas are referred to as areas within cities with a low level of physical and environmental conditions including poor housing conditions which are likened to slums or informal settlements (Kohli, Sliuzas, & Stein, 2016). These areas are usually occupied by the urban poor with low socio-economic status (Kohli et al., 2016; Cruz-Sandoval, Ortego, & Roca, 2020). Kuffer, Pfeffer, Sliuzas, Baud, and Maarseveen (2017) mentioned that there is deprivation of access to basic facilities and services by residents of these areas. Also, residents live in environments that are not safe and usually overcrowded (Kuffer et al., 2017). There is a low level of UGS concentration in deprived urban areas with existing ones being in poor conditions (Roy et al., 2018). This can therefore be considered as a dimension of deprivation which is regarded as multidimensional (Wan & Su, 2017).

A study by Derkzen et al. (2017) confirmed that the supply of UGS and their associated ES are usually less with demand being high. This situation is quite prominent in deprived urban areas where the majority of residents depend on the ES of UGS for their livelihood (Derkzen et al., 2017). When such an issue persists, it illustrates a clear mismatch between the supply of and demand for UGS and the ES they provide (Burkhard et al., 2012). Moreover, in assessing the mismatch that ensues, it can help inform urban planning and management decisions in the distribution of UGS equitably as well as ensuring their use sustainably (Ortiz & Geneletti, 2018).

2.5. Conceptual framework of the study

UGS are key in the sustainable development of cities due to the various benefits they provide. However, in deprived urban areas it is known that there are few available green spaces, but residents of such areas depend more on the provided ES for their livelihood and general wellbeing and quality of life improvement. It is therefore necessary to assess the supply of and demand for the ES of UGS in deprived urban areas. This will therefore help in identifying the potential gap(s) which can use to inform spatial planning and management decisions. Figure 2.1 presents the conceptual framework of the study.

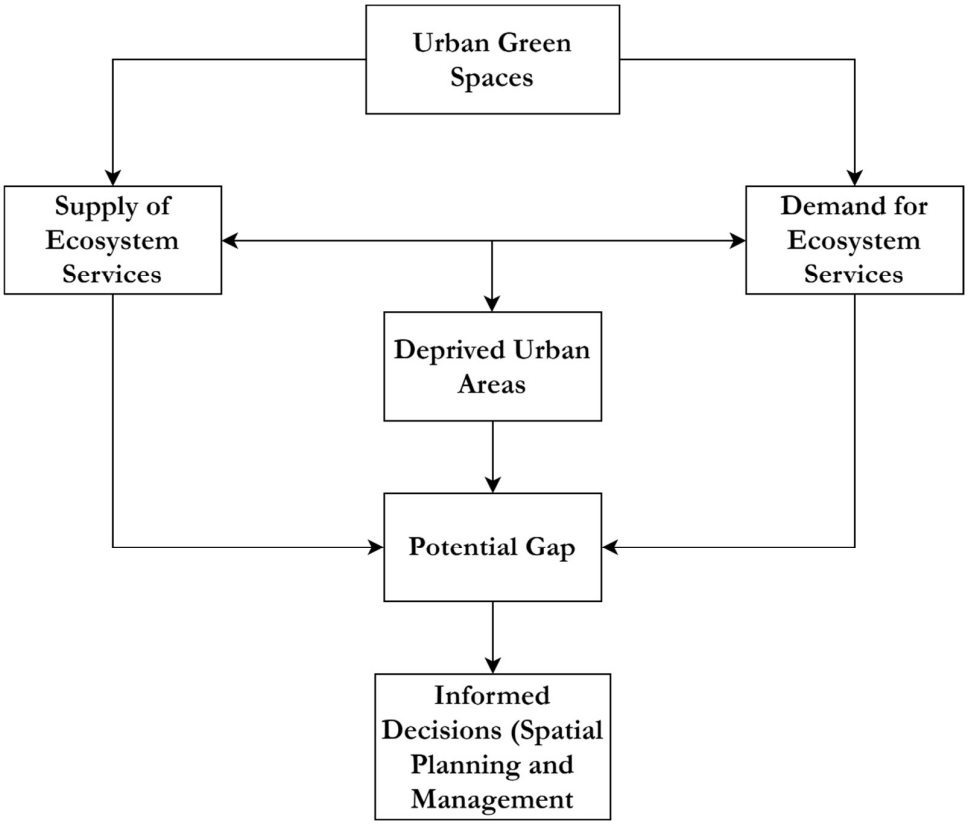

Figure 2.1: Conceptual framework of the study
Source: Author's Construct, 2021

3. RESEARCH DESIGN AND RESEARCH METHODS

This chapter describes the methods and approaches used in conducting the study. There is also a description of the study area and case studies.

3.1. Research design

For this research, the case study approach was adopted. Yin (2013) emphasizes that the main aim of the case study approach is for a better understanding of complicated social phenomena through empirical studies which involve thorough investigation into real-life situations. The case study approach was useful by helping to provide answers to the research questions leading to the achievement of the research objectives (Bryman, 2012). The case study approach for this research, therefore, facilitated the study of urban green in deprived urban areas through the assessment of the relationship between the supply of and demand for ES of UGS.

In the case of data collection and analysis, a mixed-method approach was used combining qualitative and quantitative (QUAN-qual) methods (Bryman, 2012) as well as spatial methods. The adoption of a mixed-method approach for research was driven by several motives such as triangulation and completeness (Creswell, Shope, Clark, & Green, 2006; Tonon, 2015; Martinez, Verplanke, & Miscione, 2017). Triangulation ensures the validation of both qualitative and quantitative methods to help complement each other (Bryman, 2012). Also, qualitative and quantitative methods are used for research to help achieve completeness through the delivery of a comprehensive account of the study context (Bryman, 2012; Martinez et al., 2017). In this study, a mixed-method was used for data collection and analysis to attain triangulation and completeness through the operationalization of the research objectives and questions. Therefore, the operationalization of the research objectives and questions was categorized under three main phases. One, the pre-fieldwork phase (identification of research problem, review of relevant literature, research design, description of study area, case studies selection, indicators selection, secondary data collection, and preparation of semi-structured questionnaires and interview guides). Two, fieldwork phase (primary data collection), a qualitative approach was used for conducting key informants interviews while both qualitative and quantitative approaches were used for conducting a household survey (see Figure 3.4). Three, post-fieldwork phase (data analysis, discussions, and conclusions), a qualitative approach was used for the analysis of the key informants interviews while both qualitative and quantitative approaches were used for analysing the household survey (see Figure 3.4). Appendix 3 presents the research matrix of the study.

3.2. Study area and case studies

3.2.1. Study area, Kumasi

Kumasi is the study area, which is a metropolis and the second largest city in Ghana, West Africa. Kumasi is the capital of the Ashanti Region of Ghana which is located approximately 270 km north of Accra, the national capital (Ghana Statistical Service [GSS], 2014). Kumasi has a land surface area of about 214.3 km² (GSS, 2014). It is also located in the transitional forest zone within the moist semi-deciduous south-east ecological zone with rich soil which supports vegetation and the cultivation of crops (GSS, 2014). Kumasi Metropolis was estimated to have a population of 1,730,249 according to the 2010 population census, with a population density of 8,075 persons per sq. km (GSS, 2014). Kumasi has an annual growth rate of about 3.8% which is greater than that of the Ashanti Region (2.7%) and the nation (Ghana) (2.5%) (Takyi et al., 2020). This therefore makes the city the fastest growing in Ghana with regard to population size (Takyi et

al., 2020). Kumasi's strategic location has made it possible for it to have the status of the principal inland transport terminal (GSS, 2014). This makes it effective for Kumasi in serving a central role in the large and lucrative business of goods distribution in Ghana and beyond especially to other West African countries (GSS, 2014). The higher availability of commercial and industrial activities in Kumasi due to its central and strategic location has attracted many migrants to the city in search of better opportunities (Takyi et al., 2020). This situation has resulted in a high rate of in-migration leading to the growth and expansion of new and existing slums, usually with such developments taking place on green spaces which are left idle (Takyi et al., 2020).

Kumasi, a city that gained the Garden City of West Africa accolade can no more boast of many green areas (Quagraine, 2011; Adjei-Mensah, 2014). Studies by Quagraine (2011) and Essel (2017) emphasize that there has been a depletion in nature including UGS in Kumasi since the time of colonization up to date (Quagraine, 2011; Essel, 2017). This is mainly as a result of physical urban expansion and high demand for commercial and residential activities as well as poor management practices (Quagraine, 2011a). A study by Nero (2017) shows that there was 44% decrease in vegetation cover in Kumasi from 1986 and 2014 and at the same time with 61% increase in non-vegetation areas. Furthermore, the conditions of existing parks in Kumasi are said to be very poor with declining services (Quagraine, 2011; Adjei-Mensah, 2016). Oduro-Ofori et al. (2014) emphasized that there is about 90% loss in the greenery of most of the parks, for which there has been rezoning of many into other uses. The above-mentioned therefore makes Kumasi a good area for the study. Figure 3.1 shows the location of Kumasi and the two case study areas.

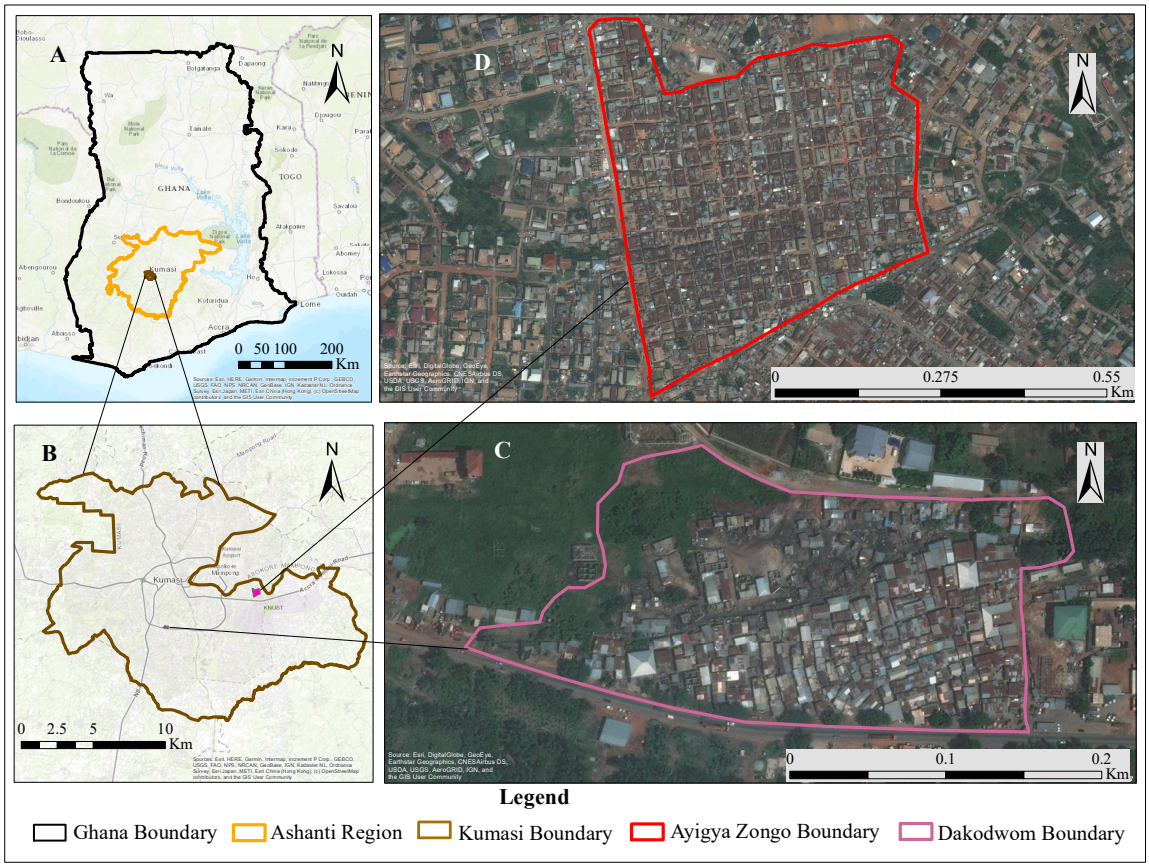

Figure 3.1: Location of the study area in Ghana (A), Location of the case study areas in Kumasi (B), Case study area 1 – Dakodwom (C), Case study area 2 – Ayigya Zongo (D)

3.2.2. Case study selection

As the study seeks to assess the match between the supply of and the demand for ES of UGS in deprived urban areas, it was therefore reasonable to undertake the study in deprived urban areas of Kumasi. A study by Takyi et al. (2020) revealed that there is a total of thirteen slum areas in Kumasi[1]. These slum areas are usually occupied by migrants from other parts of Ghana (Amoako & Cobbinah, 2011; Adubofour, Obiri-Danso, & Quansah, 2013; Doe & Aboagye, 2020; Takyi et al., 2020). Also, these slum areas are deprived of access to facilities and services with poor environmental conditions as well as poor living conditions (Amoako & Cobbinah, 2011; Takyi et al., 2020). Due to time and resource constraints, two of the deprived urban areas in Kumasi were selected for the study. The selection of the case study areas was purposively done. One area that has some available green spaces and another that has very few or lacks green spaces were selected (see Figure 3.1). The main reason for their selection was to help make a comparison between the two areas in assessing the supply of and demand for ES of UGS in deprived urban areas of Kumasi which will help to achieve the study objectives.

Hence, Dakodwom and Ayigya Zongo were selected as the two case study areas. Previous studies carried out in these two areas have shown that both areas have access to inadequate facilities and services as well as poor housing and environmental conditions (López, 2010; Amoako & Cobbinah, 2011; Doe & Aboagye, 2020; Takyi et al., 2020). The two areas are also classified as migrant settlements.

Dakodwom is also a deprived urban area that is located along the Ahodwo-Santasi road at the south-western part of Kumasi. It is located approximately 1.5 km to the south-west of the central business district (CBD) of Kumasi (Takyi et al., 2020). According to Abunyewah, Ackuayi, and Nana (2014), Dakodwom is more than a century old and the first settlers were migrants from the Central Region of Ghana who largely had a Fante ethnic background. The first settlers resided close to a river called Dakodwom from which the settlement derived its name (Abunyewah et al., 2014). The area is estimated to have a population of about 2,223 and a total number of 320 households (López, 2010; Dakpallah, 2011). It is largely inhabited by people who are Christians (97%) (López, 2010). The Google Earth Pro was used to verify whether there are some available green spaces in the area. It was also observed that as of 2019 there were some available street trees as well as open green spaces in the area.

Ayigya Zongo is a suburb of the Ayigya community located in the eastern part of Kumasi. Ayigya Zongo is estimated to have a population of 7,344 and a total number of 1,440 households. Ayigya Zongo is characterized by inadequate facilities and services, poor sanitary conditions, and small income jobs (Takyi et al., 2020). Ayigya Zongo is bounded to the south-east by Kwame Nkrumah University of Science and Technology (KNUST). The increase in the relevance of commercial activities in KNUST has attracted many people to Ayigya Zongo. The result of this is an increase in the demand for land for residential purposes. Also, there is high demand for affordable housing since proximity to KNUST has increased the value of housing (López, 2010). This has motivated many people to live in the Zongo area of the Ayigya community where there is a lower cost of housing (López, 2010). The Google Earth Pro was used to verify whether there are some available green spaces in the area. It was also observed that as of 2019 Ayigya Zongo lacked green spaces.

[1] The deprived areas were described as areas with poor sanitation and environmental conditions, inadequate facilities and services, sub-standard buildings, congestion as well as small income jobs.

3.3. Indicators selection for assessing the supply of and demand for ES of UGS

As already mentioned in the literature review, there are various ways of assessing the levels of supply of and demand for ES of UGS (see Section 2.3). This study used a mixed-method approach incorporating GIS and social science methods to consider the perspectives of the residents and experts in the field of study. This approach helps in making an effective assessment of the supply and demand variables (Chen et al., 2020). The selection of appropriate indicators is crucial for the assessment (Hegetschweiler et al., 2017). Hence, the selected indicators were influenced by the purpose of the study and the nature of the case study areas. Table 3.1 presents the indicators selected and their descriptions.

Table 3.1: Selected indicators and descriptions

Indicator	Description
Supply of ES of UGS	
Available types of UGS	The types of UGS found in the case study areas
Size of available UGS	The area covered by the UGS in the areas
Distance to UGS	The travel distance in accessing the available UGS in the areas
Available ES of UGS	The kind of ES provided by the available UGS in the areas
The current state of UGS	The condition of the available UGS for ES provision in the areas
▪ Freedom from garbage	▪ The degree to which the available UGS is devoid of litter, and it is well kept
▪ Freedom from crime	▪ The degree of safeness of the available UGS without serving as grounds for crime
▪ Availability of vegetation cover	▪ The level of greenery[2] in the available UGS
Demand for ES of UGS	
Level of satisfaction	How satisfied the residents are with the available UGS in the areas
▪ UGS availability	Satisfaction level of the residents with the size and number of UGS
▪ UGS location	Satisfaction level of the residents with the location of UGS
Preferred size of available UGS	The size of UGS preferred and demanded for
Preferred types of UGS	The types of UGS preferred and demanded for
Preferred distance to UGS	The distances residents prefer to travel for UGS access
Preferred ES of UGS	ES preferred and demanded for
The value of UGS	The value attached to UGS for ES provision
▪ Freedom from garbage	▪ The degree to which the available UGS is devoid of litter, and it is well kept
▪ Freedom from crime	▪ The degree of safeness of the available UGS without serving as grounds for crime.
▪ Availability of vegetation cover	▪ The level of greenery in the available UGS

Source: Adapted from Hegetschweiler et al. (2017) and Chen et al. (2020)

3.4. Data sources and methods for data collection

Data used for the study included both secondary and primary. The secondary data included Google Earth Pro aerial images, ArcGIS online basemap (World imagery), green spaces data, footpaths and boundaries of the case study areas, census report, and existing literature on the study. The Google Earth Pro aerial images were used in the verification of available green spaces in the selected case study areas. These were also validated through fieldwork observations from 23rd to 24th February, 2021. Green spaces and footpaths data were manually digitized from ArcGIS online basemap. The boundaries of the case study areas were informed by the local planning authorities. The average number of households and household

[2] Greenery here includes trees, grass, hedges, scrubs, flowers, and any other vegetation.

size were obtained from the census report of the Kumasi Metropolis. Literature on the study was obtained from articles, books, official reports, and other scholarly works.

Primary data was collected through a household survey and key informants interviews. The household survey was conducted using semi-structured questionnaires (both closed- and open-ended questions) to obtain information from households. The KoBoToolbox[3] was used for the generation of questionnaires while the KoBoCollect App was used for the administration of the questionnaires (see Appendix 1). KoBoToolbox is a free and open-source suite of tools for field data collection. It helps in collecting data and submitting geotagged forms, survey data, pictures, audio, and videos to a central project account. The key informants interviews were conducted to aid in-depth discussions which helped to obtain valuable information through follow-up questions (Bryman, 2012). Table 3.2 presents a summary of both secondary and data and their sources.

Table 3.2: Summary of data, their format, and sources

Data	Format	Date	Source
Secondary			
Aerial Images	Images	2019	Google Earth Pro
ArcGIS online basemap (World imagery)	Satellite images	2021	Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Green Spaces	Shapefiles	2021	Manually digitized from the ArcGIS online basemap (World imagery)
Footpaths	Shapefiles	2021	Manually digitized from the ArcGIS online basemap (World imagery)
Boundaries of case study areas	Shapefiles	2010	Local Planning Authorities
Census data	PDF	2010	Kumasi Metropolitan Assembly
Primary			
Transcribed Key Informants Interviews	Word document	2021	Fieldwork
Collated Household Survey	Excel	2021	Fieldwork

3.5. Pre-fieldwork phase

Several activities preceded the fieldwork. The activities include identification of the research problem, review of relevant literature, the research design, description of the study area, case studies selection, secondary data collection, sampling strategy, and the preparation of semi-structured questionnaires for the household survey and interview guides for the key informants interviews. These activities made it possible for the right data to be collected from the field.

3.6. Fieldwork phase

The primary data for the study was collected during the fieldwork through a household survey and key informants interviews. Due to the COVID-19 situation, the researcher was not able to travel for the fieldwork. Hence, a research assistant was used to conduct the household survey. The research assistant was a Master of Philosophy Planning student at KNUST, Kumasi, Ghana who is abreast with contemporary research methods. This made it possible for the necessary data to be collected from the households. Activities carried out during the fieldwork are summarized below:

[3] https://www.kobotoolbox.org/

3.6.1. Recruitment and training of field assistants

Five field assistants were recruited to assist the research assistant in the data collection. These field assistants were final year students of KNUST. Through a Zoom video conference on 22nd February, 2021, the research assistant together with the field assistants were briefed on the purpose of the study and how the fieldwork was to be conducted. They were subsequently taken through the household questionnaire and the collection of the data using the KoBoCollect App. They were also made to understand each question and how to ask them in the local dialect for the understanding of the respondents. Also, they were trained on how to conduct the household survey using the sampling approach as described below:

3.6.2. Sampling strategy

The sampling techniques that were used for this study included purposive sampling, systematic sampling, random sampling, and convenience sampling. Purposively, the two case study areas were selected based on factors as described under sub-Section 3.2.2 to help meet the study objectives. Also, the selection of key informants was purposively carried out. This was mainly to facilitate getting experts' knowledge and opinions regarding the supply of and demand for ES of UGS in deprived urban areas of Kumasi. Households were purposely used for the survey. To determine the sample size for the survey, the formula by Yamane (1967) was applied with a confidence level of 92% and a margin of error of 8%. This helped increase the level of accuracy of the results. The formula is given below.

$$n = \frac{N}{1 + N(\alpha)^2}$$

Where: n = sample size
N = number of households
α = the margin of error, and
1 = constant

In this case, a sample size of 141 was determined for Ayigya Zongo (with a total number of 1,440 households) and 105 for Dakodwom (with a total number of 320 households). Hence, a total of 246 sample size was determined for the two case study areas. Systematic sampling was used to select houses randomly. The total number of houses in each of the case study areas was divided by their sample sizes to determine the interval for houses to be entered for the survey. In this regard, the first house that was entered for the survey in the case study areas was the starting point for the determined intervals. A study by (López, 2010) indicated that there are 480 and 127 estimated houses in Ayigya Zongo and Dakodwom respectively. The intervals were therefore 3 for Ayigya Zongo and 1 for Dakodwom. This means that the number of houses that were between the first house entered, the second house, and the subsequent ones were 3 for Ayigya Zongo and 1 for Dakodwom. In the case study areas, more than one household occupies a house. In the houses, convenience sampling was used to select households for the survey, that is, the first household that was met in the houses was selected. If the first household was not willing to participate in the survey, any other household that is available and willing to participate in the survey was selected. Household heads were purposively selected for the survey and if the household head was not available, any member of the household who was 18 years and above was selected.

3.6.3. Reconnaissance and pilot surveys

The research and field assistants carried out reconnaissance and pilot surveys from 23rd to 24th February, 2021 to get familiarize with the case study areas. Each of the assistants carried a printed A3 aerial image to validate the available UGS in the areas. The aerial images helped the assistants to work within the boundaries of the case study areas. During the reconnaissance survey, photographs of the available green

spaces in the areas were taken (see Figure 4.6). Furthermore, a pilot survey preceded the reconnaissance survey during the same period to test the questionnaire with some selected households in the two case study areas. This made it possible to adjust some of the questions to suit the areas. For instance, the respondents in Ayigya Zongo perceived the availability of sports field in the area which was initially not considered.

3.6.4. Household survey

The household survey was carried out from 25th February to 23rd March, 2021. The household questionnaire was administered using the KoBoCollect App. The administration of the questionnaire was executed following the sampling strategy described under sub-Section 3.6.2. The questionnaire was semi-structured consisting of both closed- and opened-ended questions. This helped in deriving the required information from the households for the study. The questionnaire was structured into three main sections. The first section obtained information relating to the supply of ES of UGS in the case study areas. The second focused on the demand for ES of UGS in the areas. The third section sought the opinions of the respondents on how to improve the situation of UGS in the areas and the demographic characteristics of the respondents (see Appendix 2a). A total of 105 and 141 questionnaires were administered in Dakodwom and Ayigya Zongo respectively. Appendix 4 presents the locations of the respondents in both areas.

3.6.5. Key informants interviews

Key informants were purposively selected for interviews with the help of interview guides (see Appendix 2b). The key informants were experts in the field of UGS and deprived areas who provided useful insights into the study. The interviews were conducted from 20th February to 17th March, 2021 via Zoom video conference. The key informants provided information on 1) the situation of UGS for ES provision in the two case study areas, 2) the demand situation by residents in the areas, 3) the gap between the levels of supply and demand, and 4) the way forward for bridging the gap. The interview sessions were recorded and notes were taken on key points through the informed consent of the experts. Table 3.3 presents the key informants interviewed.

Table 3.3: Key informants interviewed

Key Informants	Department
Physical Planning Official	Physical Planning Department (PPD), Kumasi Metropolitan Assembly (KMA)
Senior Development Planning Official	KMA
Physical Planning Official	PPD, Oforikrom Municipal Assembly (OMA)
Two Senior Lecturers	Department of Planning (DoP), KNUST, Kumasi

3.7. Post-fieldwork phase

This phase involved data preparation and analysis. The household survey data was downloaded from the KoBoToolBox account and cleaned to avoid errors and inconsistencies. The cleaned data was then exported into IBM Statistical Package for Social Sciences (SPSS) software for quantitative (statistical) analysis. The recorded interviews of the key informants were transcribed into a word document. ATLAS.ti software was used for the analysis (qualitative) of the transcribed interviews through content analysis. This helped in the identification of trends and patterns in the data (Roller, 2019). Hence, quotations were generated in ATLAS.ti to complement the quantitative analysis (see Appendix 5). The open-ended responses from the survey were prepared in a word document and analysed through the generation of quotations in ATLAS.ti. Moreover, inferences were made based on the responses from the key informants

interviews and the household survey. This facilitated in coming up with the similarities and differences associated with the views and information received from the households and the experts. To assess the potential gap(s), the supply and demand variables were matched. The statistical and spatial analyses carried out are presented below:

3.7.1. Statistical analysis

The closed-ended responses of the household survey were analysed through descriptive statistics (frequency, mean, and standard deviation). The outputs generated in IBM SPSS were presented in tables, graphs, and charts for a better analysis of the data. A coefficient of variation analysis (CoV) was carried out to determine variations in the individual responses of the two case study areas. This was calculated by dividing the standard deviation of the individual responses by their mean multiplied by 100%. The closer the value to 100%, the higher the variation and vice versa. Furthermore, an independent *t*-test analysis was applied to assess the differences between the responses for both Dakodwom and Ayigya Zongo. According to Field (2009), a *t*-test can be applied to test the variation between two different samples. It was therefore hypothesized that there are significant differences between the responses of both areas in all categories of assessment. Hence, a resulting *p*-value of less than or equal to 0.05 means that the hypothesis is true and vice versa. In addition, a Chi-square test was applied to identify the factors that have a significant association with the perceptions of the respondents on the current state of available UGS for ES provision in the areas and their satisfaction levels on UGS availability and location. The Chi-square test is useful for checking the relationships between two variables (Field, 2009). The hypothesis for this was that there is a significant association between the respondents' perceptions on the current state of available green spaces and satisfaction levels on UGS availability and location and their demographic characteristics as well as the supply variables. The hypothesis was accepted when a resulting *p*-value is less than or equal to 0.05 and vice versa.

3.7.2. Spatial analysis

To determine the available UGS in the two areas, green spaces in the areas were manually digitized from the ArcGIS online basemap (World imagery). This was influenced by the fact that there is no available data on green spaces in the two areas from the local planning authorities and from open sources like OpenStreetMap (OSM). The spatial distribution of the available UGS areas was determined and their sizes were then calculated. The verification of UGS availability in the two case study areas showed that there are few green spaces in the areas which were also validated during the fieldwork. However, it was observed that some green spaces surround the areas. These green spaces can serve as service providing areas to Dakodwom and Ayigya Zongo (Syrbe et al., 2017). Hence, a decision was made to consider UGS within a 300 m buffer range from the boundaries of the two communities. This was influenced by the Accessible Natural Greenspace Standards (ANGSt) which sets out that "no person should live more than 300 m from their nearest area of natural greenspace" (Handley et al., 2003, p. 2). These areas were then referred to as Greater Dakodwom and Greater Ayigya Zongo (see Figure 3.2 and 3.3). The sizes of the available green spaces in the Greater Dakodwom and Greater Ayigya Zongo were then calculated and used for the analysis alongside those within the boundaries of the areas. Moreover, the green spaces in the Greater Dakodwom and Greater Ayigya Zongo were also considered plus those within the boundaries to assess the gap between the available UGS and the population of the two areas. In this case, the population of the Greater areas was determined by multiplying the number of houses (162 for Dakodwom and 501 for Greater Ayigya Zongo) found by the average household size (3.9) and the average number of households per house (3) (GSS), 2014).

Additionally, a GIS network analysis technique was applied to assess the distances that the residents in Dakodwom and Ayigya Zongo travel in accessing the available UGS in the areas. The network analysis

tool in ArcGIS 10.8.1 was applied to build a network dataset for walking using footpaths. The main means of access in the two communities are narrow and untarred ways (Amoako & Cobbinah, 2011), generally footpaths. This informed the decision to use footpaths that were manually digitized from the ArcGIS online basemap (World imagery). An average speed of 5 km/h was applied for the walking time. Furthermore, the service area function of the network analyst tool was applied to determine the number of houses within four categories of travel distances to access the available UGS. These distances were less than 100 m, 100-300 m, 301-600 m, and 601 m and above. A distance of 0-300 m was considered acceptable based on the ANGSt (Handley et al., 2003). To calculate the number of residents within each of the categories of the distances, the number of houses found was multiplied by the average household size (3.9) and the average number of households per house (3) (GSS), 2014).

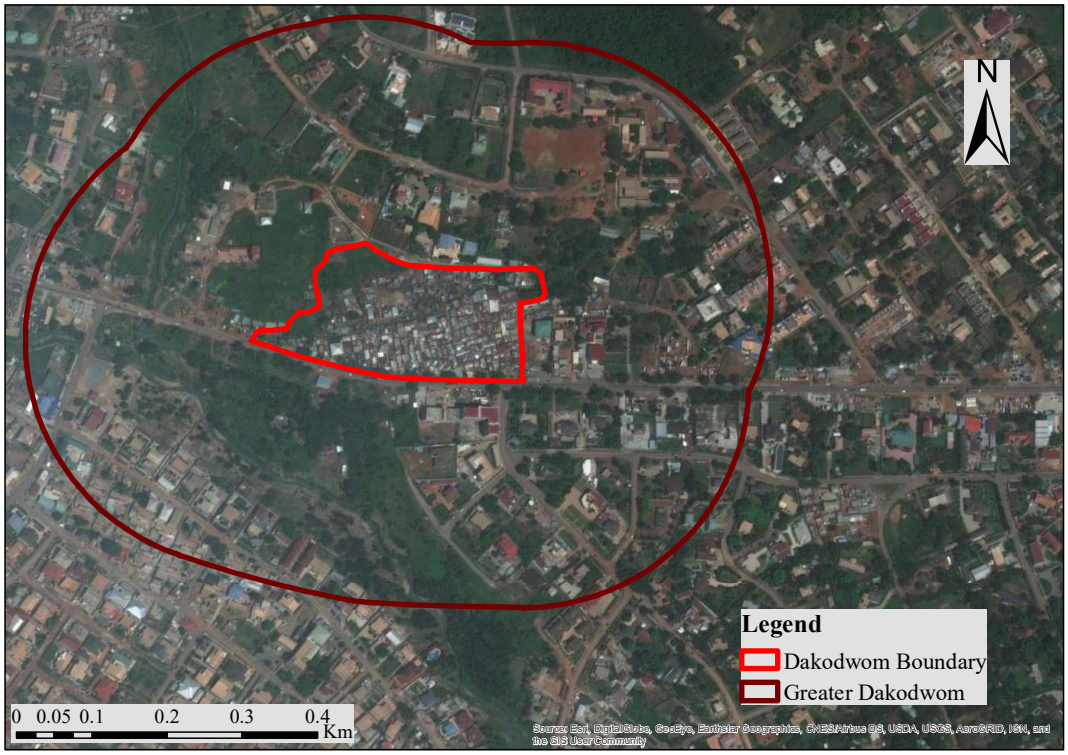

Figure 3.2: Map of 300 m buffer from the boundary of Dakodwom
(*Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community, 2021)*

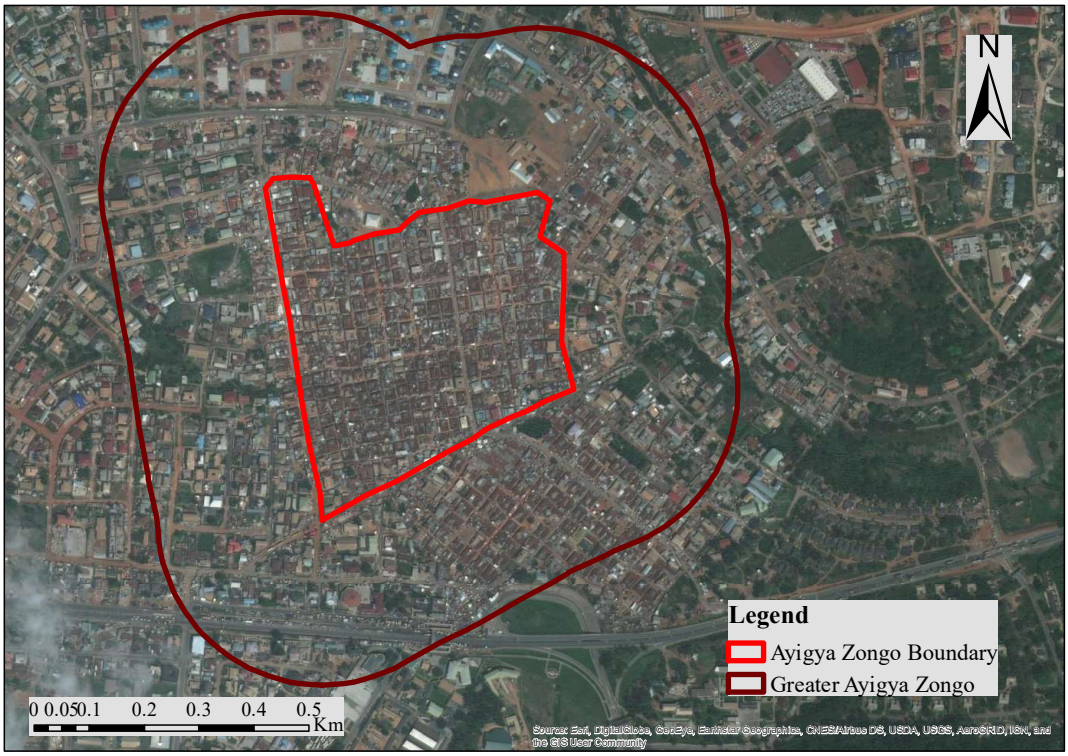

Figure 3.3: Map of 300 m buffer from the boundary of Ayigya Zongo
(*Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community, 2021)*

3.8. Ethical considerations, risk, and contingencies

The observation of research ethics was crucial in the study. This was to ensure that the rights of the key informants and the respondents of the household survey are protected and see to it that the methods used in the study are in the right order (McKenna & Gray, 2018). Explanations were given to all the respondents on the purpose of the data collection, and they were assured that their responses would be treated with the highest level of privacy and confidentiality. Appointments were scheduled with key informants in advance before the interviews. Informed consent of the key informants was sought before their involvement in the research as well as any recording that was made during the interviews. Also, informed consent of household heads was sought before their involvement in the research. All respondents were made aware of the importance of their involvement in the research for their communities. Data that was collected from the respondents are duly acknowledged.

In the current situation of COVID-19, the 1.5 rule and the wearing of a nose mask were observed as much as possible during the household survey. Due to travel restrictions resulting from the COVID-19 situation, the key informants interviews were conducted via Zoom video conference. Also, a proxy in the form of a research assistant was used to conduct the household survey in Ghana. The research assistant was familiar with the current research methods. The researcher was therefore confident that the household survey would be conducted without any casualties. However, this situation limited the researcher to adequately describe the nature of green spaces in the case study communities without being able to witness it in person. Notwithstanding, this did not affect the study objectives since the researcher received enough briefing from the research assistant.

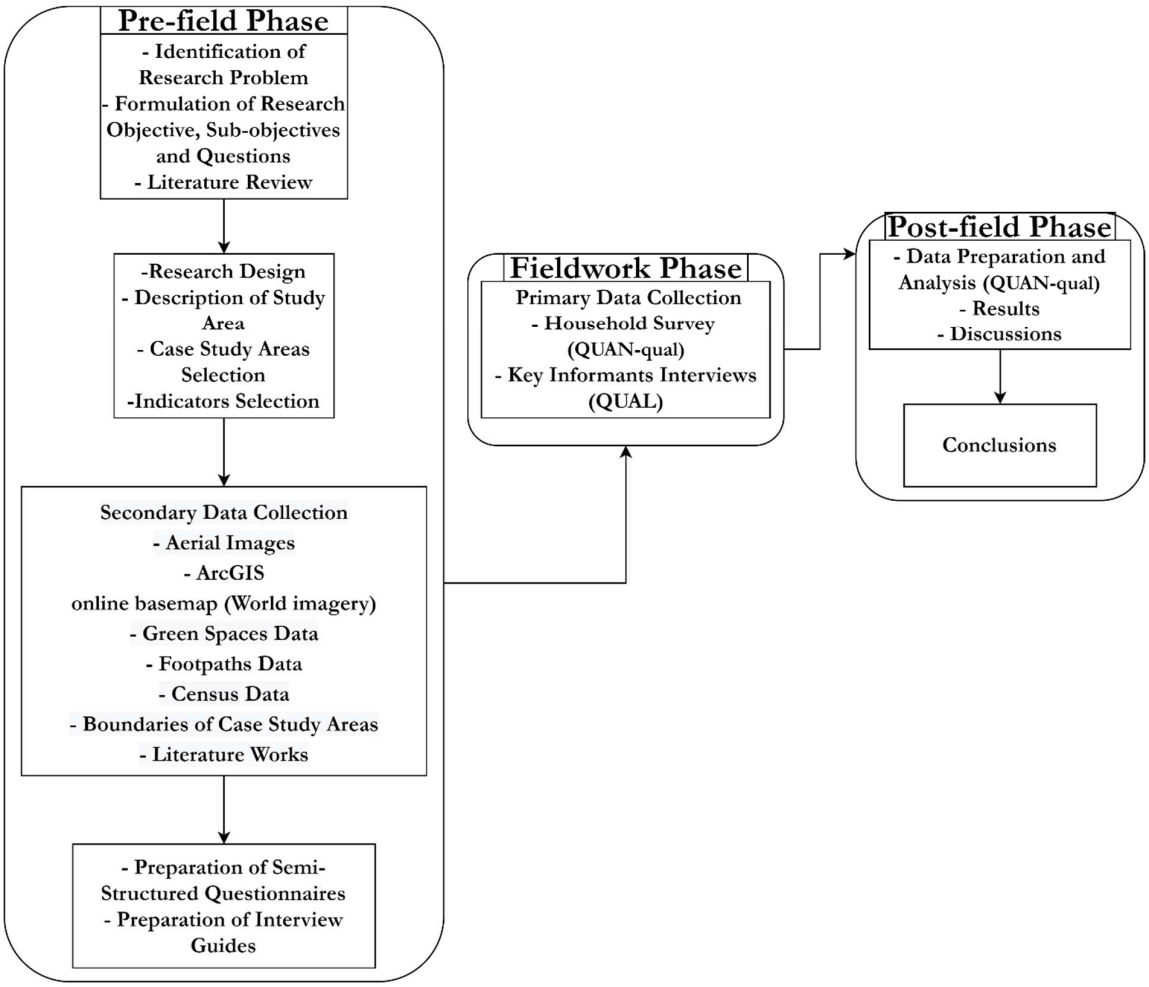

Figure 3.4: Summary of the overall research workflow
Source: Author's Construct, 2021

4. RESULTS

This chapter presents results from the study of urban green in selected deprived urban areas of Kumasi, Ghana. The chapter consists of five sections. Section 4.1 presents the demographic characteristics of the household survey respondents. Section 4.2 presents aspects on the supply of ES of UGS in the selected deprived urban areas of Kumasi, Ghana. Section 4.3 presents findings on the demand for ES of UGS. Section 4.4 presents the potential gaps identified between the supply of and demand for ES of UGS in the case studies. Finally, Section 4.5 presents spatial planning and management decisions to bridge the identified gaps.

4.1. Demographic characteristics of respondents

For the respondents' characteristics analysis, three main variables were considered: gender, age, and the highest level of education attained. Results of the household survey (Table 4.1) show that the majority of the respondents in the two case study areas are females, with 58.1% females in Dakodwom and 61.0% Ayigya Zongo. This trend deviates from the norm in many cities in Africa where household heads are dominated by males. However, the trend conforms to the census data of the Ghana Statistical Service with which there are more females than males in Kumasi, Ashanti Region, and the nation (GSS, 2012).

Moreover, the majority of the respondents were in the 26-35 age cohort for both Dakodwom (36.2%) and Ayigya Zongo (29.1%) (see Table 4.1). Overall, a larger share of the respondents was in the 18-45 age cohort with 67.7% for Dakodwom and 72.3% for Ayigya Zongo. The situation depicts a youthful population in both areas. This can be attributed to Kumasi's strategic and pivotal location with the endowment of various forms of resources and opportunities which pulls migrants from different areas of Ghana (Takyi et al., 2020). These migrants are usually dominated by the youth (Agyei-Mensah & Owusu, 2010).

The results of the household survey further show that majority of the respondents have attained basic education for both Dakodwom (46.7%) and Ayigya Zongo (38.3%) (see Table 4.1). Further analysis shows that most of the respondents have attained some level of formal education. Dakodwom (83.8%) has a larger portion of the respondents with formal education attainment than Ayigya Zongo (78.0%).

Table 4.1: Demographic characteristics of respondents

	Dakodwom (N=105)		Ayigya Zongo (N=141)	
Variable	**Frequency**	**Percentage (%)**	**Frequency**	**Percentage (%)**
Gender				
Male	44	41.9	55	39.0
Female	61	58.1	86	61.0
Total	**105**	**100**	**141**	**100**
Age				
18-25	9	8.6	27	19.1
26-35	38	36.2	41	29.1
36-45	24	22.9	34	24.1
46-55	18	17.1	21	14.9
56-65	11	10.5	13	9.2
66+	5	4.8	5	3.5
Total	**105**	**100**	**141**	**100**
Highest Level of Education Attained				
1. No Formal Education	17	16.2	31	22.0
2. Basic (Primary, Middle and JSS/JHS)	49	46.7	54	38.3
3. Post Middle/ Sec. Cert./Diploma (Teacher training/ College of education, Agric, Nursing, University Diploma, HND, etc)	2	1.9	5	3.5
4. Secondary (SSS/SHS and Secondary)	36	34.3	44	31.2
5. Tertiary (Bachelor's Degree and Postgraduate or higher)	1	1.0	7	5.0
Total	**105**	**100**	**141**	**100**

Source: Author's Household Survey, 2021

4.2. Supply of ES of UGS in Dakodwom and Ayigya Zongo

This section of the chapter presents the aspects on the supply of ES of UGS in the case studies. The aspects of supply that are analysed under the section include the type and size of available UGS, distance to available UGS, available ES of UGS, and the current state of available UGS for ES provision. All these physical characteristics of UGS were considered since they help in determining the supply level of ES (Hegetschweiler et al., 2017).

4.2.1. Available UGS – type and size

An analysis of the available UGS from satellite images shows that street trees, wetland, and sports field are the main types of UGS in Dakodwom and Ayigya Zongo (see Figures 4.1 and 4.2). Out of the three UGS, sports field is not available in Dakodwom, and in Ayigya Zongo there is no available wetland. Also, the available sports field in Ayigya Zongo is located outside the boundary of the area. In Dakodwom, the total UGS area constitutes 22.7% of the total land area (see Table 4.2). Furthermore, the total UGS area in Ayigya Zongo is 0.4% of the total land area (see Table 4.2). Hence, there is a relatively higher percentage of UGS availability in Dakodwom compared to Ayigya Zongo. The low level of UGS availability especially in Ayigya Zongo was emphasized during the key informants interviews:

"… the only green area around will have to be the wetland separating Dakodwom and the Regional Coordinating Council which can be described as a no-go area. But as we speak it has been encroached upon to the highest point and I cannot foresee any [green space] being preserved …"

Physical Planning Official, PPD, KMA
Source: Author's Key Informant Interview, 2021

"The current state of Ayigya Zongo does not make much provision for UGS. There is already limited land available for making such provision. Also, people are more interested in the physical structures than the soft landscape or green spaces. People prefer putting in more physical structures even within their private spaces than green spaces that will help promote environmental health within their spaces".

Physical Planning Official, PPD, OMA
Source: Author's Key Informant Interview, 2021

A key insight from the above quote suggests that the limited land space compels residents to take interest in other land uses rather than green spaces. This eventually leads to the invasion of green spaces by other land uses or investing in other land uses than green spaces. The expression by a Senior Lecturer of the DoP, KNUST, Kumasi, Ghana (1) supports this argument:

"Honestly, to be very sincere with you, given the level of densities and the high demand for residential spaces, many of these green areas tend to be actually converted into buildable areas although they are ecologically sensitive. You realize that there is something about these informal settlements which I normally would say that they are very high social capital. If there are assets that they find useful they have a way of protecting them. But in the case of these areas that we are talking about considering the fact that the density sizes are extremely high especially in the Ayigya Zongo area, many of the green areas, so the green spines have gradually been encroached upon. So, you only find a few areas that are the only remaining water channels, these ones you find some green spaces around them. To a large extent many of these green spaces have been encroached upon, unfortunately taken over. In the case of Dakodwom area however, due to where they are located, you realize that there are a number of wetlands or ecologically sensitive areas around. So, in that case you find that there are few areas where there are still greens" …

Source: Author's Key Informant Interview, 2021

Additionally, a further analysis considering the available UGS within 300 m buffer from the boundaries of the two areas (see Figures 4.3 and 4.4) shows a higher concentration in these ranges for Greater Dakodwom (31.7%) than Greater Ayigya Zongo (7.0%) (see Table 4.2). The results show that there are more available UGS surrounding the two areas than within. These surrounding green spaces can therefore serve as service providing areas to Dakodwom and Ayigya Zongo (Syrbe et al., 2017). However, it is important to note that the residents of the two areas would have to share the surrounding UGS with the people living within the buffer areas.

Table 4.2: Available UGS from satellite images

	Dakodwom		Ayigya Zongo	
Type of UGS	**Size**		**Size**	
	(m²)	**(ha)**	**(m²)**	**(ha)**
Street Trees	2,599.7	0.3	819.0	0.1
Wetland	7,815.2	0.8	-	
Sports Field[4]	-	-	4,894.2	0.5
Total UGS Area	**10,414.9**	**1.4**	**819.0**	**0.1**
Total Land Area (TLA)	45,791.6	4.6	222,497.9	22.2
Percentage of UGS per TLA	22.7%		0.4%	
	Greater Dakodwom		**Greater Ayigya Zongo**	
	Size		**Size**	
	(m²)	**(ha)**	**(m²)**	**(ha)**
Total UGS Area	182,652.2	18.3	63,412.9	6.3
Total Land Area (TLA)	575,570.8	57.6	903,118.7	90.3
Percentage of UGS per TLA	31.7%		7.0%	

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community, 2021

Moreover, considering the spatial distribution of available UGS shows that there is a stretch of wetland at the western part of Dakodwom (see Figure 4.1). The street trees in Dakodwom are also located in the southern part along a major road with a few located in the north-eastern part (see Figure 4.1). The few available street trees in Ayigya Zongo are also located in the southern, north-eastern, and north-western parts (see Figure 4.2). The sports field available in Ayigya Zongo is located in the north-eastern part outside the boundary (see Figure 4.2). The majority of the respondents in Ayigya Zongo indicated that this sports field is the main green space that residents in the area use.

[4] The sports field is outside the boundary of Ayigya Zongo. Therefore, it was not included in the total UGS area in Ayigya Zongo and was rather included in that of the Greater Ayigya Zongo.

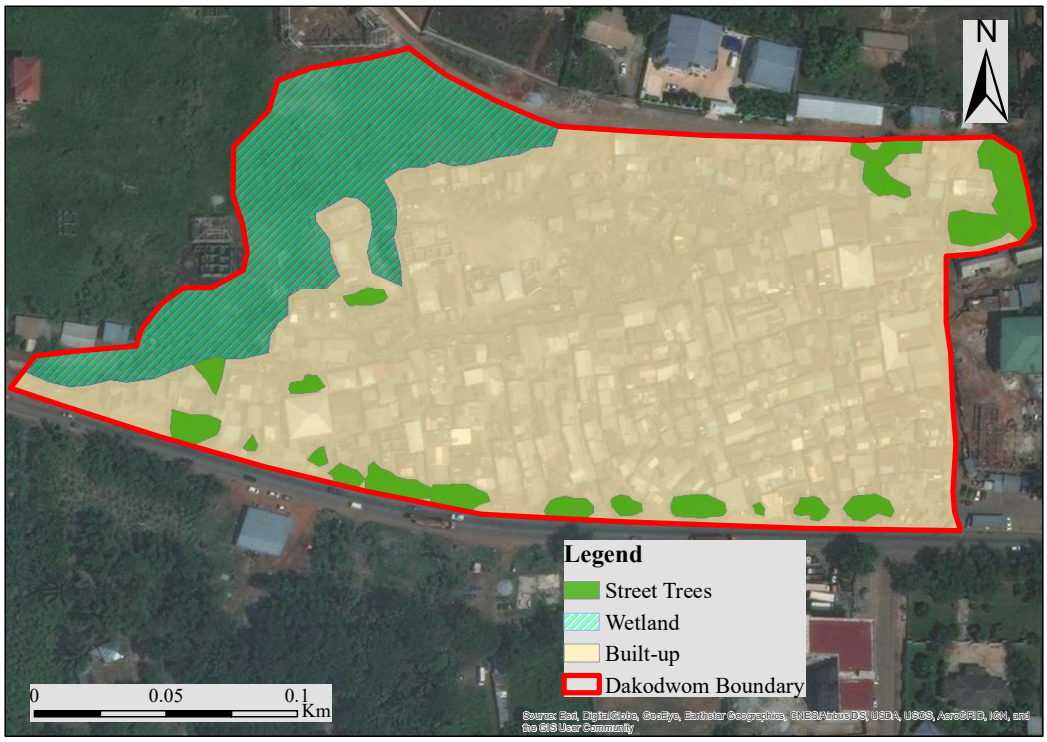

Figure 4.1: UGS map of Dakodwom
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community, 2021

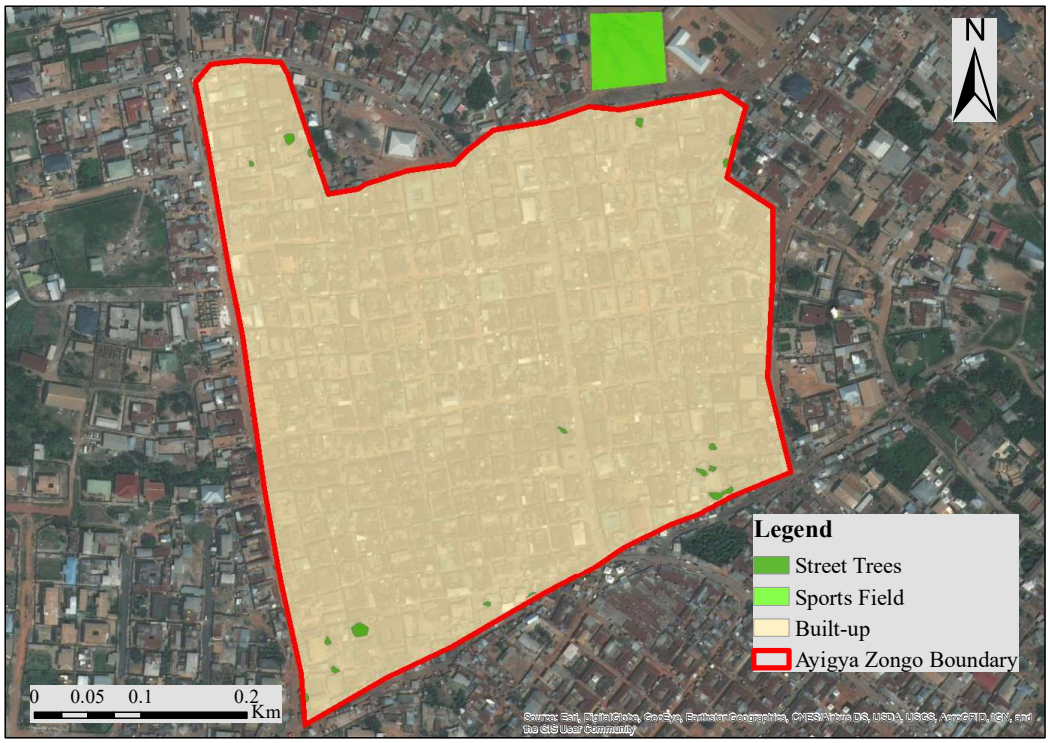

Figure 4.2: UGS map of Ayigya Zongo
(*Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community, 2021)*

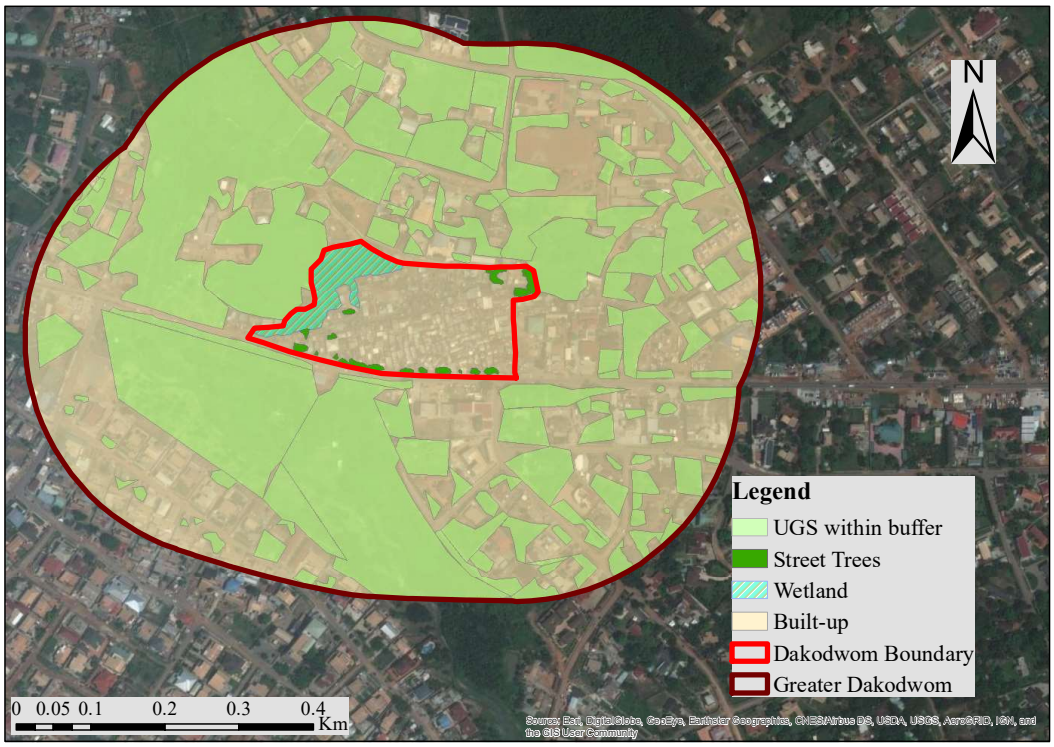

Figure 4.3: UGS map of Dakodwom considering 300 m buffer from boundary
(*Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community, 2021)*

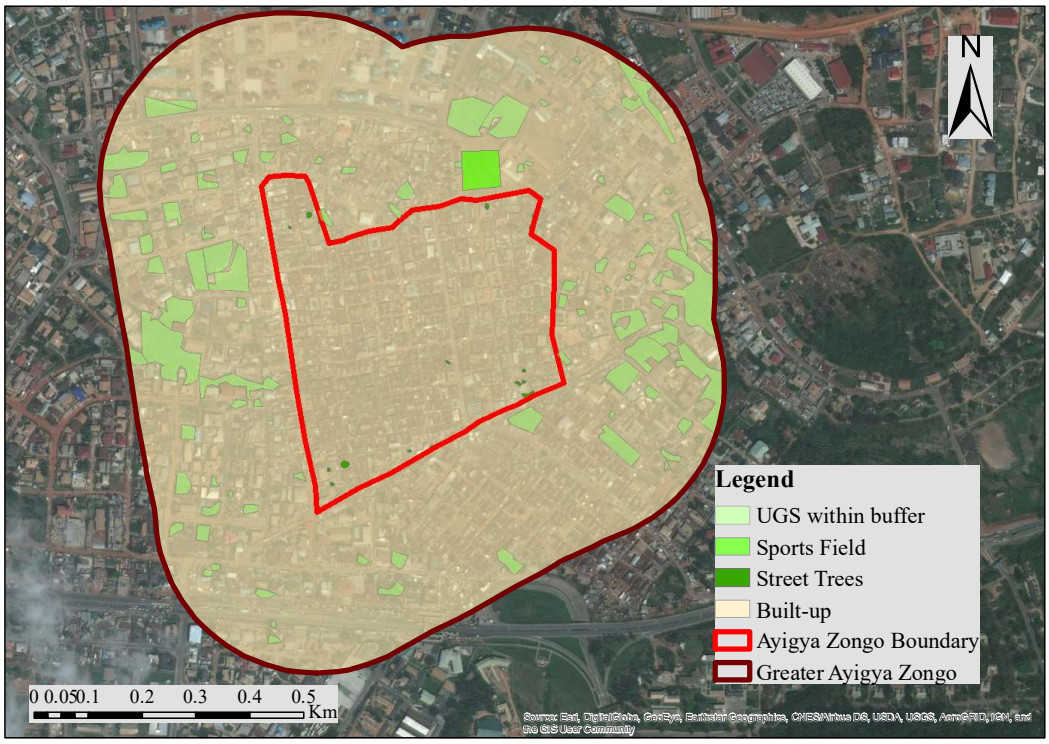

Figure 4.4: UGS map of Ayigya Zongo considering 300 m buffer from boundary
(*Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community, 2021)*

Furthermore, the results of the household survey (Figure 4.5) incorporated the perspectives of the respondents in determining the available UGS in both Dakodwom and Ayigya Zongo. The results confirmed the available UGS measured from the satellite images of the two case study areas. However, a new type of UGS was identified by the respondents which is garden. This was not captured in both areas from the satellite images. It can be attributed to the fact that some of these gardens are mainly located at the balconies and corridors of the residents especially in Dakodwom (see Figure 4.6). The availability of gardens in Dakodwom was confirmed by a Senior Lecturer of the DoP, KNUST, Kumasi, Ghana (1):

> *"…some of them [residents] also try to undertake or cultivate some kind of food stuffs within their space to supplement their incomes and these in a way provide some of the green areas" …*
>
> *Source: Author's Key Informant Interview, 2021*

For Dakodwom, 96.2% of the respondents expressed that street trees are available in the area (Figure 4.5). Moreover, 92.4% and 22.9% of the respondents indicated that there are wetlands and gardens respectively in Dakodwom (Figure 4.5). On the other side, 90.8% of the respondents in Ayigya Zongo identify sports field to be available for use by residents in the area (Figure 4.5). A small percentage of the respondents confirmed the availability of street trees (14.2%) and gardens (0.7%) in Ayigya Zongo (Figure 4.5). Also, only 1.0% and 2.1% of the respondents perceived that there is no UGS available in Dakodwom and Ayigya Zongo respectively. In general, a comparison between the results from the satellite images and the household survey shows that there is a relatively higher available UGS in Dakodwom than Ayigya Zongo. A *t*-test analysis between the responses (frequencies) for the two areas shows no statistical difference for each of the perceived available UGS (street trees – *t*-value=-0.79, *p*-value=0.58; sports field – *t*-value=1.00, *p*-value=0.50; gardens – *t*-value=-0.96, *p*-value=0.51; wetlands – *t*-value=1.00, *p*-value=0.50) (*t*-value=-0.46 and *p*-value=0.66). Figure 4.6 shows pictorial evidence of the four types of UGS available in the areas.

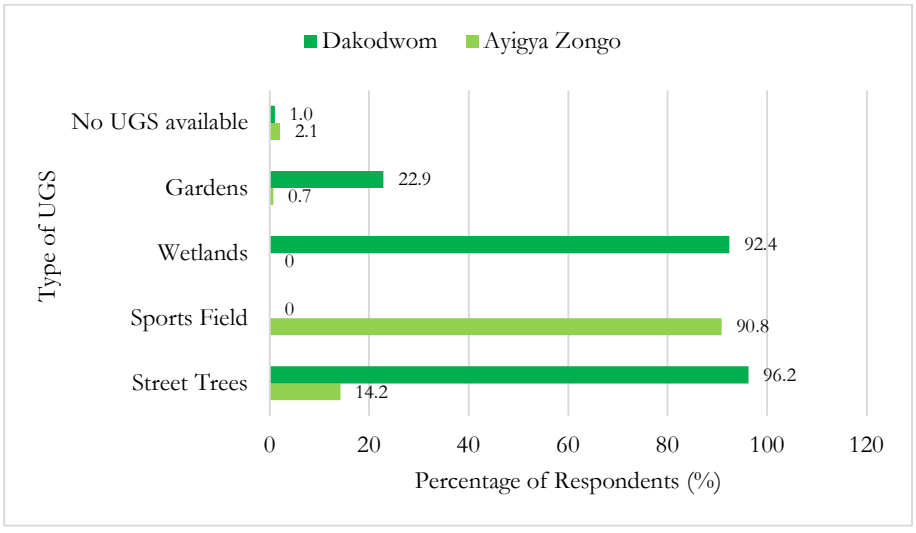

Figure 4.5: Available UGS by respondents
Source: Author's Household Survey, 2021

Figure 4.6: Pictorial evidence of available UGS in the case study areas. Street trees in Dakodwom (A); Wetland in Dakodwom (B); Garden in Dakodwom (C) and Sports field in Ayigya Zongo (D)
Source: Author's Fieldwork, 2021

4.2.2. Estimated distance from residential houses to the nearest UGS

Accessibility to green spaces is one of the factors that influence the level of supply of associated benefits (Stessens, Khan, Huysmans, & Canters, 2017; Van de Voorde, 2017; Vîlcea & Şoşea, 2020). The analysis here shows the accessibility to the nearest available UGS from residences within Dakodwom and Ayigya Zongo. The results from the GIS network analysis show that all the residents in Dakodwom (100%) travel distances (less than 100 m) shorter than the maximum range (0-300 m) to the nearest UGS from their homes (Handley et al., 2003). (see Figure 4.7 and Table 4.3). On the part of Ayigya Zongo, 59.9% and 40.1% of the residents have access to the nearest UGS within distances less than 100 m and 100-300 m respectively (see Figure 4.8 and Table 4.3). This implies that a larger share of the residents in both areas has access to available UGS within an acceptable distance (0-300 m). The relatively smaller sizes of the

two areas with walking distances can be attributed to this finding. Overall, there are shorter travel distances to available UGS in Dakodwom compared to Ayigya Zongo.

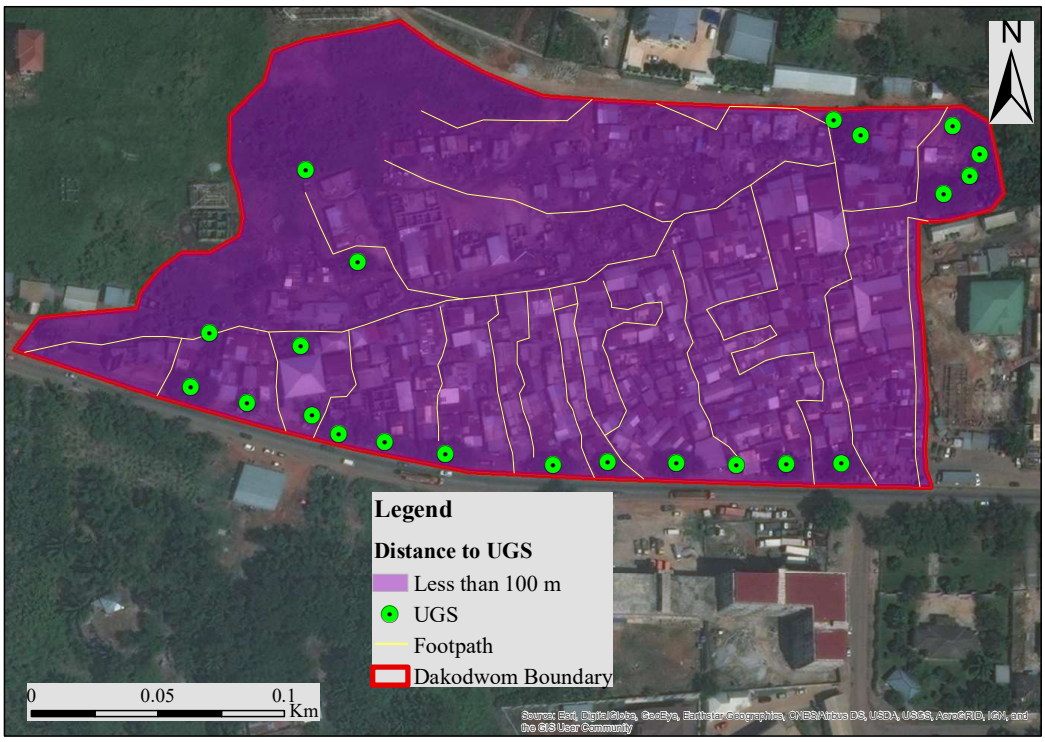

Figure 4.7: Distance to available UGS in Dakodwom
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community, 2021)

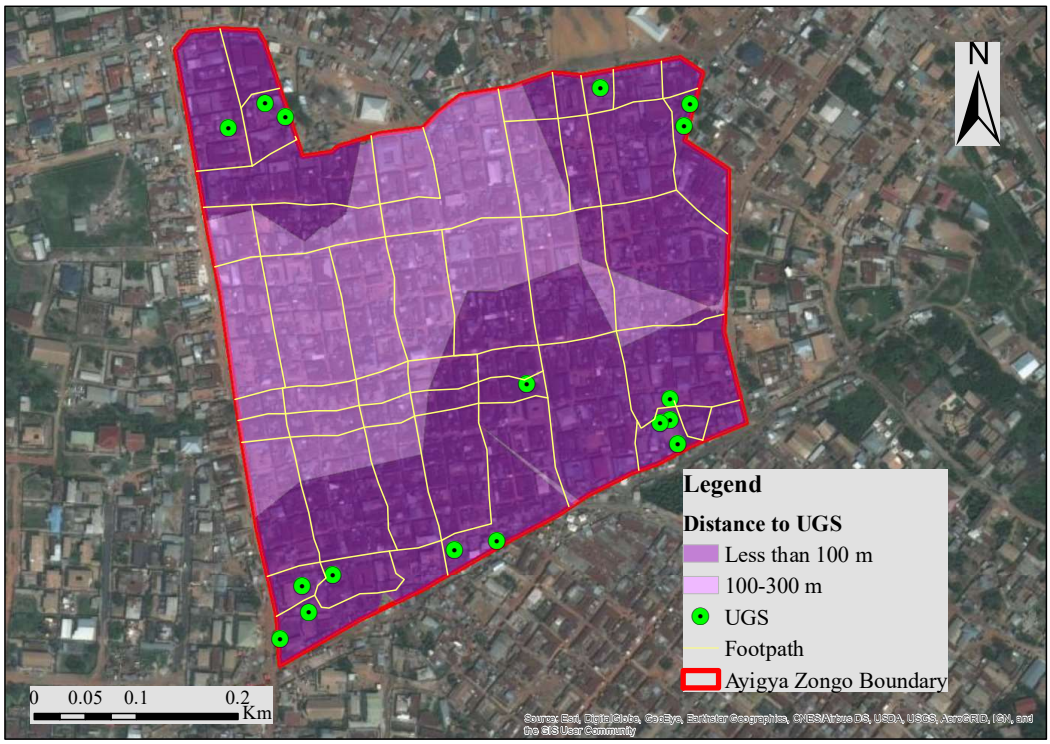

Figure 4.8: Distance to available UGS in Ayigya Zongo

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community, 2021)

Table 4.3: Residents' distances for accessing nearest UGS

	Dakodwom		Ayigya Zongo	
Distance to UGS	**Population with access**	**%**	**Population with access**	**%**
Less than 100 m	2223	100	4,402	59.9
100-300 m	-	-	2,942	40.1
Total	**2223**	**100**	**7,344**	**100**

Source: Based on Author's estimation, 2021

A further analysis based on the perspectives of the respondents was carried out to determine the estimated distances to the nearest UGS from their residences in both Dakodwom and Ayigya Zongo. The results show that the majority of the respondents in Dakodwom (55.2%) expressed having access to the nearest UGS from their residential houses within a distance of less than 100 m. In total, 83.8% of the respondents expressed that they have access to the nearest UGS within a distance of 0-300 m in Dakodwom (see Table 4.4). For Ayigya Zongo, a larger share of the respondents (39.0%) indicated that they have access to the nearest UGS within a distance of 101-300 m. In sum, 69.5% of the respondents also expressed that they have access to the nearest UGS within a distance of 0-300 m (see Table 4.4). The results do not deviate from those of the GIS analysis. However, in both areas, some of the respondents perceived having access to the nearest UGS from their homes with distances more than 300 m while the GIS analysis shows that they are all within an acceptable range. This shows that the respondents perceived longer distances to the nearest UGS, but they are rather within shorter distances.

Table 4.4: Estimated distance from residential houses to the nearest UGS by respondents

	Dakodwom (N=105)			Ayigya Zongo (N=141)		
Distance to UGS	**Frequency**	**Percentage (%)**	**Cumulative (%)**	**Frequency**	**Percentage (%)**	**Cumulative (%)**
1. Less than 100 m	58	55.2	55.2	43	30.5	30.5
2. 100-300 m	30	28.6	83.8	55	39.0	69.5
3. 301-600 m	13	12.4	96.2	29	20.6	90.1
4. 601-900 m	3	2.9	99.1	8	5.7	95.8
5. 901 m and above	-	-	-	3	2.1	97.9
6. No UGS available	1	0.9	100	3	2.1	100
Total	**105**	**100**		**141**	**100**	

Source: Author's Household Survey, 2021

4.2.3. Available ES of UGS perceived by respondents

In assessing the supply level of ES of UGS in the areas, the respondents were allowed to select or list all ES they perceive to be available in their areas. Therefore, multiple responses were possible from any one of the respondents. The results of the household survey (Table 4.5) show that regulating services (53.1%) are perceived to be more available in Dakodwom. In this regard, temperature regulation is perceived to be the highest in Dakodwom (33.3%) by the respondents. On the other hand, cultural services (85.5%) are perceived to be more available in Ayigya Zongo (see Table 4.5). Recreational activities are the perceived highest cultural ES (78.7%) available in Ayigya Zongo by the respondents (see Table 4.5). In general, a relatively higher percentage of the respondents perceived provisioning ES to be available in Dakodwom than Ayigya Zongo (see Table 4.5). A *t*-test indicates that the responses (frequencies) between the two areas for regulating services vary significantly (*t*-value=6.48 and *p*-value=0.00) while those of the provisioning and cultural services are not significant (see Table 4.5). In support of the results for Dakodwom, a Senior Development Planning Official of the KMA expressed that:

> *"… the few available green spaces in Dakodwom serve as a source of windbreak for the residents. Also, because the area [Dakodwom] is crowded the available green spaces help in circulating air in the area …".*
>
> *Source: Author's Key Informant Interview, 2021*

A respondent in Ayigya Zongo also mentioned that: *"since a lot of activities are carried out on the [sports] field, it helps in meeting people which is very nice" (Source: Author's Household Survey, 2021).* However, the Oforikrom Physical Planning Official was of the view that since the current state of Ayigya Zongo does not make provision for green spaces, it is difficult to determine which ES residents benefit from in the area:

> *"The current state of Ayigya Zongo does not make much provision for UGS…The people [residents of Ayigya Zongo] prefer putting in more physical structures even within their private spaces than green spaces that will help promote environmental health within their spaces". Therefore, one cannot tell which benefits [ES] they [residents of Ayigya Zongo] derive from green spaces".*
>
> *Source: Author's Key Informant Interview, 2021*

A comparison between the views of the key informant and the respondents of Ayigya Zongo shows that regardless of the few or the non-existence of UGS in the area, the residents perceived to be deriving some form of benefits. However, from the perspective of the key informant, such benefits are generally not available in the area.

Table 4.5: Available ES of UGS perceived by respondents

		Dakodwom (N=105)		Ayigya Zongo (N=141)	
Ecosystem Service		**Frequency**	**%**	**Frequency**	**%**
Provisioning					
Medicinal plants		23	21.9	4	2.8
Food		15	14.3	7	5.0
Wood fuel		9	8.6	1	0.7
Livestock grazing and fodder		5	4.8	1	0.7
Total		**52**	**17.9**	**13**	**4.8**
t-value	**2.34**				
sig.	**0.08**				
Regulating					
Temperature regulation		35	33.3	8	5.7
Water flow and runoff regulation		27	25.7	-	-
Erosion control		21	20.0	3	2.1
Air quality regulation		34	32.4	6	4.3
Noise reduction		20	19.0	4	2.8
Windbreak		17	16.2	5	3.5
Total		**154**	**53.1**	**26**	**9.7**
t-value	**6.48**				
sig.	**0.00***				
Cultural					
Recreation		10	9.5	111	78.7
Aesthetics		18	17.1	15	10.6
Social cohesion		25	23.8	33	23.4
Sense of place		15	14.3	25	17.7
Heritage, cultural and historical values		16	15.2	46	32.6
Total		**84**	**29.0**	**230**	**85.5**
t-value	**-1.70**				
sig.	**0.16**				
Total all frequencies		**290**		**269**	

*Statistical significance at 0.05 level (2-tailed)

Source: Author's Household Survey, 2021

Additionally, the respondents associated the ES perceived to be available with the type of UGS that they regard for providing such services in the areas. In total, 65% of the ES perceived to be available in Dakodwom were associated with street trees (see Figure 4.9). Regulating services were the most associated ES with the street trees in Dakodwom, followed by cultural services, with provisioning services being the least (see Figure 4.9). The wetland in Dakodwom was associated with 22% of the perceived ES including provisioning services (medicinal plants and livestock grazing and fodder) and regulating services (water flow and runoff regulation and erosion control) (see Figure 4.9). Moreover, 13% of the ES in Dakodwom were associated with the available gardens which included provisioning services (food) and cultural services (recreation and aesthetics) (see Figure 4.6). In confirmation of the results, one respondent in Dakodwom mentioned that: *"…the available street trees for example help in cooling the environment…" (Source: Author's Household Survey, 2021).*

For Ayigya Zongo, a larger share of the perceived ES (86%) was associated with the available sports field in the area with cultural services being the most (see Figure 4.9). Also, 10% of the ES in Ayigya Zongo were associated with the few available street trees in the area with regulating and provisioning services being the majority (see Figure 4.6). Furthermore, only 4% of the perceived ES in Ayigya Zongo were associated with gardens in the area which consisted of provisioning services (medicinal, plants, food, and livestock grazing and fodder) (see Figure 4.9). The quote from one of the respondents in Ayigya Zongo is

that: *"…we undertake sporting activities and exercises on the sports field" (Source: Author's Household Survey, 2021).* The above results show that although there are few available UGS in both areas; however, the residents are of the view that they enjoy different kinds of ES from them.

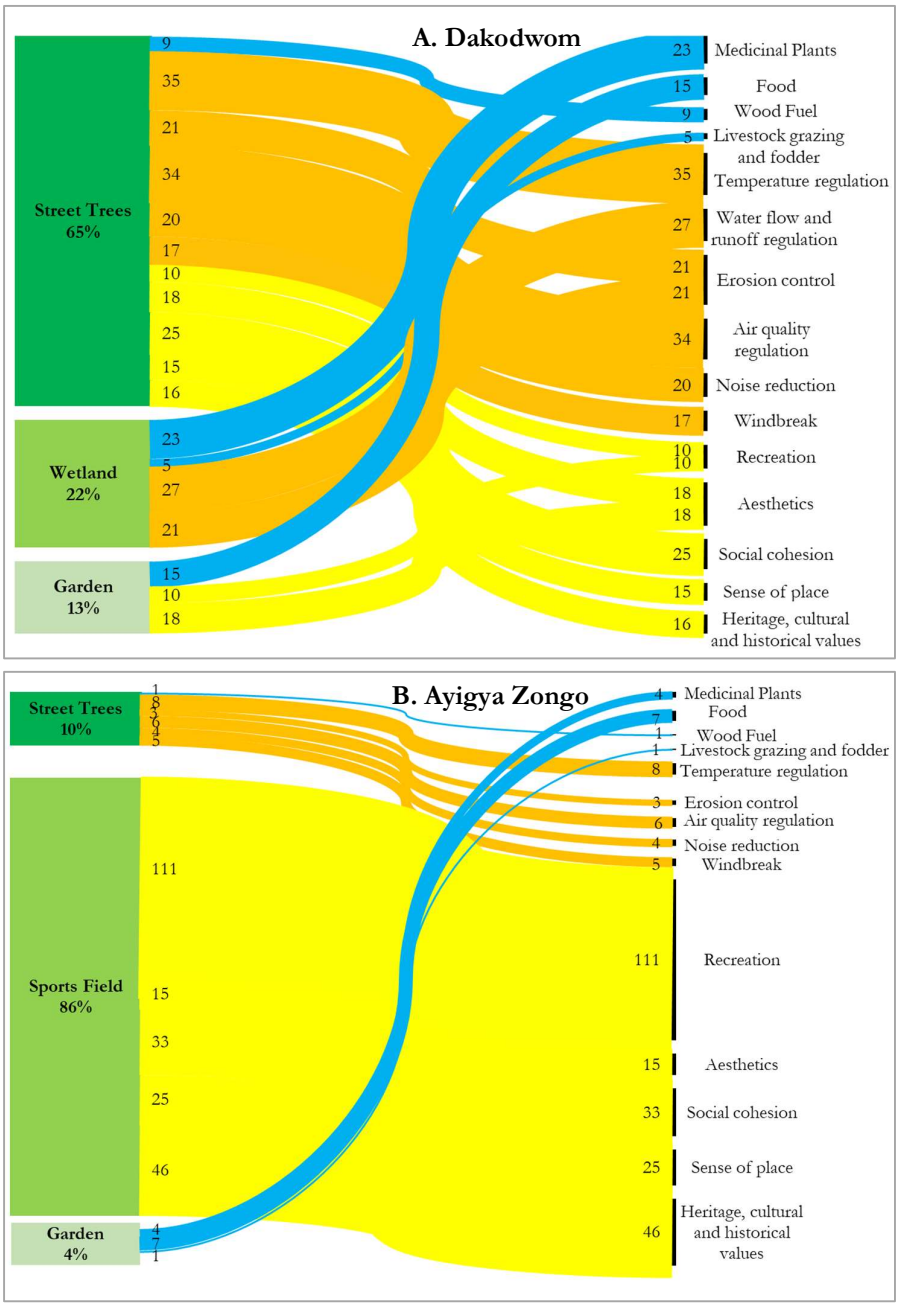

Figure 4.9: Available UGS and provided ES: Blue colour represents provisioning services; Orange colour represents regulating services and Yellow colour represents cultural services
Source: Author's Household Survey, 2021

4.2.4. Perception on the current state of UGS for ES provision by respondents

In order to assess the current state of the available UGS for ES provision, the quality of the UGS was considered. Three main criteria were used for the assessment, these are freedom from garbage, freedom from crime, and availability of vegetation cover (see Table 3.1). Based on these criteria, the respondents rated the current state of available UGS in both areas for ES provision. This rating was based on a five-point Likert scale ranging from very bad (1) to very good (5).

The results of the study show that the majority of the respondents in both Dakodwom (71.4%) and Ayigya Zongo (61.0%) perceived the available UGS to be either good or very good in terms of freedom from garbage (see Figure 4.10). Furthermore, 77.2% and 58.2% of the respondents respectively in Dakodwom and Ayigya Zongo expressed that the available UGS in the areas are good or very good considering freedom from crime (see Figure 4.10). However, a larger share of the respondents in both Dakodwom (52.4%) and Ayigya Zongo (34.0%) perceived the availability of vegetation cover to be either bad or very bad (see Figure 4.10). Surprisingly, a relatively higher percentage of the respondents in Dakodwom gave a negative assessment for the availability of vegetation cover than Ayigya Zongo. It is interesting to note that there are more available UGS in Dakodwom compared to Ayigya Zongo. The results of the study indicate that a higher percentage of the respondents (31.2%) in Ayigya Zongo was uncertain in perceiving the availability of vegetation cover than Dakodwom (17.1%). This could be attributed to the finding. Also, an expression made by the Oforikrom Physical Planning Official on Ayigya Zongo suggests that the residents are more interested in building physical structures than creating or managing green spaces. Hence, the inadequate UGS is not of much concern to the respondents. As a result, this could also be an influencing factor affecting their perceptions on the availability of vegetation cover in the area.

> *"… also, people are more interested in the physical structures than the soft landscape or green spaces. People prefer putting in more physical structures even within their private spaces than green spaces that will help promote environmental health within their spaces".*
>
> *Source: Author's Key Informant Interview, 2021*

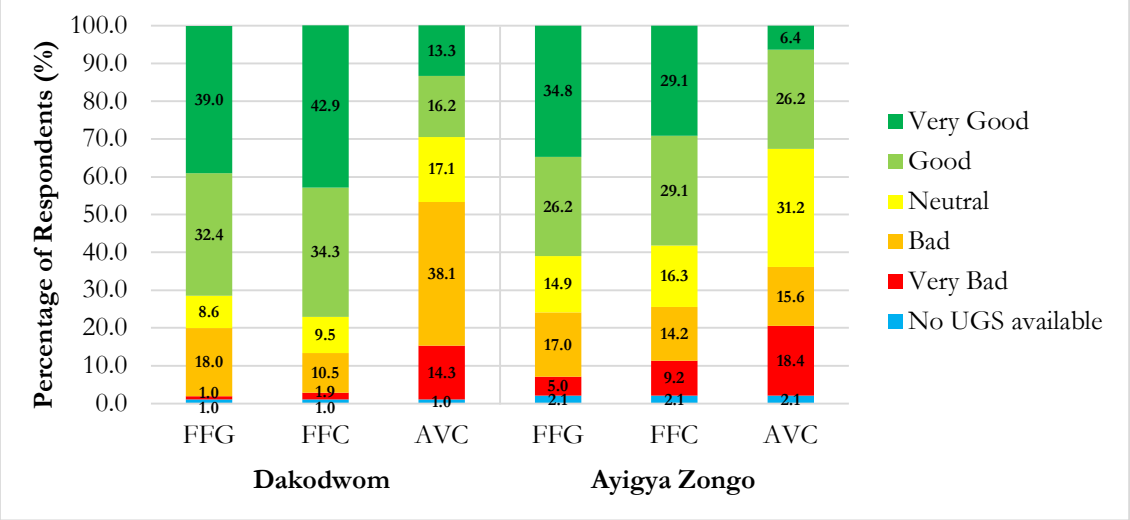

Figure 4.10: Perception on the current state of UGS for ES provision by respondents in terms of Freedom from garbage (FFG), Freedom from crime (FFC), Availability of vegetation cover (AVC)
Source: Author's Household Survey, 2021

Further statistical analysis of the study also shows that a relatively higher percentage of respondents in Dakodwom (mean=3.91) gave a positive perception about the available UGS being free from garbage compared to Ayigya Zongo (mean=3.70) (see Table 4.6). A *t*-test analysis shows no statistical difference between the responses of the two areas (see Table 4.6). Regardless, the CoV shows a relatively higher variation in the responses of Ayigya Zongo than Dakodwom (see CoV in Table 4.6). Moreover, a higher percentage of the respondents also gave positive feedback on the absence of crime in the available UGS in Dakodwom (mean=4.07) compared to Ayigya Zongo (mean=3.56). In addition, a *t*-test analysis shows a statistical difference between the responses of Dakodwom and Ayigya Zongo (*p*-value=0.00). Also, there is a relatively higher variation in the individual responses in terms of freedom from crime in Ayigya Zongo than Dakodwom (see CoV in Table 4.6). On the side of availability of vegetation cover, comparatively, a higher percentage of the respondents in Dakodwom (mean=2.76) expressed a negative view on the available UGS than Ayigya Zongo (mean=2.86) (see Table 4.6). There is no statistical difference considering the responses of the two areas (see Table 4.6). However, there is a relatively higher variation in the responses of Dakodwom compared to Ayigya Zongo. In summary, the results of the study show that the available UGS in the two areas are free from garbage and crime as perceived by the respondents. On the contrary, the available UGS in both areas have few vegetation covers which was perceived by the respondents. This finding affirms earlier ones where it has been emphasized that there are few available greens in the areas especially Ayigya Zongo (see sub-Section 4.2.1).

In addition, a Chi-square test was applied to ascertain the factors that affect the perceptions of the respondents on the current state of UGS in both areas. The demographic characteristics and other supply variables were considered. The results show that there is a significant association between gender (*p*-value=0.025) and the rating on freedom from garbage in Dakodwom (see Appendix 6a). Overall, more females gave a positive rating on the aspect. Moreover, the association between the UGS being free from garbage and the perceived types of available green spaces (*p*-value=0.005) is statistically significant in Ayigya Zongo (see Appendix 6a). A higher perceived sports field availability is associated with a positive ranking on freedom from garbage. In terms of freedom from crime, there is a significant association with the estimated distance to the available UGS (*p*-value=0.005) in Dakodwom (see Appendix 6a). Shorter travel distances are highly associated with a positive perception on freedom from crime in Dakodwom. Also, there is a significant association between the perceived types of available UGS (*p*-value=0.021) and estimated distance in accessing green spaces (*p*-value=0.002), and the availability of vegetation cover criteria in Dakodwom (see Appendix 6a). In general, UGS within shorter travel distances are associated with a lower level of vegetation cover in Dakodwom. The higher perceived availability of street trees and wetland is also associated with less vegetation cover in Dakodwom.

Table 4.6: Perception on the current state of UGS for ES provision by respondents

Variable	Dakodwom	Ayigya Zongo	t-value	sig.
Freedom from Garbage			-1.34	0.18
Mean	3.91	3.70		
Standard Deviation	1.14	1.26		
CoV (%)	29.2	34.0		
Freedom from Crime			-3.25	0.00*
Mean	4.07	3.56		
Standard Deviation	1.06	1.31		
CoV (%)	26.2	36.7		
Availability of Vegetation Cover			0.64	0.52
Mean	2.76	2.86		
Standard Deviation	1.27	1.20		
CoV (%)	46.1	41.8		

*Statistical significance at 0.05 level (2-tailed)

Source: Author's Household Survey, 2021

4.2.5. Perception on the adequacy of UGS for ES provision by respondents

To ascertain the level of supply of UGS for ES provision in the two areas, the perceptions of the respondents were considered. Overall, the majority of the respondents, 72.3% and 75.2% respectively in Dakodwom and Ayigya Zongo perceived that there is no adequate UGS for ES provisions in the areas (see Figure 4.11). Hence, the results of the study show that the majority of the respondents perceived that there is a low level of supply of UGS for ES provision in both areas. The finding is confirmed by a Senior Lecturer of the DoP, KNUST, Kumasi, Ghana, and some respondents in the two areas:

> *"… to a large extent, they [green spaces] are non-existent. The only few are what nature have left or reserved for them [residents]. For instance, you have a water body traversing the space they cannot completely remove those little green areas around them. But given how scarce land is, every single space or any plot of land is a targeted space for residential development. So that makes it really difficult to provide these essential green infrastructures which are meant to support their very existence and make their living comfortable".*
>
> Senior Lecturer, DoP, KNUST, Kumasi, Ghana (1)
> *Source: Author's Key Informant Interview, 2021*

> *"The park [sports field] is the only green space serving all our needs"; "The space in the community does not give room for green spaces"; "The population exceeds the size of the park, in the sense that the population requires a bigger space"; "There are not enough space, every place have been used for buildings" …*
>
> Four respondents in Ayigya Zongo
> *Source: Author's Household survey, 2021*

> *"We [residents] do not have a field with green grasses within the community"; "Trees available are not enough and can be found only along the main road"; "Because of few available trees, the sun is very hot which affect our environment" We don't enjoy shade from trees when it is hot"; "Land are mostly used for residential purposes".*
>
> Five respondents in Dakodwom
> *Source: Author's Household survey, 2021*

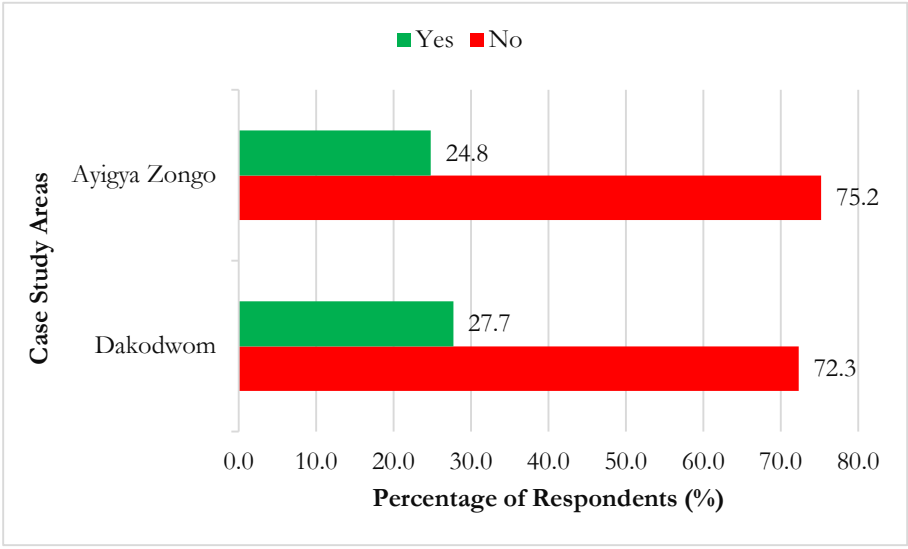

Figure 4.11: Perception on the adequacy of UGS for ES provision by respondents
Source: Author's Household survey, 2021

4.3. Demand for ES of UGS in Dakodwom and Ayigya Zongo

To assess the level of demand for ES of UGS in Dakodwom and Ayigya Zongo, attributes relating to satisfaction, needs, preference, and value for UGS were considered. Specifically, the respondents' level of satisfaction with available UGS and location, the need for additional UGS, preferred UGS and ES, and the value of UGS for ES provision. These aspects influence the demand level of ES of UGS (Burkhard et al., 2012; Hegetschweiler et al., 2017; Syrbe et al., 2017).

4.3.1. Satisfaction with UGS availability and location for ES provision by respondents

As previously mentioned, residents' level of satisfaction with available UGS and their locations affects the demand level. The respondents of the two areas expressed their levels of satisfaction concerning UGS availability and location for providing ES. These expressions were based on a five-point Likert scale ranging from very dissatisfied (1) to very satisfied (5). The results from the household survey show that a larger share of the respondents in Dakodwom (41.9%) and Ayigya Zongo (49.7%) were either satisfied or very satisfied with the number of available UGS in the areas (see Figure 4.12). The results show that despite the few available UGS in the areas, the majority of the residents are content. Some of the respondents made various claims which support the finding:

> *"There is no space and perhaps we [residents] are squatters so we are in no position to complain"; "We are content with it [green space] for now because nothing can be done since there isn't space"; "They [green spaces] are enough based on the community size"; "Because the houses here [Dakodwom] are very close to each other so I don't think there can be more [green spaces]".*
>
> Four respondents in Dakodwom
> *Source: Author's Household survey, 2021*

> *"There is no land available for such green spaces here"; "Because the place is a slum so there will not be enough space for them [green spaces]"; Due to land issues here [Ayigya Zongo], there is no room for green spaces".*
>
> Three respondents in Ayigya Zongo
> *Source: Author's Household survey, 2021*

The statements by the respondents in support of their satisfaction with the available UGS in their areas suggest that limited land space is the main influencing factor. The residents feel that since land is limited in the areas it would be difficult to accommodate green spaces; hence, they are pleased with the few that are available.

The results of the respondents' level of satisfaction with the location of the available UGS show that 74.3% of the respondents in Dakodwom and 70.2% in Ayigya Zongo are satisfied or very satisfied (see Figure 4.12). This implies that residents in both areas are happy with the distance they travel to access the available UGS. The finding supports an earlier one where it was revealed that the residents travel shorter distances to access the available UGS in the areas (see sub-Section 4.2.2). The following sentiments by some of the respondents in the areas buttress the finding:

> *"They [green spaces] are not far from my house"; "They are very close to the place where I leave"; "It [green space] is just a short walking distance to the area".*
>
> Three respondents in Dakodwom
> *Source: Author's Household Survey, 2021*

> *"The sports field is close to my house"; "The location of the [sports] field is very good for everyone and it is very accessible"; "Walking to the [sports] field is not far which is good".*
>
> Three respondents in Ayigya Zongo
> *Source: Author's Household Survey, 2021*

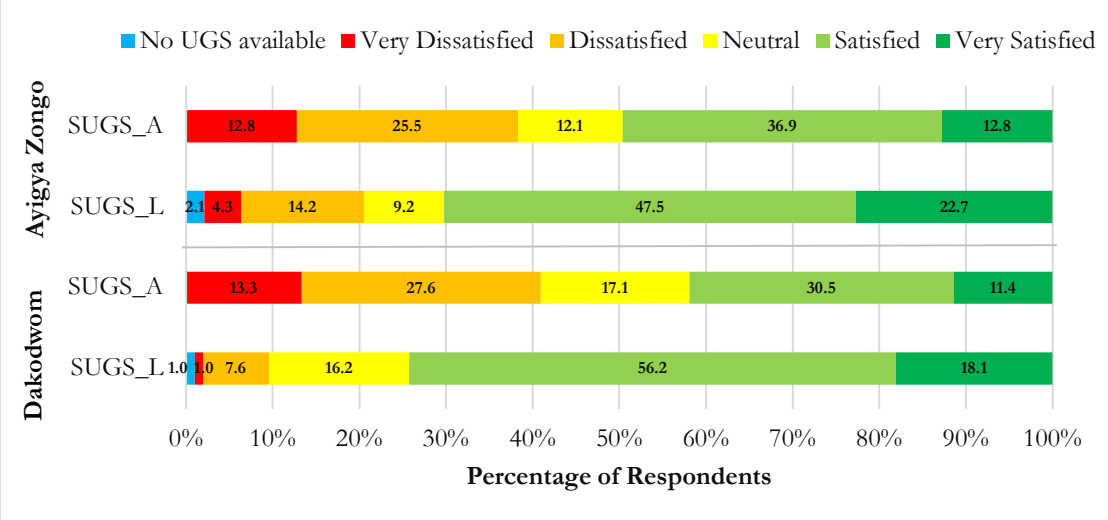

Figure 4.12: Level of satisfaction with UGS Availability (SUGS_A) and Location (SUGS_L) for ES provision by respondents
Source: Author's Household Survey, 2021

Furthermore, statistical analysis between the responses of the two areas shows that in terms of UGS availability satisfaction level, the respondents in Ayigya Zongo (mean=3.11) gave a similar positive satisfaction rate as Dakodwom (mean=2.99) (see Table 4.7). Interestingly, there are more available UGS in Dakodwom than Ayigya Zongo. This finding can be attributed to the fact that the respondents expressed not having enough space for UGS. A *t*-test shows no statistical difference between the responses of the two areas (see Table 4.7). However, there was a higher variation in the responses for Dakodwom than

Ayigya Zongo (see CoV in Table 4.7). This shows a heterogeneous situation in the areas. In the case of the level of satisfaction with the location of available UGS, there was a higher positive satisfaction level of respondents in Dakodwom (mean=3.84) than Ayigya Zongo (mean=3.72) (see Table 4.6). With a *t*-test analysis, no statistical difference was identified between the responses for both areas (see Table 4.7). Notwithstanding, there was a higher variation level in the responses of Ayigya Zongo than Dakodwom. This means that there was more consistency in the responses for Dakodwom.

Table 4.7: Level of satisfaction with UGS availability and location for ES provision by respondents

Variable	Dakodwom	Ayigya Zongo	t-value	sig.
Satisfaction with UGS Availability			0.75	0.45
Mean	2.99	3.11		
Standard Deviation	1.26	1.28		
CoV (%)	42.1	41.2		
Satisfaction with UGS Location			-0.91	0.36
Mean	3.84	3.72		
Standard Deviation	0.85	1.11		
CoV (%)	22.1	29.8		

*Statistical significance at 0.05 level (2-tailed)

Source: Author's Household Survey, 2021

Additionally, the factors that might have influenced the level of satisfaction of the respondents were analysed with the Chi-square test. The results show that there is a significant association between respondents' satisfaction level on UGS availability and their education level (*p*-value=0.034) and the estimated distance to available green spaces (*p*-value=0.000) in Dakodwom (see Appendix 6b). The larger share of the respondents with a lower level of education expressed positive satisfaction. Also, those with shorter travel distances gave higher satisfaction levels. On the side of Ayigya Zongo, the perceived types of available UGS (*p*-value=0.002) and estimated distance to such green spaces (*p*-value=0.000) are significantly associated with satisfaction level on UGS availability (see Appendix 6b). There is a higher satisfaction rate associated with the perceived available sports field in the area. Furthermore, the respondents with shorter travel distances in accessing green spaces gave a higher satisfaction level. Similarly, with regard to satisfaction with UGS location, there is a significant association with estimated distance to UGS (*p*-value=0.000) and the perceived available types of green spaces (*p*-value=0.016) in Ayigya Zongo (see Appendix 6b). Hence, the shorter the distance the higher the satisfaction level with the UGS location. Equally, the higher the perceived availability of sports field the higher the respondents are satisfied with the location.

4.3.2. Demand for additional UGS for ES provision by respondents

The household survey results show that majority of the respondents in both Dakodwom and Ayigya Zongo expressed the need for additional UGS in their areas. In total, 59.0% and 68.8% of the respondents in Dakodwom and Ayigya Zongo respectively show interest in additional UGS in the areas (see Figure 4.13). The results show that a relatively higher percentage of the respondents in Ayigya Zongo see the need for additional UGS for ES provision than Dakodwom. This finding implies that although the residents are satisfied with the available UGS, they still see the need for more especially in Ayigya Zongo.

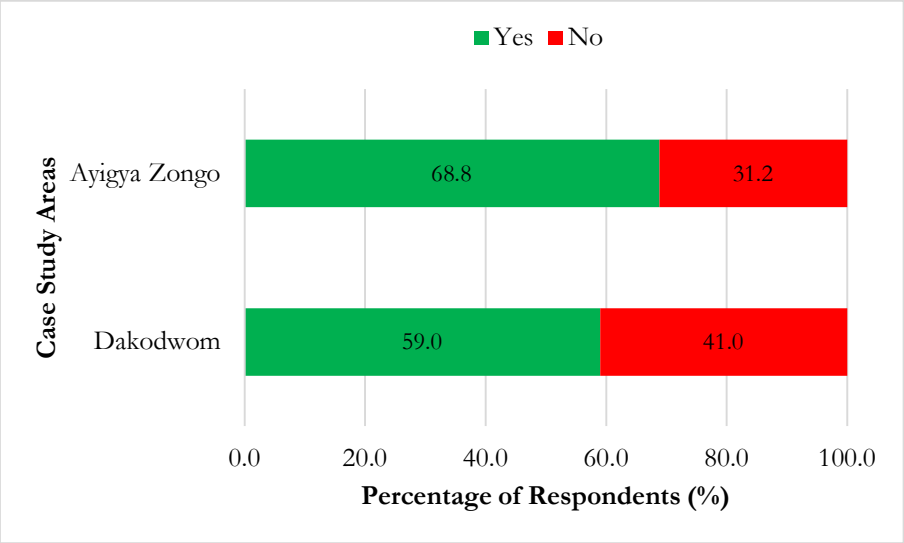

Figure 4.13: Demand for additional UGS by respondents
Source: Author's Household Survey, 2021

A further analysis was carried out based on the demographic characteristics of the respondents to determine the category of people who are demanding for additional UGS to provide ES in both areas (see Table 4.8). The results show that for the gender category, the proportion of males (59.1%) and females (59.0%) demanding for more UGS are similar in Dakodwom. Contrarily, in Ayigya Zongo, the percentage of females (73.3%) is higher than males (61.9%). Furthermore, the percentage of females (41.0%) in Dakodwom who do not see the need for more UGS is also similar to males (40.9%). However, there is a higher percentage of males (38.2%) than females (26.7%) in Ayigya Zongo. The analysis indicates that a higher percentage of males and females in Ayigya Zongo demand for more UGS than Dakodwom. These findings corroborate the results of Figure 4.13 where a higher percentage of the respondents are demanding for more UGS in Ayigya Zongo than Dakodwom.

The age groups of the respondents demanding for additional UGS were also considered. The results show that a higher percentage of the respondents in the 26-25 age cohort demand for more UGS in both Dakodwom (71.1%) and Ayigya Zongo (78.0%) (see Table 4.8). This is followed by those in the 56-65 age cohort for Dakodwom (63.6%) and the 18-25 age cohort for Ayigya Zongo (77.8%) (see Table 4.8). This shows that a higher percentage of the youth in Ayigya Zongo expressed the need for extra UGS compared to Dakodwom. Moreover, a relatively higher percentage of the youth (18-45 age cohort) and older people (46-66+ age cohort) are not demanding for more UGS in Dakodwom compared to Ayigya Zongo (see Table 4.8).

Additionally, the highest level of education attained by the respondents was also considered in assessing the demand for additional UGS. The household survey results show a higher percentage of the respondents with a basic education demanding for more UGS in both Dakodwom (61.2%) and Ayigya Zongo (74.1%) (see Table 4.8). It is also important to note that there is a higher percentage of the respondents who have post middle education expressing the need for extra UGS in Ayigya Zongo (80.0%) with none in Dakodwom (see Table 4.8). In general, a higher percentage of the respondents with no formal and basic education demand for additional UGS than those with post middle, secondary, and tertiary education in Dakodwom (see Table 4.8). This implies that the residents with a lower level of education see the need for more UGS than those with higher education levels in Dakodwom. However, the opposite of this finding exists in Ayigya Zongo (see Table 4.8).

Table 4.8: Demand for additional UGS considering demographic characteristics of respondents

	Dakodwom (N=105)				Ayigya Zongo (N=141)			
UGS Demand	**Yes**	**%**	**No**	**%**	**Yes**	**%**	**No**	**%**
Gender								
Male	26	59.1	18	40.9	34	61.8	21	38.2
Female	36	59.0	25	41.0	63	73.3	23	26.7
Total	**62**	**59.0**	**43**	**41.0**	**97**	**68.8**	**44**	**31.2**
Age								
18-25	4	44.4	5	55.6	21	77.8	6	22.2
26-35	27	71.1	11	28.9	32	78.0	9	22.0
36-45	13	54.2	11	45.8	19	55.9	15	44.1
46-55	9	50.0	9	50.0	13	61.9	8	38.1
56-65	7	63.6	4	36.4	9	69.2	4	30.8
66+	2	40.0	3	60.0	3	60.0	2	40.0
Total	**62**	**59.0**	**43**	**41.0**	**97**	**68.8**	**44**	**31.2**
Highest Level of Education Attained								
1. No Formal Education	10	58.8	7	41.2	18	58.1	13	41.9
2. Basic (Primary, Middle and JSS/JHS)	30	61.2	19	38.8	40	74.1	14	25.9
3. Post Middle/ Sec. Cert./Diploma (Teacher training/ College of education, Agric, Nursing, University Diploma, HND, etc)	0	0	2	100.0	4	80.0	1	20.0
4. Secondary (SSS/SHS and Secondary)	22	61.1	14	38.9	30	68.2	14	31.8
5. Tertiary (Bachelor's Degree and Postgraduate or higher)	0	0	1	100.0	5	71.4	2	28.6
Total	**62**	**59.0**	**43**	**41.0**	**97**	**68.8**	**44**	**31.2**

Source: Author's Household Survey, 2021

4.3.3. Type of UGS demanded for by respondents

Since preferences influence the demand for UGS of ES (Hegetschweiler et al., 2017); it was worthwhile to assess the type of UGS that residents demand for in both areas. The respondents demanding for additional UGS (Figure 4.13) identified the types of UGS they want. Table 4.9 shows that a higher share of the respondents demanding for additional UGS expressed the need for sports field in both Dakodwom (45.7%) and Ayigya Zongo (48.5%). One of the respondents in Dakodwom stated that*: "If there is one [sports field] available for the kids it will be cool" (Source: Author's Household Survey, 2021).* Another respondent in Ayigya Zongo also expressed that: *"With our [residents] population, it [sports field] is too small for us [residents] when we [residents] are having activities there [sports field]" (Source: Author's Household Survey, 2021).* Under sub-Section 4.2.1, it was revealed that there is no sports field in Dakodwom while Ayigya Zongo has one available. It is therefore not surprising for a higher percentage of the respondents to demand for sports field. Furthermore, a relatively higher percentage of the respondents in Ayigya Zongo (27.0%) demand for street trees than Dakodwom (18.1%) (see Table 4.9). This can be understood since there are few available street trees in Ayigya Zongo compared to Dakodwom. Moreover, there is also a higher percentage of respondents demanding for gardens in Ayigya Zongo (26.2%) than Dakodwom (22.9%) (see Table 4.9). Wetlands are the least demanded type of UGS in both areas with Ayigya Zongo having a relatively higher percentage than Dakodwom (see Table 4.9). A *t*-test analysis between the responses (frequencies) of the two areas for all the four types of UGS shows no statistical difference (see Table 4.9). The results show a homogeneous demand for all the types of UGS in the areas.

Table 4.9: Type of UGS demanded for by respondents

	Dakodwom (N=105)		Ayigya Zongo (N=141)			
Type of UGS	**Frequency**	**Percentage (%)**	**Frequency**	**Percentage (%)**	**t-value**	**sig.**
Street Trees	19	18.1	38	27.0	-0.45	0.73
Sports Field	48	45.7	68	48.2	-0.24	0.83
Gardens	24	22.9	37	26.2	-0.29	0.80
Wetlands	1	1.0	5	3.5	-0.78	0.58

*Statistical significance at 0.05 level (2-tailed)

Source: Author's Household Survey, 2021

Furthermore, Appendix 7a presents the results considering the demographic characteristics of the respondents demanding for additional UGS, the different types they expressed the need for. The results show that in terms of gender, a similar percentage of males (18.2%) and females (18.0%) demand for street trees in Dakodwom. On the side of Ayigya Zongo, a relatively higher percentage of females (27.9%) demands for street trees than males (25.5%). For sports field, there is a higher percentage of males (52.3%) demanding for it than females (41.0%) in Dakodwom. However, in Ayigya Zongo, a higher percentage of females (48.8%) demands for sports field than males (47.3%). This situation shows that females also show interest in benefitting from the ES that sports field provides. Additionally, a higher percentage of females demands for both gardens and wetland than males in Dakodwom (see Appendix 7a). Also, in Ayigya Zongo, a higher percentage of females demands for gardens than males but the demand for wetlands was the opposite (see Appendix 7a). A relatively higher share of males in Dakodwom perceived the supply of gardens while in Ayigya Zongo females perceived it. This supports why a larger portion of females demands for gardens in Dakodwom. The finding reflects the everyday situation where generally females show more interest in engaging in backyard planting than males.

For age, a higher percentage of the respondents in the 56-65 age cohort demands for street trees in both Dakodwom (36.4%) and Ayigya Zongo (38.5%). This implies that there is a higher demand for street trees by older people in both areas. A higher percentage of the respondents in the 26-35 age cohort demands for sports field in Dakodwom (52.6%) while in Ayigya Zongo it is those in the 56-65 age cohort (61.5%). The finding shows that a higher percentage of the youth in Dakodwom demands for sports field which is different from that of Ayigya Zongo where the demand is by older people. For gardens, there is a higher percentage of demand by the respondents in the 26-35 age cohort in the two areas. Hence, gardens are highly demanded for by the youth in both Dakodwom and Ayigya Zongo. The relatively lower demand for wetlands reflects through all age groups (see Appendix 7a).

Moreover, in terms of the highest education attainment by the respondents, a higher percentage of the respondents with basic education (22.4%) demands for street trees in Dakodwom. The situation is different in Ayigya Zongo where a higher percentage of the respondents with a secondary level of education (31.8%) demands for street trees. For sports field, there are higher percentages of the respondents with a basic (49.0%) and a post middle education (60.0%) demanding for it in Dakodwom and Ayigya Zongo respectively. Also, with gardens, a higher percentage of the respondents with no formal education (29.4%) demands for it in Dakodwom while in Ayigya Zongo it is those with post middle education (60.0%). The demand for wetlands is also generally low across all educational levels in both areas (see Appendix 7a). Overall, the demand for the different types of UGS is relatively higher among those with a lower level of education compared to the higher ones. This finding supports that of sub-Section 4.3.2 considering the level of educational attainment of the respondents who expressed the need for additional UGS, especially in Dakodwom.

4.3.4. Estimated size of UGS demanded for by respondents

The size of UGS that respondents expressed their interests in was another factor that was considered to assess the demand level. The size of a sports field was used as a proxy which assisted the respondents in estimating the size of UGS they want. One sports field was estimated to be equal to 1 ha of UGS. With reference to this, an estimation of the size of UGS demanded for by the respondents was made. The results show that a larger share of the respondents demanding for additional UGS in Dakodwom (28.6%) expressed the need for UGS which are less than the size of a sports field (see Table 4.10). However, in Ayigya Zongo a larger share of the respondents expressed the need for UGS equal to the size of a sports field. In general, only a smaller share of the respondents demands for UGS which are thrice or more the size of a sports field in both Dakodwom and Ayigya Zongo (see Table 4.10). These results indicate that there is a higher demand for small-sized UGS compared to large-sized UGS in the two areas. One of the respondents in Dakodwom made a statement in support: *"Because of the space in our community [Dakodwom], it [green space] should not be big" (Source: Author's Household Survey, 2021).* Also, expression by a respondent in Ayigya Zongo affirmed the finding: *The community [Ayigya Zongo] needs just something [green space] small to enjoy the benefits…this will also protect people [residents] from being moved out of their homes as a result of limited land space" (Source: Author's Household Survey, 2021).* Moreover, the situation is more distinct in Dakodwom (mean=1.77) than Ayigya Zongo (mean=2.06) (see Table 4.10). A *t*-test analysis (Table 4.10) shows that there is no difference between the responses given for both areas. Regardless, there are variations in the individual responses for the two areas. Dakodwom has a relatively higher variation in its responses than Ayigya Zongo (see CoV in Table 4.9). This implies that the responses for Ayigya Zongo were more consistent.

Table 4.10: Estimated size of UGS demanded for by respondents

	Dakodwom (N=105)			Ayigya Zongo (N=141)		
Size of UGS	**Frequency**	**Percentage (%)**	**Cumulative (%)**	**Frequency**	**Percentage (%)**	**Cumulative (%)**
1. Less than the size of a sports field	30	28.6	28.6	36	25.5	25.5
2. Equal to the size of a sports field	20	19.0	27.6	31	22.0	47.5
3. Twice the size of a sports field	9	8.5	56.1	21	14.9	62.4
4. Thrice the size of a sports field	2	1.9	58.0	6	4.3	66.7
5. Four times the size of a sports field	1	1.0	59.0	3	2.1	68.8
6. No demand	43	41.0	100	44	31.2	100
Total	**105**	**100**		**141**	**100**	
Mean		1.77			2.06	
Standard Deviation		0.93			1.06	
CoV (%)		52.5			51.4	
t-value			1.75			
sig.			0.08			

*Statistical significance at 0.05 level (2-tailed)

Source: Author's Household Survey, 2021

Additionally, the demographic characteristics of the respondents demanding for additional UGS were used in assessing the sizes they expressed the need for (see Appendix 7b). The results show that a larger share of males (50.0%) demands for small-sized UGS (less than or equal to the size of a sports field) than females (45.9%) in Dakodwom. The situation tends to be different in Ayigya Zongo where a larger share

of females (48.9%) demands for small-sized UGS than males (45.5%). In all, there is a lower demand for large-sized UGS (thrice or more the size of a sports field) among males and females in both areas (see Appendix 7b).

Similarly, there is also a higher demand for small-sized UGS considering the ages of the respondents demanding for additional green spaces. It was revealed that a larger share of the respondents in the 26-35 age cohort demands for small-sized UGS in both Dakodwom (60.5%) and Ayigya Zongo (60.9%) (see Appendix 7b). In sum, a relatively larger share of the youth demands for small-sized UGS than older people in both areas.

For the category of the highest level of education attained, a large share of respondents with no formal education (52.9%) demands for small-sized UGS in Dakodwom. On the other side, the respondents with basic education (59.2%) have a larger share expressing the need for small-sized UGS in Ayigya Zongo. Overall, a larger share of the respondents demanding for additional UGS with a lower level of education demands for small-sized UGS than those with the higher (see Appendix 7b).

4.3.5. Preferred location for UGS by respondents

To ascertain the distance that the respondents demanding for additional UGS would like to travel for accessing green spaces and associated benefits, their preferred location was first assessed. Figure 4.14 shows that a larger share of the respondents in both Dakodwom (44.8%) and Ayigya Zongo (57.5%) prefer to have UGS with their communities. This indicates that the residents desire for UGS closer to them which are within shorter distances for direct benefits. The following expressions by some of the respondents support the finding: *"… the community [Dakodwom] do not really have green spaces so I think it would be best for us to also get some [green spaces] we can boast of …"* (a respondent in Dakodwom) (*Source: Author's Household Survey, 2021*). *"… so that the children can get a place [green space] to play, and if it [green space] is closer then we [residents] will not spend much time when going there [green space] …"* (a respondent in Ayigya Zongo) (*Source: Author's Household Survey, 2021).*

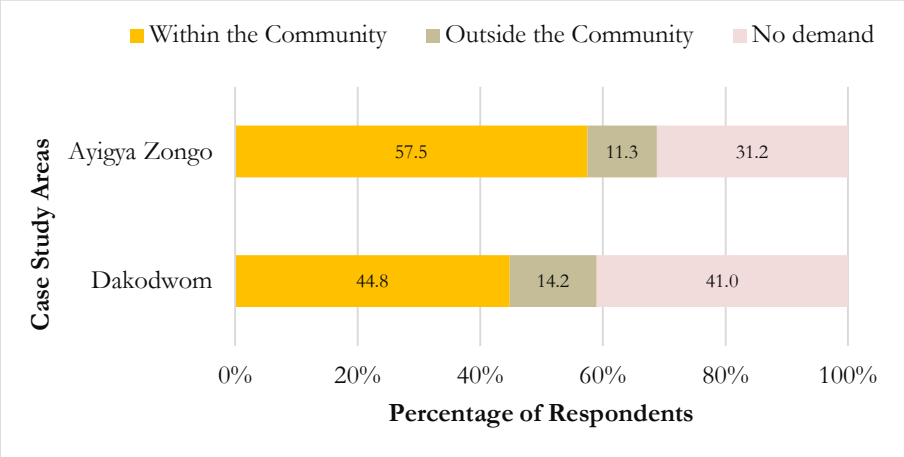

Figure 4.14: Preferred location for UGS by respondents
Source: Author's Household Survey, 2021

4.3.6. Preferred distance to the nearest UGS from residential houses by respondents

A further analysis was done to determine the distance that the respondents demanding for more UGS desire to travel to access green spaces. Table 4.11 shows that a larger share of the respondents prefers to travel shorter distances (less than 100 m and 100-300 m) for UGS access in both Dakodwom (46.7%) and

Ayigya Zongo (54.6%). Moreover, a smaller share of the respondents in Dakodwom prefers to travel a distance of 901 m or above to access UGS while none exit in Ayigya Zongo. This shows that the residents in both areas prefer UGS within shorter distances. The results confirm the respondents' choice of location for UGS in both areas (see Figure 4.11).

Table 4.11: Preferred distance to the nearest UGS from residential houses by respondents

	Dakodwom (N=105)			Ayigya Zongo (N=141)		
Distance to UGS	**Frequency**	**Percentage (%)**	**Cumulative (%)**	**Frequency**	**Percentage (%)**	**Cumulative (%)**
1. Less than 100 m	34	32.4	32.4	43	30.5	30.5
2. 100-300 m	15	14.3	46.7	34	24.1	54.6
3. 301-600 m	9	8.5	55.2	18	12.8	67.4
4. 601-900 m	3	2.8	58.0	2	1.4	68.8
5. 901 m and above	1	1.0	59.0	-	-	-
6. No demand	43	41.0	100	44	31.2	100
Total	**105**	**100**		**141**	**100.0**	

Source: Author's Household Survey, 2021

Moreover, the demographic characteristics of the respondents demanding for additional UGS were also analysed to know the preferred distances to green spaces of the different categories (see Appendix 7c). The results show that a relatively larger share of males (47.8%) prefers to travel shorter distances (0-300 m) to UGS than females (45.9%) in Dakodwom. In contrast, a larger share of females (57.0%) expressed the need for shorter distances in accessing green spaces than males (50.9%) in Ayigya Zongo. The analysis shows a variation in gender preferences for distances to UGS in the two areas.

In the case of age, the respondents demanding for additional UGS in the 26-35 (57.9%) and the 56-65 (69.3%) age cohorts have a larger share of them with preferences for shorter distances in green space access in Dakodwom and Ayigya Zongo respectively (see Appendix 7c). This implies that a larger share of the youth in Dakodwom and the older people in Ayigya Zongo prefer to travel shorter distances in accessing UGS. The finding presents a variation in age for preferred distances for green space access in the two areas.

Also, considering the level of education of the respondents demanding for more UGS, the results show that a larger share of those with no formal education (53.0%) prefers to travel shorter distances in Dakodwom (see Appendix 7c). In Ayigya Zongo, a larger share of the respondents with a preference for shorter distances has a basic level of education (61.1%) (see Appendix 7c). The preferences for shorter distances are similarly shared among those with lower and higher levels of education, especially in Ayigya Zongo.

4.3.7. ES of UGS demanded for by respondents

The respondents demanding for more green spaces were allowed to make multiple selections or list all kinds of ES of UGS they need in their areas. The results show that cultural services are the most demanded for by the respondents in both Dakodwom (41.7%) and Ayigya Zongo (79.6%) (see Table 4.12). Based on this finding, recreational activities are demanded for the most in both areas (Dakodwom (42.9%) and Ayigya Zongo (56.0%) (see Table 4.12). Comparatively, there is a relatively higher demand for cultural ES in Ayigya Zongo than Dakodwom. Moreover, regulating services are the second category of ES of UGS that are being demanded for by the respondents with a higher percentage in Ayigya Zongo (37.9%) compared to Dakodwom (22.8%); temperature regulation and air quality regulation are more prominent (see Table 4.12). Provisioning services are least demanded for by the respondents with a higher percentage in Ayigya Zongo (17.8%) than Dakodwom (10.4%) (see Table 4.12). The results show that the

residents in both areas show much interest in the socio-cultural benefits of UGS more than the environmental and economic. In general, there is a relatively higher demand for the three categories of ES in Ayigya Zongo than Dakodwom. This could be attributed to the fact that there are more available UGS in Dakodwom providing different benefits to residents compared to Ayigya Zongo (see sub-Sections 4.2.1 and 4.2.3). The results of a *t*-test analysis show no statistical difference between the responses (frequencies) of the two areas for all the three categories of ES (see Table 4.12). This shows a homogeneous demand for all three categories of ES in the areas.

Table 4.12: ES of UGS Demanded for by Respondents

		Dakodwom (N=105)		Ayigya Zongo (N=141)	
Ecosystem Service		**Frequency**	**%**	**Frequency**	**%**
Provisioning					
Medicinal plants		13	12.4	18	12.8
Food		15	14.3	20	14.2
Wood fuel		3	2.9	4	2.8
Livestock grazing and fodder		-	-	6	4.3
Total		**31**	**10.7**	**48**	**17.8**
t-value	**-0.77**				
sig.	**0.47**				
Regulating					
Temperature regulation		22	21.0	22	15.6
Water flow and runoff regulation		5	4.8	4	2.8
Erosion control		7	6.7	16	11.3
Air quality regulation		22	21.0	30	21.3
Noise reduction		4	3.8	13	9.2
Windbreak		6	5.7	17	12.1
Total		**66**	**22.8**	**102**	**37.9**
t-value	**-1.20**				
sig.	**0.26**				
Cultural					
Recreation		45	42.9	79	56.0
Aesthetics		20	19.0	21	14.9
Social cohesion		24	22.9	47	33.3
Sense of place		8	7.6	27	19.1
Heritage, cultural and historical values		24	22.9	40	28.4
Total		**121**	**41.7**	**214**	**79.6**
t-value	**-1.58**				
sig.	**0.17**				
Total all frequencies		**218**		**364**	
Total for available ES		**290**		**269**	

*Statistical significance at 0.05 level (2-tailed)

Source: Author's Household Survey, 2021

Furthermore, the demographic characteristics of the respondents demanding for more green space were used in assessing the kind of ES of UGS they demand for (see Appendix 7d). The results for gender shows that there is a higher demand for all the three categories of ES (provisioning, regulating and cultural) by females than males in both Dakodwom and Ayigya Zongo. This implies that females expressed more need for the benefits of UGS than males in both areas (see Appendix 2d).

In the case of age, there is a higher demand for all the three categories of ES by the respondents demanding for additional green spaces in the 26-35 age cohort in both Dakodwom and Ayigya Zongo (see Appendix 7d). In general, a relatively higher percentage of the three categories of ES are demanded by the

youth (18-45 age cohort) than the older age (46 and above) in both areas (see Appendix 7d). This finding suggests that the youth expressed more need for enjoying the benefits of green spaces in both Dakodwom and Ayigya Zongo.

In addition, the results in terms of the highest education attainment show that there is a higher demand for all the three categories of ES by the respondents demanding for more UGS with a basic education in both areas (see Appendix 7d). This implies that the residents with a lower level of education expressed more need for benefitting from green spaces than those with higher. However, there is no large difference between the two groups (see Appendix 7d).

4.3.8. Value of the state of UGS for ES provision by respondents

The value attached to UGS for ES provision was the last factor considered in assessing the demand level. Here, the respondents demanding for additional UGS made expressions as to how they want the state of the green spaces to be. The same criteria used in assessing the current state of the available UGS for ES provision were also applied here. The respondents' rating on the value they attach to UGS for ES provision was based on a five-point Likert scale ranging from very low (1) to very high (5). The results show that a larger share of the respondents attaches positive value to UGS which are free from garbage in both Dakodwom (56.1%) and Ayigya Zongo (55.3%) (see Figure 4.15). Moreover, 55.1% and 53.2% of the respondents expressed a high or very high value for UGS devoid of crime in Dakodwom and Ayigya Zongo respectively (see Figure 4.15). On the side of availability of vegetation cover, a positive value (high or very high) was attributed in both Dakodwom (52.3%) and Ayigya Zongo (49.8%) (see Figure 4.15). It is worthwhile to note that a relatively higher share of the respondents in Dakodwom gave a positive value for all the three criteria compared to Ayigya Zongo (see mean for both areas in Table 4.13). Furthermore, apart from freedom from garbage, a *t*-test analysis shows that there are statistical differences between the responses for the two areas regarding freedom from crime and availability of vegetation cover (see Table 4.13). This means that the responses differed base on the two criteria for both areas. Also, there are higher variations of the individual responses for all the three criteria for Ayigya Zongo than Dakodwom (see CoV for both areas in Table 4.13). The finding suggests that the responses for Dakodwom were more consistent. The following expressions were made by some of the respondents in both areas which supports the results of the analysis:

> *"We [residents]do not want bad scent around [in green spaces]"; "To motivate people for its [green space] usage"; "We [residents]do not want crimes to affect our enjoyment of the area [green space]"; "Should [green space] always be safe to access anytime of the day"; "To provide shade and comfort during usage"; "In order to make the place [Dakodwom] attractive and beautiful".*
>
> Six respondents in Dakodwom
> *Source: Author's Household Survey, 2021*

> *"To avoid sicknesses and diseases related to unclean sites [green spaces] and make room for more activities"; "For it [green space] to be always neat to prevent us [residents] from falling sick"; "For the safety of residents and even the community in general"; "For the safety of people especially children"; "There should be trees all around to help cool the environment"; "To make the place [Ayigya Zongo] nice and provide shade, fresh air, and serve as windbreaks".*
>
> Six respondents in Ayigya Zongo
> *Source: Author's Household Survey, 2021*

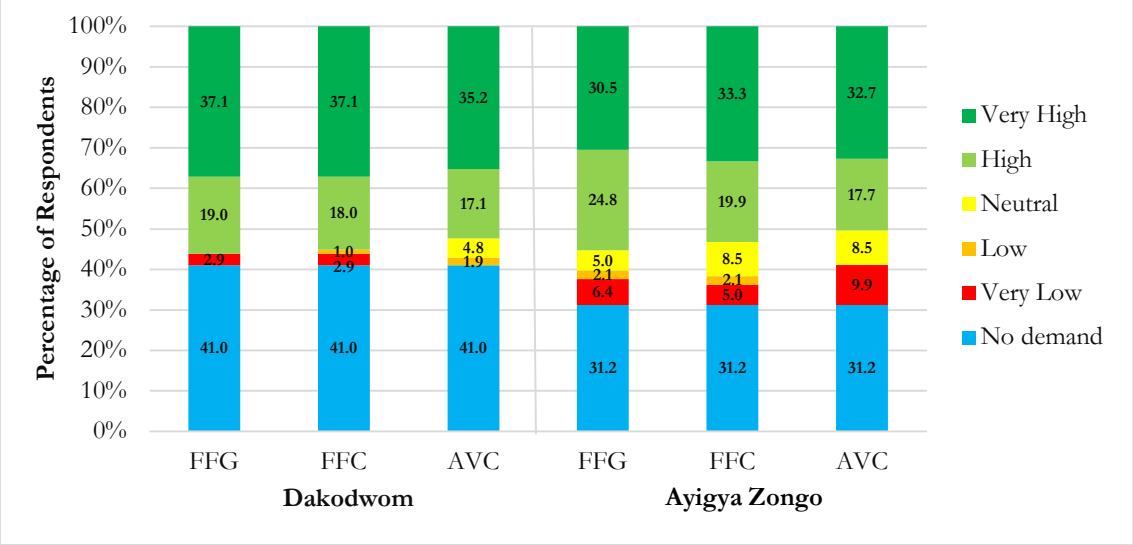

Figure 4.15: Value of the state of UGS for ES provision by respondents in terms of Freedom from garbage (FFG), Freedom from crime (FFC), Availability of vegetation cover (AVC)
Source: Author's Household Survey, 2021

Table 4.13: Value of the state of UGS for ES provision by respondents

Variable	Dakodwom	Ayigya Zongo	t-value	sig.
Freedom from Garbage			0.43	0.67
Mean	4.48	4.03		
Standard Deviation	0.92	1.22		
CoV (%)	20.5	30.3		
Freedom from Crime			-2.06	0.04*
Mean	4.45	4.08		
Standard Deviation	0.97	1.18		
CoV (%)	21.8	28.9		
Availability of Vegetation Cover			-2.77	0.01*
Mean	4.45	3.92		
Standard Deviation	0.78	1.38		
CoV (%)	17.6	35.3		

*Statistical significance at 0.05 level (2-tailed)
Source: Author's Household Survey, 2021

Equally, the demographic characteristics of the respondents demanding for more UGS was analysed to identify the values that the various groups attached to the state of green spaces for ES provision (see Appendix 7e). The results show that concerning freedom from garbage and crime, a larger share of males expressed a positive value (high or very high) than females in Dakodwom. This situation is relatively the opposite in Ayigya Zongo with a larger share of females than males. For the availability of vegetation cover, there is a similar share of males and females expressing positive value to the state of UGS for ES provision in Dakodwom. However, in Ayigya Zongo, a larger share of males gave a positive value than females (see Appendix 7e). The findings show that there are variations between the two areas in gender with regard to the value they attached to UGS for ES provision.

Moreover, with the consideration of age, it was revealed that a larger share of the respondents in the 26-35 age cohort attached positive value to the state of UGS in terms of freedom from garbage and crime in both Dakodwom and Ayigya Zongo (see Appendix 7e). With regards to availability of vegetation cover,

larger shares of the respondents in the 56-65 and the 26-35 age cohorts expressed positive value in Dakodwom and Ayigya Zongo respectively. Overall, a larger portion of the youth (18-45 age cohort) attached positive value for all the three categories than the older people (46 and above age cohort).

Additionally, with respect to the highest education attained by the respondents demanding for more UGS, a large portion of those with a secondary education gave positive value for freedom from crime and availability of vegetation cover in Dakodwom (see Appendix 7e). Also, in the case of freedom from garbage a large share of the respondents with a basic education expressed positive value (see Appendix 7e). On the side of Ayigya Zongo, a larger share of the respondents with a post middle education gave positive value for all the three criteria. In general, there is a small variation among the respondents with lower and higher education levels of education who expressed positive values, more especially in Ayigya Zongo.

4.4. Potential Gap(s) between the supply of and demand for ES of UGS in Dakodwom and Ayigya Zongo

After the assessment of the supply and demand levels of ES of UGS in Dakodwom and Ayigya Zongo, this section elaborates on the potential gap(s) existing between the two aspects. To ensure sustainable usage of natural resources including green areas, an appropriate match should be ensured between the services provided (supply) and the needs of society (demand) (Burkhard et al., 2012). Hence, the supply attributes of ES of UGS were matched with the demand to help identify potential gap(s) that prevail in the two areas.

4.4.1. Match between available UGS and population

The first step taken in identifying the potential gap(s) was to assess the relationship between the available UGS and the population of Dakodwom and Ayigya Zongo. This led to the determination of UGS per capita of the two areas. UGS per capita was initially calculated for only within the two areas and later the 300 m buffer range was added. The results show that UGS per capita for Dakodwom is 4.68 m² and 0.11 m² for Ayigya Zongo (see Table 4.14). A comparison with the World Health Organization (WHO) standard of UGS per capita of 9 m² shows a deficit of 4.32 m² and 8.89 m² for Dakodwom and Ayigya Zongo respectively (see Table 4.14). In this case, available UGS in both areas are not sufficient to meet the needs of the residents. The situation is more critical in Ayigya Zongo which has a very small size of UGS per capita compared to Dakodwom. The available UGS from the satellite images gave a clear indication that they are not enough for the residents. This was supported by the perceived available green spaces by the respondents. The finding also confirms the results presented under sub-Section 4.2.5 where the respondents perceived that the available UGS are not adequate for ES provision in their areas. Moreover, the result from the key informants interviews similarly suggest that there is a huge gap considering the level of supply of green spaces in the two areas and their population.

> *Yes, there is a huge gap since green places are largely non-existent in these areas [Dakodwom and Ayigya Zongo]. If you were using the population per capita or the number of people who require green space and you look at the densities in these areas [Dakodwom and Ayigya Zongo], then they [the population] will need to be probably provided with about twice of what you will normally find in formal areas [well-off areas] because they [Dakodwom and Ayigya Zongo]. tend to have high densities and the room occupancy rate is very high. So, there is a huge demand that has not being met.*
>
> Senior Lecturer, DoP, KNUST, Kumasi, Ghana (1)
> *Source: Author's Key Informant Interview, 2021*

What I will say is that they [green spaces] are not enough, but we shouldn't forget that there is no land available for creating such green spaces. However, since the settlements are slum areas which are crowded and haphazardly developed, ventilation is very poor and such green spaces if available will help provide them a place where at least they can get some fresh air which will also help to control the spread of communicable diseases.

Senior Development Planning Official, KMA
Source: Author's Key Informant Interview, 2021

Since these areas [Dakodwom and Ayigya Zongo] are considered as informal settlements, city authorities do not consciously provide and protect green spaces in the areas. So green spaces are encroached upon and there is no conscious investment to protect them [green spaces]. Therefore, green spaces are grossly inadequate in these areas.

Senior Lecturer, DoP, KNUST, Kumasi, Ghana (2)
Source: Author's Key Informant Interview, 2021

Of course, there is a huge gap, but I do not know how to quantify this [gap]. All I can say is that the green spaces are not adequate to meet the needs [demand] of the people in these areas [Dakodwom and Ayigya Zongo].

Physical Planning Official, PPD, KMA
Source: Author's Key Informant Interview, 2021

A further analysis considering the addition of green spaces within the 300 m buffer (see Figures 4.3 and 4.4) from the boundaries of the two areas to the existing ones within the areas show UGS per capita of 46.9 m² and 4.9 m² respectively for Dakodwom and Ayigya Zongo (see Table 4.14). This implies that although there are few available green spaces in Dakodwom, the residents can benefit from surrounding ones (Greater Dakodwom). However, they will have to share with residents within the 300 m buffer range. On the part of Ayigya Zongo, UGS within the 300 m buffer (Greater Ayigya Zongo) will still not be enough to support the residents with a per capita deficit of 4.1 m² (see Table 4.14). Comparatively, residents in Dakodwom are far better off in terms of enjoying the benefits of UGS compared to Ayigya Zongo. Hence, presenting a gap between the supply and demand levels of UGS for ES provision in Ayigya Zongo. These results conform to those of the satellite images and the perceptions of the respondents and the key informants interviews which show a lower level of UGS availability Ayigya Zongo compared to Dakodwom. Going forward, the results can be used to inform decision-making in terms of spatial planning and management of UGS in the areas.

Table 4.14: Size of available UGS and population

Area	UGS Size (m²)	Population	UGS Per Capita (m²)	UGS Per Capita Deficit (m²)
Dakodwom	10,414.9	2223	4.68	4.32
Ayigya Zongo	819.0	7344	0.11	8.89
Dakodwom + Greater Dakodwom	193,067.1	4,118	46.9	-
Ayigya Zongo + Greater Ayigya Zongo	64,231.9	13,206	4.9	4.1

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community, 2021

4.4.2. Match between the type of UGS perceived to be supplied and demanded for by respondents

The perspectives of the respondents were also considered in determining the potential gap(s) between the levels of supply of and demand for ES of UGS in Dakodwom and Ayigya Zongo**.** In this case, the perceived type of available UGS was matched with what the respondents are actually demanding for. The results (Table 4.15) show that a larger share of the respondents (45.7%) demanding for additional UGS expressed the need for sports field in Dakodwom. However, there is no available sports field in the area presenting a gap between what is available and what the residents demand for. Moreover, in Ayigya Zongo the demand for gardens (26.2%) does not meet the perceived supply (0.7%) (see Table 4.15). Also, the demand for street trees (27.0%) is higher than the perceived supply in Ayigya Zongo. This finding confirms the results presented with the satellite images and the perception of the respondents on the type UGS available in the areas (see sub-Section 4.2.1). In addition, further analysis revealed that a larger number of the respondents who perceived the availability of the types of UGS demands for less (see Table 4.16). Contrarily, a larger number of the respondents who did not perceive the availability of particular types of UGS demands for more of them (see Table 4.16). These situations generally existed in both Dakodwom and Ayigya Zongo.

Table 4.15: Type of UGS perceived to be supplied and demanded for by respondents

	Dakodwom				Ayigya Zongo			
Type of UGS	**Supply**	**%**	**Demand**	**%**	**Supply**	**%**	**Demand**	**%**
Street trees	101	96.2	19	18.1	20	**14.2**	38	**27.0**
Sport Field	0	**0.0**	48	**45.7**	128	90.8	68	48.2
Gardens	24	22.9	24	22.9	1	**0.7**	37	**26.2**
Wetlands	97	92.4	1	1.0	0	0.0	5	3.5

Source: Author's Household Survey, 2021

Table 4.16: Variation in Supply of and Demand for Type of UGS by respondents

	Dakodwom					Ayigya Zongo				
Type of UGS			**Demand**					**Demand**		
			Yes	**No**	**Total**			**Yes**	**No**	**Total**
Street trees	**Supply**	**Yes**	15	86	**101**	**Supply**	**Yes**	7	13	**20**
		No	4	0	4		**No**	31	90	121
		Total	**19**	86	105		**Total**	**38**	103	141
Sports field		**Yes**	0	0	**0**		**Yes**	60	68	**128**
		No	48	57	105		**No**	8	5	13
		Total	**48**	57	105		**Total**	**68**	73	141
Gardens		**Yes**	7	17	**24**		**Yes**	1	0	**1**
		No	17	64	81		**No**	36	104	140
		Total	**24**	81	105		**Total**	**37**	104	141
Wetlands		**Yes**	0	97	**97**		**Yes**	0	0	**0**
		No	1	7	8		**No**	5	136	141
		Total	**1**	104	105		**Total**	**5**	136	141

Low — High counts

Source: Author's Household Survey, 2021

4.4.3. Match between the estimated and the preferred distances to nearest UGS by respondents

To assess the potential gap(s) between the supply and demand levels of ES of UGS in Dakodwom and Ayigya Zongo, physical accessibility was also considered. From the perspectives of the respondents, the estimated (supply) and the preferred (demand) distances to UGS in both areas were matched to determine potential gap(s). Overall, the respondents demanding for additional UGS in both Dakodwom and Ayigya Zongo indicated their preferred distances for accessing such green spaces. The results show that a larger share of the respondents prefers to travel short distances (0-300 m) to access UGS in both areas. A comparison between the GIS analysis and the perceived estimated distances to UGS show that a higher percentage of the respondents in both areas can reach the available green spaces with shorter distances. This implies that the requirement of a large number of the respondents would be meet in the two areas in terms of physical accessibility to UGS. Hence, the key issue here will be the creation of more UGS to help reduce the pressure on the few available ones since a larger share of the residents preferred and can access them within shorter distances.

4.4.4. Match between the perceived ES supplied by available UGS and demanded for by respondents

The perceived ES provided by the available UGS in Dakodwom and Ayigya Zongo was also matched with what are actually demanded for by the residents. The results (Table 4.17) show that cultural ES perceived to be available (29.0%) do not meet the demand (41.7%) of the respondents of Dakodwom. There is a higher demand for cultural ES such as recreation, aesthetics, social cohesion, and heritage, cultural and historical values than what is perceived to be supplied (see Table 4.17). The situation is more critical for recreational activities (see Table 4.17). In the case of Ayigya Zongo, the demand for provisioning (17.8%) and regulating ES (37.9%) exceed the perceived supply (provisioning – 4.8% and regulating – 9.7%) (see Table 4.17). The perceived supply of all the available provisioning and regulating ES in Ayigya Zongo does not satisfy the demand of the respondents (see Table 4.17). This is more obvious for provisioning services such as medicinal plants and food as well as regulating services like temperature regulation and air quality control (see Table 4.17). In general, the gap between the ES perceived to be available and what are being demanded for is more serious in Ayigya Zongo compared to Dakodwom. The finding confirms that residents in Dakodwom are relatively better off than those in Ayigya Zongo in terms good enjoying the benefits of UGS. Previous results from the satellite images, the perspectives of the respondents, and the key informants interviews corroborate the finding. Moreover, further analysis shows that a larger number of the respondents who perceived the supply of provisioning and cultural services demand for less in Dakodwom (see Table 4.18). The opposite exists in Ayigya Zongo (see Table 4.18). Also, a larger number of the respondents who already perceived the supply of regulating services demands for less in both Dakodwom and Ayigya Zongo (see Table 4.18). In addition, with respect to specific services such as temperature and air quality regulation, a larger number of the respondents who already perceived the available supply, demands for more in Dakodwom. Similarly, a larger share of the respondents who perceived the availability of recreational activities and heritage, cultural, and historical values, demands for more in Ayigya Zongo. It is not surprising as these services in both areas are the most demanded for in their various categories of the ES (see Table 4.17).

Table 4.17: Perceived ES supplied by available UGS and demanded for by respondents

	Dakodwom				Ayigya Zongo			
Ecosystem Service	**Supply**	**%**	**Demand**	**%**	**Supply**	**%**	**Demand**	**%**
Provisioning								
Medicinal plants	23	21.9	13	12.4	4	2.8	18	12.8
Food	15	14.3	15	14.3	7	5.0	20	14.2
Wood fuel	9	8.6	3	2.9	1	0.7	4	2.8
Livestock grazing and fodder	5	4.8	-	-	1	0.7	6	4.3
Total	**52**	**17.9**	**31**	**10.7**	**13**	**4.8**	**48**	**17.8**
Regulating								
Temperature regulation	35	33.3	22	21.0	8	5.7	22	15.6
Water flow and runoff regulation	27	25.7	5	4.8	-	-	4	2.8
Erosion control	21	20.0	7	6.7	3	2.1	16	11.3
Air quality regulation	34	32.4	22	21.0	6	4.3	30	21.3
Noise reduction	20	19.0	4	3.8	4	2.8	13	9.2
Windbreak	17	16.2	6	5.7	5	3.5	17	12.1
Total	**154**	**53.1**	**66**	**22.8**	**26**	**9.7**	**102**	**37.9**
Cultural								
Recreation	10	9.5	45	42.9	111	78.7	79	56.0
Aesthetics	18	17.1	20	19.0	15	10.6	21	14.9
Social cohesion	25	23.8	24	22.9	33	23.4	47	33.3
Sense of place	15	14.3	8	7.6	25	17.7	27	19.1
Heritage, cultural and historical values	16	15.2	24	22.9	46	32.6	40	28.4
Total	**84**	**29.0**	**121**	**41.7**	**230**	**85.5**	**214**	**79.6**
Total all frequencies	**290**		**218**		**269**		**364**	

Source: Author's Household Survey, 2021

Table 4.18: Variation in perceived ES supplied by available UGS and demanded for by respondents

	Dakodwom					Ayigya Zongo				
Ecosystem Service			Demand					Demand		
			Yes	**No**	**Total**			**Yes**	**No**	**Total**
Provisioning										
Medicinal plants	**Supply**	**Yes**	5	18	**23**	**Supply**	**Yes**	3	1	**4**
		No	8	74	82		**No**	15	122	137
		Total	**13**	92	105		**Total**	**18**	123	141
Food		**Yes**	7	8	**15**		**Yes**	3	4	**7**
		No	8	82	90		**No**	17	117	134
		Total	**15**	90	105		**Total**	**20**	121	141
Wood fuel		**Yes**	2	7	**9**		**Yes**	1	0	**1**
		No	1	95	96		**No**	3	137	140
		Total	**3**	102	105		**Total**	**4**	137	141
Livestock grazing and fodder		**Yes**	0	5	**5**		**Yes**	1	0	**1**
		No	0	100	100		**No**	5	135	140
		Total	**0**	105	105		**Total**	**6**	135	141
Regulating										
Temperature regulation		**Yes**	13	22	**35**		**Yes**	2	6	**8**
		No	9	61	70		**No**	20	113	133
		Total	**22**	83	105		**Total**	**22**	119	141
Water flow and Runoff regulation		**Yes**	4	23	**27**		**Yes**	0	0	**0**
		No	1	77	78		**No**	4	137	141
		Total	**5**	100	105		**Total**	**4**	137	141
Erosion control		**Yes**	3	18	**21**		**Yes**	2	1	**3**
		No	4	80	84		**No**	14	124	138
		Total	**7**	98	105		**Total**	**16**	125	141
Air quality regulation		**Yes**	12	22	**34**		**Yes**	1	5	**6**
		No	10	61	71		**No**	29	106	135
		Total	**22**	83	105		**Total**	**30**	111	141
Noise reduction		**Yes**	4	16	**20**		**Yes**	1	3	**4**
		No	0	85	85		**No**	12	125	137
		Total	**4**	101	105		**Total**	**13**	128	141
Windbreak		**Yes**	3	14	**17**		**Yes**	3	2	**5**
		No	3	85	85		**No**	14	122	136
		Total	**6**	99	105		**Total**	**17**	124	141
Cultural										
Recreation		**Yes**	5	5	**10**		**Yes**	65	46	**111**
		No	40	55	95		**No**	14	16	30
		Total	**45**	60	105		**Total**	**79**	62	141
Aesthetics		**Yes**	8	10	**18**		**Yes**	6	9	**15**
		No	12	75	87		**No**	15	111	126
		Total	**20**	85	105		**Total**	**21**	120	141
Social cohesion		**Yes**	6	19	**25**		**Yes**	19	14	**33**
		No	18	62	80		**No**	28	80	108
		Total	**24**	81	105		**Total**	**47**	94	141
Sense of place		**Yes**	6	9	**15**		**Yes**	12	13	**25**
		No	2	88	90		**No**	15	101	116
		Total	**8**	97	105		**Total**	**27**	114	141
Heritage, cultural and historical values		**Yes**	8	8	**16**		**Yes**	24	22	**46**
		No	16	73	89		**No**	16	79	95
		Total	**24**	81	105		**Total**	**40**	101	141

Low  High counts

Source: Author's Household Survey, 2021

4.4.5. Match between the perceived current state of available UGS and their value by respondents for ES provision

The current state (quality) of available UGS was the final aspect considered for assessing the potential gap(s) between the supply and demand levels for ES provision in Dakodwom and Ayigya Zongo. The perceived current state of available UGS was matched with how the respondents value such aspect. As indicated earlier, the criteria used were freedom from garbage, freedom from crime, and availability of vegetation cover. The results of the perceived current state (Figure 4.10) and the value of UGS (Figure 4.15) show that in terms of the availability of vegetation cover criteria, the perceived current state is below the value the respondents attached to such aspect in both areas. Also, a larger number of the respondents who perceived the availability of vegetation cover to be bad or very bad attached a high or very high value to this aspect (see Figure 4.16 and Appendix 8). This implies that the degree of vegetation cover availability in green spaces in the two areas does not meet the residents' requirements. As a result, there is a mismatch between the quality supplied and what is demanded for with regard to this aspect. With the sunflower scatterplot (Figure 4.16), the higher a specific combination was found, the higher the number of petals.

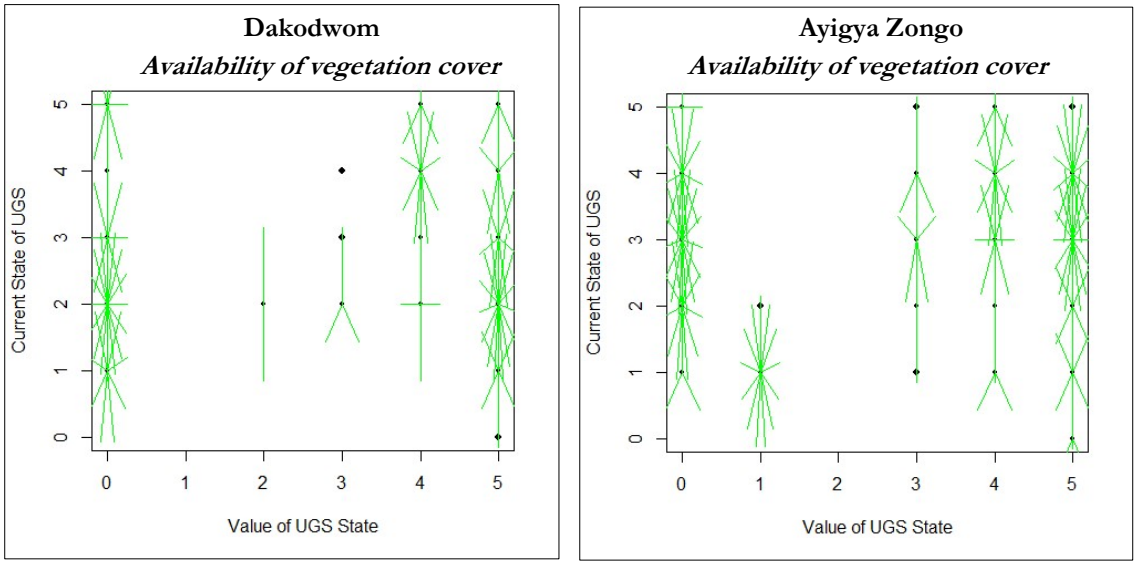

Figure 4.16: Variation in the state of vegetation cover availability and value attached to it by respondents (Current state of UGS: Very bad – 1, Bad – 2, Neutral – 3, Good – 4, Very good – 5; Value of UGS state: Very low – 1, Low – 2, Neutral – 3, High – 4, Very high – 5)

Source: Author's Household Survey, 2021

4.5. Making informed decisions based on the identified gaps

The identified gaps between the supply and demand levels of ES of UGS in Dakodwom and Ayigya Zongo call for actions. Thus, to ensure equitable access to UGS and associated benefits, it would be necessary to put measures in place to bridge the gap in deprived urban areas where residents are more disadvantaged compared to well-off areas. Under this section, two main approaches are considered, that is, spatial planning and management of green spaces in the two areas incorporating the opinions of the key informants.

4.5.1. Spatial planning decisions for UGS in Dakodwom and Ayigya Zongo

Generally, residents in deprived urban areas have poor living conditions (Amoako & Cobbinah, 2011; Kohli et al., 2016; Kuffer et al., 2017; Takyi et al., 2020). In order not to worsen their conditions, effective decisions have to be taken to plan for green spaces in such areas. The finding of Cobbinah et al. (2021) showed that there is an absence of operational local spatial plans in a large number of deprived urban areas in Ghana. This poses a challenge to effectively plan for green spaces in these areas. Notwithstanding, a conscious effort has to be made to improve access to UGS by residents in the areas since these green spaces are capable of enhancing their lives environmentally, socially, economically, and culturally. Therefore, the following planning decisions could be taken.

A conscious effort has to be made to plan for green spaces within the surrounding areas of the deprived communities. Due to the limited land space in these deprived settlements, planning for green spaces within nearby areas would be a good way of improving overall access to UGS by the residents. The decision can be informed by international standards such as the WHO 9 m² UGS per capita and the ANGSt of a minimum of 2 ha of green space within 300 m from home (Girma, Terefe, & Pauleit, 2019). This implies that the distance from the deprived areas should be considered approximately 300 m. Hence, the green spaces provided should be within a maximum of 300 m from the boundaries of the areas. Also, quantitatively, the population of the residents in the deprived areas as well as those within the neighbouring areas have to be considered to determine the size of green spaces to provide. A Senior Development Planning Official of KMA made an expression that their department plan to take advantage of the peripheries of Dakodwom to provide more green spaces for the benefit of the residents.

> *"… now we [the department] are taking advantage of the peripheries that is towards the wetland to plant some trees which will be beneficial to them [the residents]".*
>
> *Source: Author's Key Informant Interview, 2021*

Furthermore, with strict enforcement of the Land Use and Spatial Planning Act [Act 925] (2016) of Ghana, areas within the 300 m range from the boundaries of the communities can be zoned for green spaces. Section 85(j and k) of the Act states that "The Planning Authority shall provide guidelines in respect of zoning schemes affecting the creation of green belts; and national, regional, district and local parks". The operationalization of the Act 925 came up during the key informants interviews.

> *"There is a provision in the Land Use and Spatial Planning Act that supports the creation of green spaces. So, when this is effectively enforced, I think we [Planning Authority] can plan for some green spaces for them [the deprived areas], but unfortunately it is not being operationalized".*
>
> Physical Planning Official, PPD, KMA
> *Source: Author's Key Informant Interview, 2021*

Finally, there would be the need for a participatory planning approach. The residents of the deprived areas and the traditional authority[5] who owns a larger share of lands in Ghana should be involved throughout the planning process. The local planning authority should hold discussion sessions with the traditional authorities to enlighten them on the relevance of green spaces to the residents so that they (traditional authority) can make some land available for the provision of the green spaces. Furthermore, the planning authority should organize meetings to engage the community members to determine the type of green spaces they want and the benefits they want to derive from such green spaces. This will go a long way to ensure that the green spaces provided are not abandoned by the residents. Also, the people will feel part

[5] Traditional authority comprises of kings and chiefs who own a larger share of lands in Ghana.

of the whole process and accept the outcomes as their own. Furthermore, during the meetings, the planning authority should encourage the residents to create green spaces such as domestic gardens within their private spaces, and even where there is enough space, they can plant trees as well. This approach would also help add up to the total green spaces in the areas.

4.5.2. Management decisions for UGS in Dakodwom and Ayigya Zongo

After planning and providing green spaces in the communities a key challenge now will be how to manage them. For effective management of UGS in deprived areas the first step will be the strict enforcement of the Land Use and Spatial Planning Act which empowers the local planning authority to put measures in place to prevent encroachment on green spaces. Section 4(h) states that "For the purpose of achieving its objects the Planning Authority shall ensure the control of physical development in uncontrolled or less controlled but sensitive areas such as forest reserves, nature reserves, wildlife sanctuaries, green belts, coastal wetlands, water bodies, water catchment areas, mining areas, open spaces, and public parks". However, without the appropriate logistics, it would be difficult for the planning authority to enforce this Act. Hence, the capacity of the planning authority should be built through the provision of adequate logistics, funds, and other relevant materials needed to carry out their duties. This will ensure that the provisions of the Act are being operationalized without any form of interference especially from politicians (Diko & Palazzo, 2019), which will lead to the effective management of green spaces in the areas.

Additionally, another management decision that can be taken to improve UGS access in the deprived areas would the targeting of the existing green spaces in the communities and provide more greeneries. The results of the study show that a larger share of the respondents expressed the availability of vegetation cover in the available green spaces to be bad or very bad. Therefore, adequate greeneries can be provided in these areas to improve their quality. The improved quality will ensure an increase in the benefits provided to the residents. The strategy is supported by one of the key informants.

> *"With these existing green areas, we [Planning Authority] can consciously go in there, plant trees and get the community involve …".*
>
> Physical Planning Official, PPD, KMA
> *Source: Author's Key Informant Interview, 2021*

Moreover, UGS management in the deprived areas will require a collaborative effort of all stakeholders. The various stakeholders including the planning authority, traditional authority, and community members should come together to ensure that green spaces within these areas are adequately protected without any form of encroachment. Adjei-Mensah, Andres, Baidoo, Eshun, and Antwi (2017) recommended the involvement of all stakeholders for urban green spaces management in Kumasi. Therefore, when this is done, UGS can be managed effectively which will improve access to green spaces in the areas, thereby increasing their benefits to the residents. The approach was stressed during the key informant interview.

> *"It is a collaborative effort between all stakeholders within the urban space i.e the traditional authority, the planning authority who has the mandate to ensure that regulations binding physical development are embarked on or enforced as well as private developers who also have control over the space, they have been given …".*
>
> Physical Planning Official, PPD, OMA
> *Source: Author's Key Informant Interview, 2021*

The next approach is to educate the residents on the importance of green spaces to their wellbeing and health. The planning authority should put in a continuous effort to make the residents aware that the services that the green spaces provide such as temperature and air quality regulation help prevent them

from disease infection; hence, they should prioritize green spaces in the areas. Also, other stakeholders like the traditional authority should be enlightened on this issue. This will help drive positive attitudes towards green spaces management. One of the key informants also proposed this approach.

> *"… people must be made to understand the true benefits of urban green spaces. If this is not done, I do not see why we will spend money to consciously provide green spaces. So, we need to improve the environmental literacy among stakeholders from policymakers, the traditional authorities and those [residents] who use the green spaces …".*
>
> Senior Lecturer, DoP, KNUST, Kumasi, Ghana (2)
> *Source: Author's Key Informant Interview, 2021*

Lastly, some of the community members should be used as urban green spaces guards. This will require the volunteering effort of the members. Their responsibility will be to ensure that there is no encroachment on green spaces in the areas. Hence, helping in the preservation of UGS through which the residents can enjoy enough benefits. As cited by Cobbinah et al. (2021) community members comprising of the youth worked together with the local planning authorities during the depletion of green spaces in some small South African towns to protect existing UGS (McConnachie, Shackletona, & McGregor, 2008). This approach can be operationalized in the deprived areas as a key management strategy for green spaces.

4.6. Summary

This chapter presented the results of the study. The results are based on the sub-objectives of the study and provided answers to the research questions. Accordingly, the results on the supply side show that there are few available UGS for ES provision in both Dakodwom and Ayigya Zongo. Therefore, residents of both areas expressed the need for additional UGS regardless of their claims of limited land space to accommodate such green spaces. In assessing potential gap(s) between the supply and demand levels it was revealed that there are deficits of UGS per capita in the two areas with the situation being more critical in Ayigya Zongo. This confirms why the majority of residents in Dakodwom are more pleased with the travel distance to access the nearest UGS from their residential houses than Ayigya Zongo. Also, considering access to surrounding green spaces for both areas showed that Dakodwom is better off compared to Ayigya Zongo. In this case, the residents of Dakodwom can benefit more from surrounding UGS than Ayigya Zongo where there are still few available green areas outside the community. Furthermore, there is a relatively higher demand for cultural ES like recreation than the perceived level of supply in Dakodwom. Also, the perceived regulating ES supplied in Ayigya Zongo do not meet the demand of the residents with temperature and air quality regulations being the most obvious. Additionally, in both Dakodwom and Ayigya Zongo the level of demand for provisioning ES exceeds the perceived supply. Moreover, the quality of available UGS for ES provision in terms of availability of vegetation cover does not meet the expectations of the respondents. Hence, the results of the study have shown that there are gaps between the supply and demand levels of ES of UGS in Dakodwom and Ayigya Zongo. Thus, the demand exceeds the level of supply. To bridge this gap, effective spatial planning and management decision has to be taken which requirements a collaborative effort of all stakeholders.

5. DISCUSSION

This chapter presents a discussion on the key findings of the study in Sections 5.1 to 5.6. Section 5.7 presents a guide for similar and future studies based on an improvement in the conceptual framework of the study. Lastly, Section 5.8 reflects on the limitations of the study.

5.1. Land scarcity affecting the availability of UGS

The results of the study indicate that there are few available UGS in both Dakodwom and Ayigya Zongo. The situation in Ayigya Zongo is more alarming where it was observed that green spaces are largely non-existent with UGS constituting only 0.4% of the total land area. The findings from the key informants interviews show that green spaces in these deprived urban areas have largely been encroached upon. This is attributed to the fact that there is limited land space, hence, these green spaces compete with other uses such as residential and commercial and they are eventually taken over. This finding confirms those of the studies by Adjei-Mensah (2014); Cobbinah and Darkwah (2016); Essel (2017) and Quagraine (2011) showing that there is the invasion of green spaces by other uses in Kumasi. Many other African cities and even cities in the Global North are experiencing a similar situation (Cobbinah et al., 2021; Cobbinah & Darkwah, 2016; Oduwaye, 2013). For example, a study by Girma, Terefe, Pauleit, et al. (2019) in Sebeta Town, Ethiopia showed that there was a reduction in green space area by 51.8% with an annual loss rate of 3.9% between 2003-2016. Also, in the Global North, findings from McDonald, Forman, and Kareiva (2010) showed that most of the cities in the United States have lost a larger portion of their green spaces to built-up areas. However, the situation is more obvious and pervasive in the Global South where there are higher growth rates coupled with weak planning systems with which developments take place before they are being planned for (Cobbinah, Erdiaw-Kwasie, & Amoateng, 2015; Jim, 2004; Mpofu, 2013).

Furthermore, the limited land space in the deprived areas which compels residents to show interest in other land uses makes them less concerned when green spaces in the areas get depleted (also see Section 5.2). This situation was confirmed by the key informants. However, the finding of the study suggests that the residents are aware of the destruction of UGS in the areas as the majority of them perceived that there is a low level of UGS supply for their benefits. The situation presents a gap between the available UGS and the population in Dakodwom and Ayigya Zongo. Thus, the UGS per capita of the two areas in comparison with the WHO 9 m² standard show deficits. Adjei-Mensah (2016) reported UGS per capita of Kumasi as 4.7m² in 2016. This implies that there is also a great deficit at the citywide scale. However, a comparison with those of Dakodwom (4.7 m²) and Ayigya Zongo (0.8 m²) shows a more critical situation in Ayigya Zongo. The finding corroborates with the results from the satellite images and the key informants interviews. Furthermore, it was found that there are relatively more available green spaces outside the boundaries of both Dakodwom and Ayigya than within. The surrounding areas of the two settlements especially Dakodwom are well developed (well-off areas). The residents of the two areas can benefit from these surrounding green spaces; however, they would have to share with people living in the neighbouring areas (Roy et al., 2018; Syrbe et al., 2017). This finding supports what is found in literature that there is more UGS concentration in well-off areas compared to deprived areas (Cruz-Sandoval et al., 2020; Roy et al., 2018). Similarly, UGS per capita of the two areas including surrounding green spaces (within 300 m from their boundaries) also show that the residents of Ayigya Zongo (4.1 m²) are underprivileged. This situation calls for much attention as it is evidenced in the study that high densities of the areas result in overcrowding; therefore, the availability of UGS in the areas would be beneficial for local climate regulation which is relevant to the health of the residents as emphasized by the key informants.

5.2. Factors influencing the satisfaction level of the respondents on UGS availability and location

The results of the study show that a larger share of the respondents expressed being satisfied with UGS availability in both Dakodwom and Ayigya Zongo. This implies that regardless of the few available green spaces in the areas the residents are pleased. The majority of the respondents attributed this decision to the fact that there is limited land space in the areas to permit the creation of more green spaces. The finding shows an adaptation and coping bias in the two areas (Berhe, Martinez, & Verplanke, 2014). Thus, the perception on UGS availability is good but there are actually few available green spaces.

Moreover, the results of the Chi-square test show a statistically significant association between the respondents' level of satisfaction on the UGS available and their education level and estimated distance to green spaces in Dakodwom. Generally, the respondents with a lower level of education and those who travel shorter distances in accessing the available green spaces expressed a higher satisfaction outcome. A study by Ostoić et al. (2017) observed that people with higher education usually have positive attitudes towards green spaces and express more concern in case of green spaces depletion. This agrees with the results of this current study. Also, a study by Nielsen and Hansen (2006) showed that residents within shorter travel distances from their homes to green spaces enjoy more benefits and there is high frequency for the use of such UGS by the residents. This could explain the finding of this current study, where accessibility to available green spaces was also an influencing factor for a higher level of satisfaction on UGS availability in both Dakodwom and Ayigya Zongo. Hence, the respondents perceived to be satisfied with UGS availability in the two areas since they can reach the available green spaces within shorter distances. Furthermore, the majority of the respondents in both Dakodwom and Ayigya Zongo gave a higher satisfaction level in terms of the location of the available green spaces in the areas. There is a significant association between the respondents' satisfaction level on UGS location and estimated distance and the perceived types of available green spaces in Ayigya Zongo. In this case, the access to green spaces within shorter distances specifically to the perceived sports field in the area influenced the satisfaction level of the respondents.

5.3. Influence of shorter travel distances on available UGS

Findings from the study show that the majority of the residents in Dakodwom and Ayigya Zongo can reach the available green spaces in the areas within shorter travel distances (within 0-300 m or 5 mins walk). Moreover, a larger share of the respondents demanding for additional UGS prefers to have them within shorter distances. This shows that physical accessibility to available UGS in the areas is of less concern. The GIS network analysis method applied for the assessment makes the outcome less disputable as it takes the travel routes of the residents, which other methods such as the Euclidean distance do not consider (Oh & Jeong, 2007; Yu, Zhu, & He, 2020). This helps to minimize travel costs (barriers) to represent the actual travel distance of the residents (Almohamad, Knaack, & Habib, 2018; Yu et al., 2020). However, due to the few available UGS and the high population of the two areas, there would be great pressure on the existing green spaces. The situation is depicted by the UGS per capita deficits of the two areas with that of Ayigya Zongo (8.9 m^2) being more pervasive. Hence, the decision to create or make more green spaces available within the reach of the residents in the areas would help bridge the gap.

5.4. Available types of UGS influencing ES supply and demand

The study results show that there are four main types of UGS available in Dakodwom and Ayigya Zongo. Street trees and wetland are available in Dakodwom while in Ayigya Zongo sports field and street trees are available. The residents in both areas also perceived to have gardens available. This finding conforms to the study by Adegun (2019) which showed that these types of UGS are the main green spaces available in Kya Sands, an informal settlement in Johannesburg, South Africa. The availability of wetland in

Dakodwom affirms what is found in literature that many deprived urban areas especially in the Global South are located near ecologically sensitive areas such as streams or on wetlands (Adegun, 2017; Davis, 2006; Kohli, Sliuzas, Kerle, & Stein, 2012). Additionally, the findings of Adegun (2019) and Roy et al. (2018) show that residents of deprived urban areas in Africa cultivate some plants in containers, pots, or shacks close to their dwellings. This description is similar to the kind of gardens identified in Dakodwom (see Figure 4.6). These plants are also grown for aesthetic and beautification purposes (Adegun, 2018).

Furthermore, the findings of the study show that these available types of UGS influence the ES perceived to be supplied in the areas. For example, there are relatively more street trees in Dakodwom with which regulating services were perceived to be the highest ES provided in the area by the respondents with temperature regulation being the most. The identification of temperature regulation in Dakodwom is highlighted in studies on informal settlements by Oluwafeyikemi and Julie (2015) in Lagos and Gopal and Nagendra (2014) in Bangalore. These studies revealed that the growing of plants close to the dwellings of residents in these areas helps provide some form of temperature regulation mechanism. This is quite similar in Dakodwom (see Figure 4.6). Also, it was observed that the residents show more interest in cultural services such as recreational activities, therefore, a larger share of the respondents demands for them. These cultural services are greatly associated with sports field as seen in Ayigya Zongo and other deprived urban areas (Adegun, 2017). Hence, the majority of the respondents demands for sports field in Dakodwom; however, there is no sports field in the area which presents a gap between what is available and demanded for by the residents.

Moreover, in Ayigya Zongo the perceived available sports field is highly associated with cultural services with recreational activities being the most provided ES. Similarly in Kya Sands informal settlement in Johannesburg, the sports field is recognized for providing diverse forms of cultural ES, including recreation and social cohesion for residents (Adegun, 2017). Also, the relatively fewer available street trees in Ayigya Zongo influence the perceived supply of less regulating services. Therefore, a larger share of the respondents demands for street trees for the provision of regulating services such as temperature and air quality regulation which are perceived to be less available. This situation leads to high unmet needs of the residents in the area.

In addition, provisioning services were the least ES perceived to be available in the two areas which deviate from the study by Derkzen et al. (2017) and Shackleton et al. (2018) which found that provisioning services are more available to the residents of deprived urban areas and small towns. The respondents in Dakodwom perceived more available provisioning services compared to Ayigya Zongo. This can be attributed to the fact that there are more gardens perceived to be available in Dakodwom than Ayigya Zongo. A larger share of the respondents demands for provisioning services such as food and medicinal plants in Ayigya Zongo than Dakodwom. This therefore influence the demand for gardens in Ayigya Zongo which were observed to be few in the area. The implication of this is high unsatisfied requirements of the residents. In general, the demographic characteristics of the respondents influence their demand, with females, the youth, and those with a lower level of education being prominent. Supporting services are not recognized by the residents in both areas. Also, from literature, it is not clear how residents of deprived urban areas benefit from supporting services (Adegun, 2017). The impacts of these supporting services are highly indirect compared to the other services (MEA, 2005) which might support why they are not being recognized by the residents.

5.5. Relationship between the perceived current state of available UGS and their value by respondents for ES provision

The respondents demanding for more UGS show high value (which means high importance) for the quality of green spaces in both Dakodwom and Ayigya Zongo. The perceived quality of the available green spaces concerning freedom from garbage and crime meets the requirements of the residents in the two areas. However, in terms of the availability of vegetation cover, there is a mismatch between the existing and how the respondents value such a state. The low level of available vegetation cover in green spaces in both areas leaves a larger share of the respondents unsatisfied. The availability of vegetation cover is a key factor that can affect the benefits that residents derive from green spaces. Therefore, to ensure adequate UGS benefits to the residents it would be necessary to make enough provision for greenery in the areas. This will also encourage UGS usage among the residents thereby helping to improve their overall wellbeing.

5.6. Implications of the informed decisions to address the identified gaps

The lack of coordination among stakeholders is a key challenge for effective UGS management in Kumasi (Cobbinah & Nyame, 2021). Hence, bridging the gaps between the supply and demand levels requires a collaborative effort of all stakeholders (local planning authorities and other government agencies, traditional authorities, and residents) to ensure the operationalization of the planning and management strategies for UGS in the deprived urban areas (Section 4.5). To reach a successful outcome would require legislative backing which the Land Use and Spatial Planning Act of Ghana provides. Hence, the need for strict enforcement of the Act to empower the local planning authorities to take the lead in the planning and the management of UGS in the areas. Also, another key requirement would be capacity building in terms of logistics, personnel, and funding for the institutions involved. Lastly, making UGS a priority by all stakeholders especially the residents in the areas would help in achieving a positive outcome thereby ensuring adequate benefits of green spaces in the deprived urban areas.

5.7. Guide based on the conceptual framework of the study for similar and further studies

This section presents a guide based on an improvement in the conceptual framework to reflect the findings of the study (Figure 5.1). Here, the types of UGS identified in the case studies, the indicators used in assessing the level of supply and demand for ES of UGS, and the identified gaps and informed decisions to bridge these gaps are incorporated. The approach of comparing results from the GIS analysis for determining the available UGS and the travel distances to such green spaces with the perspectives of the respondents and the key informants was useful. Through this approach for instance garden was identified as another type of UGS available in the areas from the respondents and the key informants which the GIS analysis did not capture. This shows how local perspectives are important when undertaking such studies. Hence, the framework provides an overview of the potential gaps between the supply of and demand for ES of UGS in deprived UGS in the Global South and the possible way forward for improvement. This can serve as a guide for similar and further studies in the future.

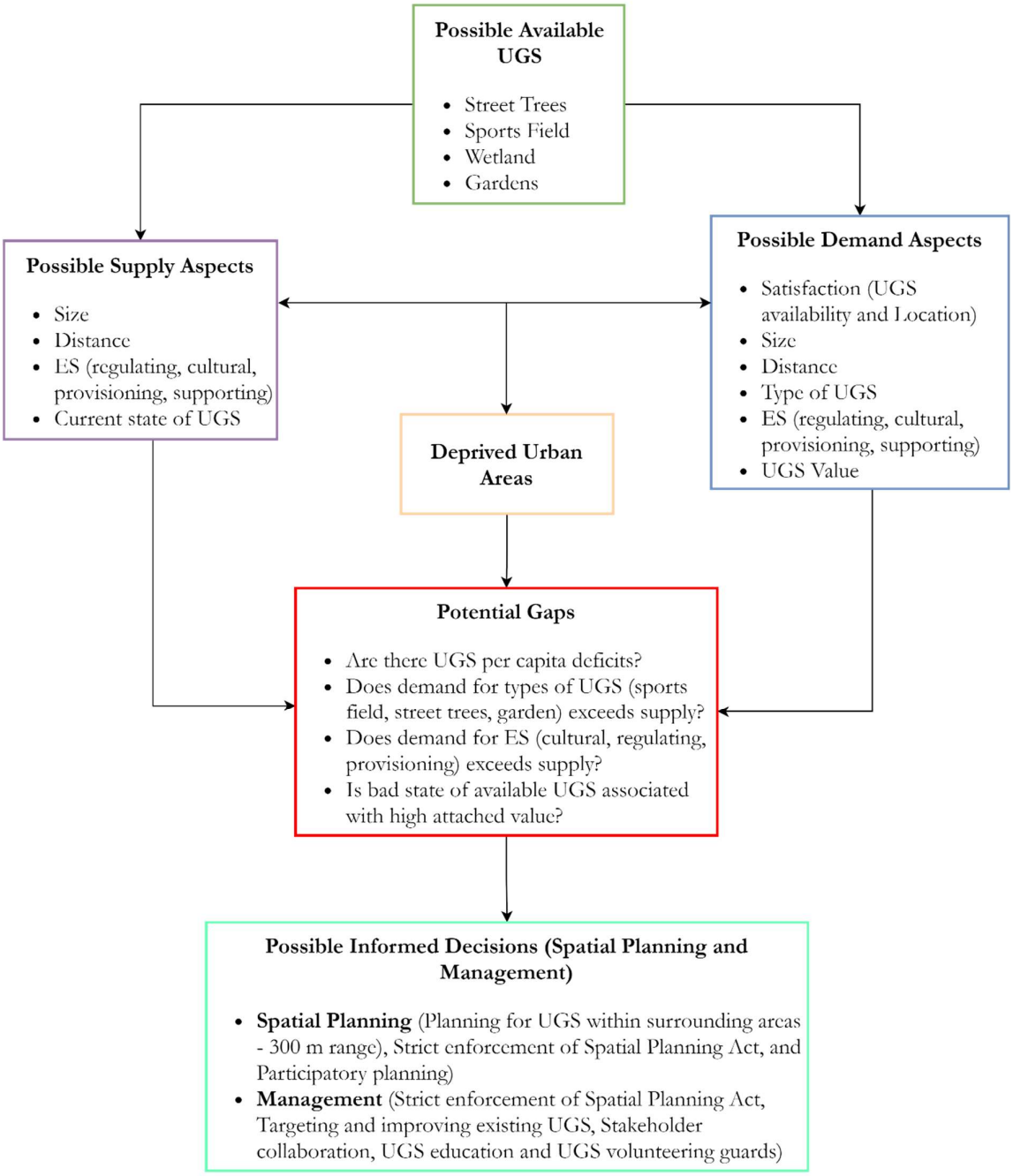

Figure 5.1: Guide based on the conceptual framework of the study for similar and further studies
Source: Author's Construct, 202

5.8. Limitations of the study

A key limitation for this study was the fact that the researcher could not personally go to the field. The COVID-19 situation did not make this possible. This made it difficult for the research in describing the state of UGS in the two areas. The state here refers to the type, size, distance, and quality. Nonetheless, with the help of the research assistant, an overview of the situation in the areas was captured.

The mixed-method approach used for the study was useful in achieving the research objectives. However, in assessing the available ES in the areas, only the perspectives of the respondents and key informants were considered. This makes it hard to accept such ES as what are actually supplied in the areas. It is therefore suggested for other methods to be used in similar or future studies (see Section 6.2). However, this does not relegate the results as the approach has been used in similar studies such as (Derkzen et al., 2017; Roy et al., 2018).

Moreover, there are more than ten deprived urban areas in Kumasi, but due to time and resource constraints, only two of them were selected for the study. Although several studies report that deprived urban areas have similar conditions, some distinctions can always be found. Hence, the consideration of more of the deprived areas would have been better for the study. However, with the selection of one deprived area with some available green spaces and one which seems to lack, a generalization can be made to reflect other areas.

6. CONCLUSION

The main objective of the study was to analyse the match between the supply of and demand for ES of UGS in selected deprived urban areas of Kumasi, Ghana. Based on this, Dakodwom and Ayigya Zongo were selected as the case studies. The study combined methods of GIS with social sciences to incorporate the perspectives of residents in the two areas as well as key informants who are experts in the field. This chapter presents a summary of the key findings based on the research objectives, conclusion, and areas for further research.

6.1. Summary of key findings and conclusion

The findings of the study show that there are few available UGS within shorter travel distances in both Dakodwom and Ayigya Zongo. However, the situation in Ayigya Zongo is more critical with only 0.4% of UGS out of the total land area. Generally, UGS are seen to be non-existent presenting per capita deficits, especially in Ayigya Zongo although the residents have the opportunity to benefits from UGS within their surroundings with which they would have to share with the people in the neighbouring areas. Regardless of the few available UGS in the areas, the residents perceived to enjoy some kind of benefits from them. The residents in Dakodwom perceived more available regulating services which are associated with the available street trees and wetland in the area. In Ayigya Zongo, cultural services are highly recognized due to the perceived available sports field. Overall, the residents in both areas accept that there is a low level of UGS supply for ES provision in the area. Furthermore, despite the low level of UGS supply in the two areas, the residents expressed that they are satisfied since there is limited land space to accommodate more. Notwithstanding, the majority of them expressed the need for additional UGS in the areas. A larger share of the respondents shows interest in cultural services in Dakodwom; hence, they demand for sports field. This presents a gap since there is no available sports field in the area. On the side of Ayigya Zongo, regulating and provisioning services are demanded by a larger share of the respondents. With this, street trees and gardens are demanded for to provide such services. The demand here exceeds the supply leaving a larger number of the residents unsatisfied. It is also observed that the availability of vegetation cover in green spaces in both areas is perceived to be poor; however, a larger share of the respondents attached a positive value to such state with which their requirements are not met. It was found that demand is influenced by the demographic characteristics of the respondents with which females, the youth, and people with a lower education status were more crucial. Moreover, it is decided that the identified gaps could be bridged with spatial planning and management strategies. These require a collaborative effort of all stakeholders involved with the support of effective legislation.

In conclusion, the state of UGS in the deprived urban areas has shown to be not a problem in terms of physical accessibility but rather quantitatively and qualitatively. The study has provided a strong case that although there is the depletion of UGS in the Global South; however, the situation in deprived urban areas is more pervasive. This confirms the findings of studies such as (Cobbinah et al., 2021; Cruz-Sandoval et al., 2020). Moreover, residents in the areas perceived to have more access to regulating and cultural services deviating from the findings of Derkzen et al. (2017) and Shackleton et al. (2018) suggesting that provisioning services are readily available to the people in deprived areas. Further, the residents in the areas show more interest in the socio-cultural benefits of UGS than the environmental and economic which was similarly observed by (Roy et al., 2018). The population of these deprived urban areas with higher densities shows a huge unmet requirement of residents from UGS which calls for the attention of all stakeholders with effective legislation. Finally, the study contributes to bridging the gap on

the little studies on UGS in deprived urban areas in the Global South by providing an overview of the relationship between the supply of and demand for ES of UGS in such areas.

6.2. Areas for further research

With the analysis of the match between the supply of and demand for ES of UGS in the selected deprived urban areas of Kumasi, Ghana, the following areas can be considered for further studies:

- The study assessed the available ES of UGS in the deprived urban areas through the perspectives of the residents and key informants, further studies can employ GIS, remote sensing, and modelling methods to determine the actual supply. Little is known about the use of these methods for ES assessment in deprived urban areas where there are poor environmental conditions, which could be resolved through the availability of ES such as temperature and air quality regulation. The use of GIS, remote sensing, and modelling methods will help to know the actual ES supply in these deprived areas, which can influence the planning and management decisions of UGS in the areas.
- The study assessed the level of supply of and demand for ES of UGS in deprived urban areas without considering the actual usage of these green spaces. Therefore, further studies can look into UGS use in deprived urban areas. This will help provide an understanding of daily UGS usage in these areas.
- The findings of the study show that the residents in the deprived urban areas recognize and show more interest in cultural ES. Several studies in the Global North have reported the relevance of cultural ES to the wellbeing and health of people. However, little is known about the significance of these cultural ES to wellbeing and health of people in the Global South especially in deprived urban areas where residents cherish such services for their everyday activities. Hence, further studies can be done in this area.

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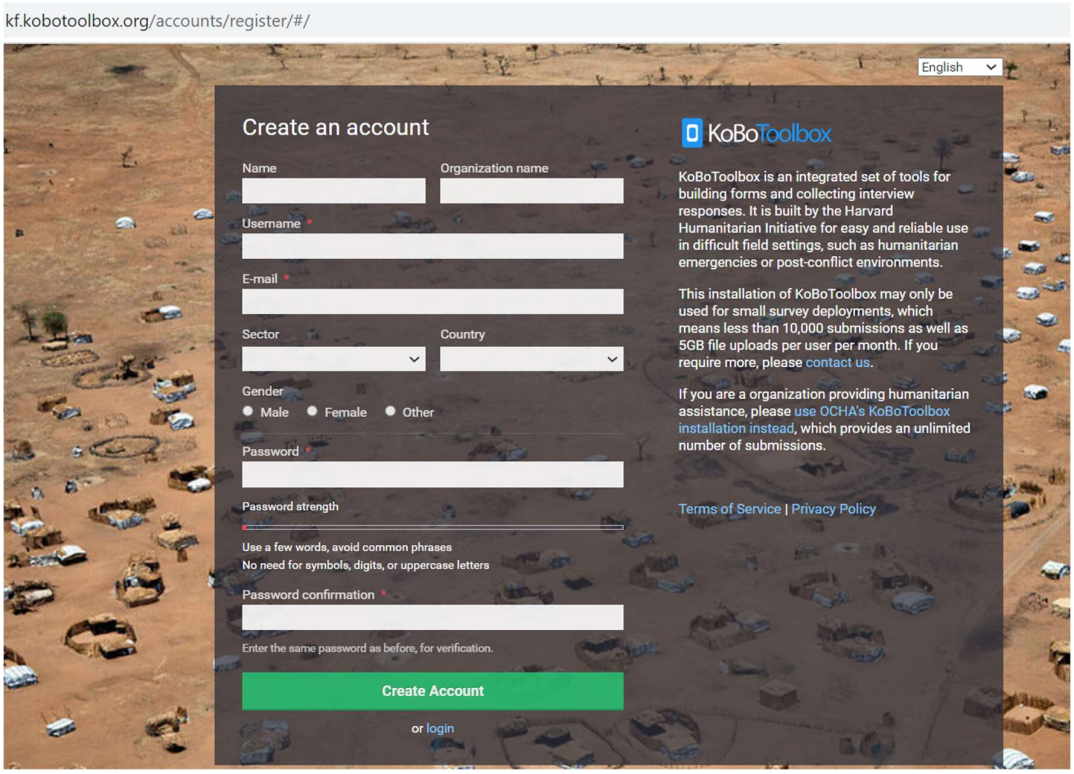
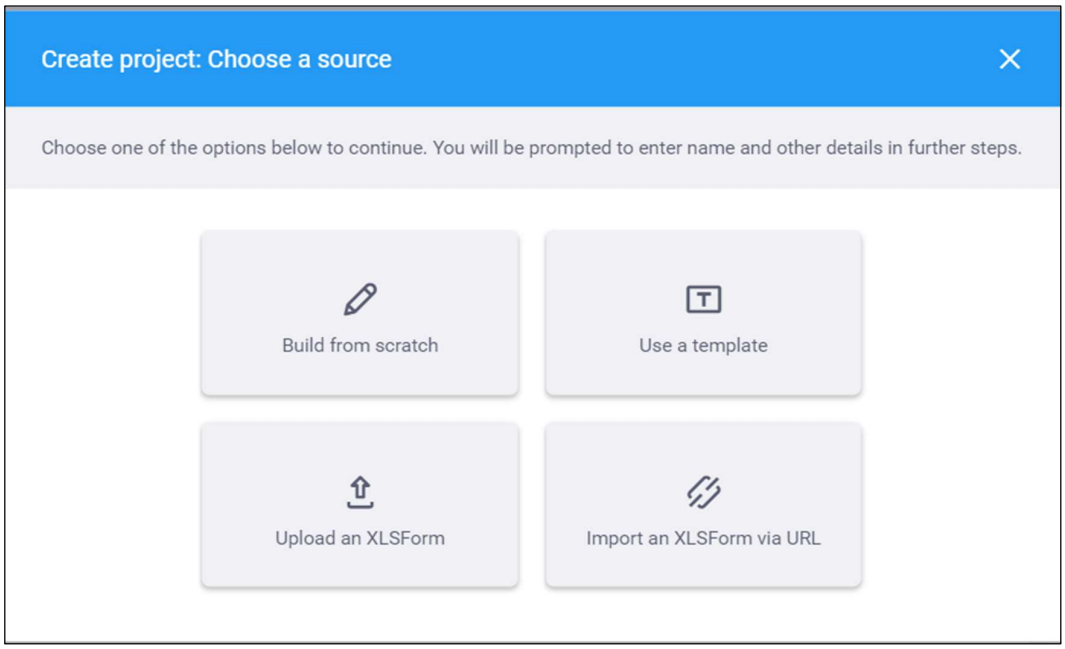
APPENDICES

Appendix 1: Creation, preparation, and execution of household survey questionnaire using KoBoToolbox

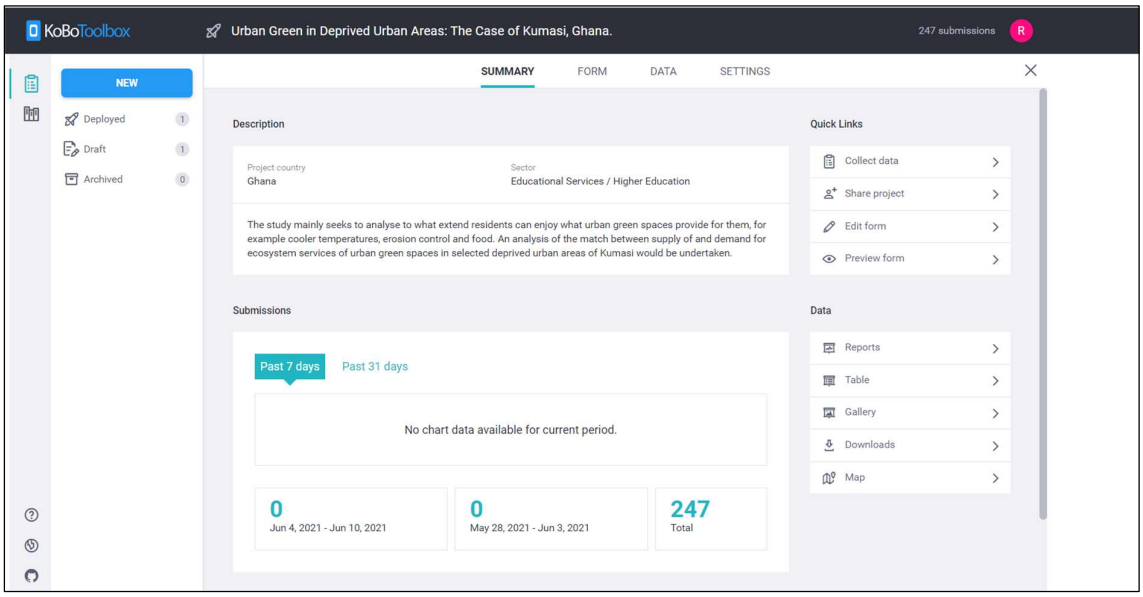
Appendix 1a: Creating a KoboToolbox account



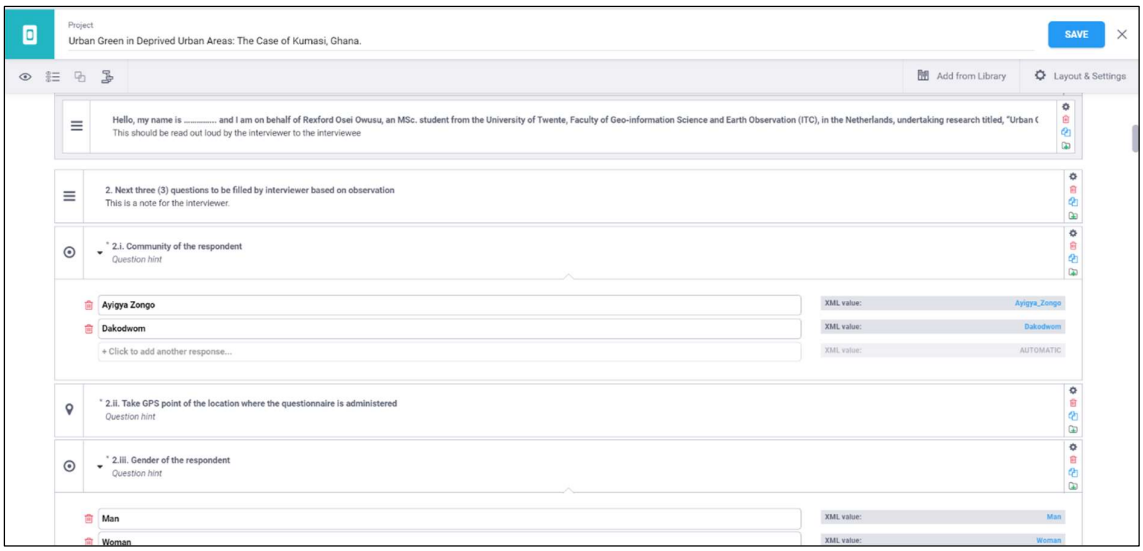
Appendix 1b: Creating a project in KoboToolbox



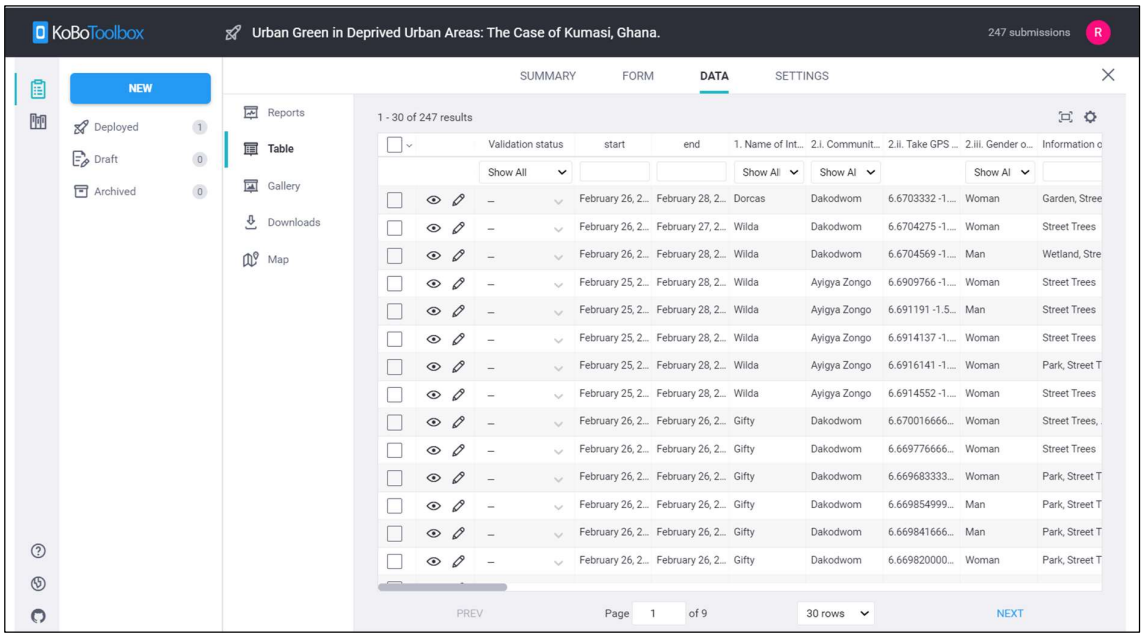
Appendix 1c: Summary of the project in KoBoToolbox



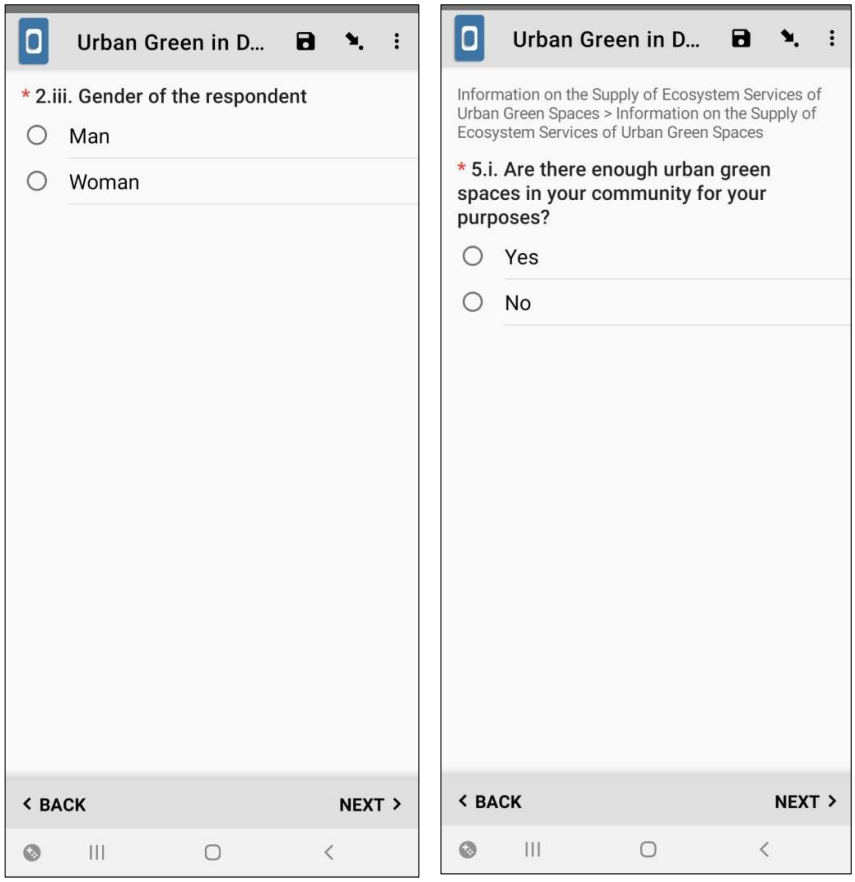
Appendix 1d: View of the questionnaire input in KoBoToolbox



Appendix 1e: View of data submitted to KoBoToolbox account



Appendix 1f: View of the questionnaire in the KoBoCollect App



Appendix 2: Primary data collection instruments

Appendix 2a: Household questionnaire

Introduction

Hello, my name is …….. and I am on behalf of Rexford Osei Owusu, an MSc. student from the University of Twente, Faculty of Geo-information Science and Earth Observation (ITC), in the Netherlands, undertaking research titled, *"Urban Green in Deprived Urban Areas: The Case of Kumasi, Ghana"*. The study explores the extent to which residents can enjoy what urban green spaces provide for them, such as cooler temperatures, erosion control, and food. In this study, urban green spaces are defined as any public or private land areas, such as parks, trees, gardens, wetlands, and open green spaces. The study's outcome would be useful in informing decision-making regarding spatial planning and management of urban green spaces in deprived urban areas.

Therefore, this survey seeks to derive information from households of selected urban areas in Kumasi. For this study, the researcher has chosen to focus on Ayigya Zongo and Dakodwom. Household heads are to be selected as respondents for this survey. If the household head is not available, any household member who is 18 years and above can be chosen. Can you please spare some time to participate in the survey and answer some questions scheduled for about 30 minutes? There are no right or wrong answers to answering the questions.

Please be assured that any information provided would be treated with the privacy it deserves and used purely for academic purposes.

Before we proceed do you have any questions or concerns about this survey?

(To be filled by the interviewer)

1. Community of the respondent

a. Ayigya Zongo ( )

b. Dakodwom ( )

A. Information on the Supply of Ecosystem Services of Urban Green Spaces

2. What type of urban green space(s) is/are available in your community? Please select all applicable.

a. Park ( )

b. Street Trees ( )

c. Garden ( )

d. Wetland ( )

e. Sports Field ( )

f. Other ( ), please specify…….

If no urban green space(s) is/are available, please move to question 10.

3. Urban green spaces can provide multiple benefits, for example, cooler temperatures, erosion control, recreation, and noise reduction. Which of the following benefits are you and other household members provided within your community? Select other and specify if the benefit(s) provided is/are not in the options available. Also, identify the types of urban green spaces you perceive for the provision of the benefits in your community.

Ecosystem Service	Select	Type of Urban green space
Medicinal Plants		
Food		
Wood Fuel		
Livestock grazing and fodder		
Temperature regulation		
Water flow and runoff regulation		
Erosion control		
Air quality regulation		
Noise reduction		
Windbreak		
Recreation		
Aesthetics		
Social cohesion		
Sense of place		
Heritage, cultural and historical values		
Soil protection		
Nutrient deposition		
Other, please specify…..		

4. What is the estimated distance from your house to the nearest urban green space?
a. Less than 100 m ( )
b. 100-300 m ( )
c. 301-600 m ( )
d. 601-900 m ( )
e. 901 m and above ( )

5. What is the current state of the urban green space(s) for the provision of the benefits in your community in terms of freedom from garbage, freedom from crime, and availability of vegetation cover?

5a.i. Free from garbage
a. Very good ( )
b. Good ( )
c. Neutral ( )
d. Bad ( )
e. Very bad ( )

5a.ii. What is/are your reason(s) for the choice under question 5a.i?
……
……
……

5b.i Free from criminal attacks
a. Very good ( )
b. Good ( )
c. Neutral ( )
d. Bad ( )
e. Very bad ( )

5b.ii. What is/are your reason(s) for the choice under question 5b.i?
……
……
……

5c.i Availability of vegetation cover (was explained by the interviewer as the availability of greenery)
a. Very good ( )
b. Good ( )
c. Neutral ( )
d. Bad ( )
e. Very bad ( )

5c.ii. What is/are your reason(s) for the choice under question 5c.i?
……
……
……

6. Are there enough urban green spaces in your community for your purposes?
a. Yes ( )
b. No ( )

7. What is/are your reason(s) for the choice under question 6?
……
……
……

B. Information on the Demand for Ecosystem Services of Urban Green Spaces

8. How satisfied are you with regards to the location of the urban green spaces in your community?
a. Very satisfied ( )
b. Satisfied ( )
c. Neutral ( )
d. Dissatisfied ( )
e. Very Dissatisfied ( )

9. What is/are your reason(s) for the choice under question 8?
……
……
……

10. How satisfied are you with the availability of urban green space(s) for your purposes in your community?
a. Very satisfied ( )
b. Satisfied ( )
c. Neutral ( )
d. Dissatisfied ( )
e. Very Dissatisfied ( )

11. What is/are your reason(s) for the choice under question 10?
……
……
……

12. Do you want (additional) urban green spaces in your community?
a. Yes ( )
b. No ( )

13. If yes, what type of urban green space(s) do you want in your community? Please select all that are applicable.
a. Park ( )
b. Street Trees ( )
c. Garden ( )
d. Wetland ( )
e. Sports Field ( )
f. Other ( ), please specify…….

14. If no, why don't you want urban green spaces in your community?
……
……
……

If no, please move to question 23.

15. Where do you want the urban green space(s) in your community?
a. Within your neighbourhood ( )
b. Outside your neighbourhood ( )

16. What is/are your reason(s) for the choice under question 15?
……
……
……

17. What is the estimated size of the urban green space(s) you want in your community?
a. Less than the size of a sports field ( )
b. Equal to the size of a sports field ( )
c. Twice the size of a sports field ( )
d. Thrice the size of a sports field ( )
e. Four times the size of a sports field ( )
f. Five or more times the size of a sports field ( )

18. What is/are your reason(s) for the choice under question 17?
……
……
……

19. As mentioned earlier urban green spaces can provide multiple benefits, for example, cooler temperature, erosion control, recreation, and noise reduction. Which of the following benefits do you and

other household members want to derive from the urban green spaces in your community? Select other and specify if the benefit(s) is/are not in the options available.

Ecosystem Service	**Select**
Medicinal Plants	
Food	
Wood Fuel	
Livestock grazing and fodder	
Temperature regulation	
Water flow and runoff regulation	
Erosion control	
Air quality regulation	
Noise reduction	
Windbreak	
Recreation	
Aesthetics	
Social cohesion	
Sense of place	
Heritage, cultural and historical values	
Soil protection	
Nutrient deposition	
Other, please specify …..	

20. How far do you want your house to be away from the nearest urban green space?
a. Less than 100 m ( )
b. 100-300 m ( )
c. 301-600 m ( )
d. 601-900 m ( )
e. 901 m and above ( )

21. What is/are your reason(s) for the choice under question 20?
……
……
……

22. How important is the state of the urban green space(s) for you for the provision of benefits in your community in terms of freedom from garbage, freedom from crime, and availability of vegetation cover?

22a.i. Free from garbage
a. Very High ( )
b. High ( )
c. Neutral ( )
d. Low ( )
e. Very Low ( )

22a.ii. What is/are your reason(s) for the choice under question 22a.i?
……
……
……

22b.i Free from criminal attacks
a. Very High ( )
b. High ( )
c. Neutral ( )
d. Low ( )
e. Very Low ( )

22b.ii. What is/are your reason(s) for the choice under question 22b.i?
……
……
……

22c.i Availability of vegetation cover (was explained by the interviewer as the availability of greenery)
a. Very High ( )
b. High ( )
c. Neutral ( )
d. Low ( )
e. Very Low ( )

22c.ii What is/are your reason(s) for the choice under question 22c.i?
……
……
……

C. Suggestions for Improvement and Background Information of Respondent

23. In your opinion, what should be done about urban green spaces in your community for the effective provision of benefits?
……
……
……

24. Gender of the respondent
a. Man ( )
b. Woman ( )

25. May I know your age please? …….

26. Highest level of education attained by the respondent
a. No Formal Education
b. Basic (Primary, Middle and JSS/JHS) ( )
c. Secondary (SSS/SHS and Secondary) ( )
d. Post Middle/ Sec. Cert./Diploma (Teacher training/ College of education, Agric, Nursing, University Diploma, HND, etc) ( )

e. Tertiary (Bachelor's Degree and Post Graduate or higher ( )
(Source: Ghana Statistical Service, 2012)

27. Any additional comment(s)
……
……
……

Thank you very much for your time

Appendix 2b: Key informants interview guides

Hello, my name is Rexford Osei Owusu, an MSc. student from the University of Twente, Faculty of Geo-information Science and Earth Observation (ITC), in the Netherlands. I am undertaking research titled, *"Urban Green in Deprived Urban Areas: The Case of Kumasi, Ghana"*. The study mainly seeks to analyze to what extend residents can enjoy what urban green spaces provide for them, for example, cooler temperatures, erosion control, and food. In this study, urban green spaces are defined as any land area either public or private, such as parks, trees, gardens, wetlands, and open green spaces. Also, ecosystem services are referred to as the benefits derived from the urban green spaces. The study's outcome would be useful in informing decision-making in terms of spatial planning and management of urban green spaces in deprived urban areas.

Therefore, this interview seeks to derive information from key informants who are experts in the fields of urban green spaces and deprived urban areas in Kumasi. For my study, I have chosen to focus on Ayigya Zongo and Dakodwom. Since you are …… I have also contacted you. Can you please spare some time to participate in the interview and answer some questions which are scheduled for about 45 minutes? There are no right or wrong answers to answering the questions.
Please be assured that any information provided would be treated with the privacy it deserves and used purely for academic purposes. Your name would not be mentioned in the study, rather only your position in your department will be mentioned. With your kind permission, I would like to record the interview for reference. Before we proceed do you have any questions or concerns about this interview?

A. Questions for the Physical Planning Official, Kumasi Metropolitan Assembly

1. How long have you been working in this department?
2. What is the role of the department in Kumasi?
3. For my study I have chosen to focus on Ayigya Zongo and Dakodwom. What role does the department play in planning ecosystem services of urban green spaces in Ayigya Zongo and Dakodwom?
4. What role does the department play in planning and managing Ayigya Zongo and Dakodwom?
5. Urban green spaces provide various ecosystem services such as cooler temperatures, erosion control, recreation, noise reduction, quality air, and food. What ecosystem services are provided by the available urban green spaces in Ayigya Zongo and Dakodwom?
6. Are the provided ecosystem services enough in Ayigya Zongo and Dakodwom?
7. Do residents need more of such ecosystem services in Ayigya Zongo and Dakodwom?
8. From your experiences, is there a gap between the provided ecosystem services of urban green spaces and the ecosystem services of urban green spaces that residents need in Ayigya Zongo and Dakodwom? **[If no gap, move to question 12].**
9. In your opinion, what can be done to bridge the gap between the provided ecosystem services of urban green spaces and the ecosystem services of urban green spaces that residents need in Ayigya Zongo and Dakodwom?
10. What kind of measures has your department taken to help bridge the gap?

11. Do you know of other measures taken by other departments to help bridge the gap? **[If yes, please what are they] [If no, move to question 12]**
12. Is there anything you would want to add?

B. Questions for the Senior Development Planning Official, Kumasi Metropolitan Assembly
1. How long have you been working in this department?
2. What is the role of the department in Kumasi?
3. For my study I have chosen to focus on Ayigya Zongo and Dakodwom. What role does the department play in planning ecosystem services of urban green spaces in Ayigya Zongo and Dakodwom?
4. What role does the department play in planning and managing Ayigya Zongo and Dakodwom?
5. Urban green spaces provide various ecosystem services such as cooler temperatures, erosion control, recreation, noise reduction, quality air, and food. What ecosystem services are provided by the available urban green spaces in Ayigya Zongo and Dakodwom?
6. Are the provided ecosystem services enough in Ayigya Zongo and Dakodwom?
7. Do residents need more of such ecosystem services in Ayigya Zongo and Dakodwom?
8. From your experiences, is there a gap between the provided ecosystem services of urban green spaces and the ecosystem services of urban green spaces that residents need in Ayigya Zongo and Dakodwom? **[If no gap, move to question 12].**
9. In your opinion, what can be done to bridge the gap between the provided ecosystem services of urban green spaces and the ecosystem services of urban green spaces that residents need in Ayigya Zongo and Dakodwom?
10. What kind of measures has your department taken to help bridge the gap?
11. Do you know of other measures taken by other departments to help bridge the gap? **[If yes, please what are they] [If no, move to question 12]**
12. Is there anything you would want to add?

C. Questions for the Physical Planning Official, Oforikrom Municipal Assembly
1. How long have you been working in this department?
2. What is the role of the department in Kumasi?
3. For my study I have chosen to focus on Ayigya Zongo and Dakodwom. What role does the department play in planning ecosystem services of urban green spaces in Ayigya Zongo and Dakodwom?
4. What role does the department play in planning and managing Ayigya Zongo and Dakodwom?
5. Urban green spaces provide various ecosystem services such as cooler temperatures, erosion control, recreation, noise reduction, quality air, and food. What ecosystem services are provided by the available urban green spaces in Ayigya Zongo and Dakodwom?
6. Are the provided ecosystem services enough in Ayigya Zongo and Dakodwom?
7. Do residents need more of such ecosystem services in Ayigya Zongo and Dakodwom?
8. From your experiences, is there a gap between the provided ecosystem services of urban green spaces and the ecosystem services of urban green spaces that residents need in Ayigya Zongo and Dakodwom? **[If no gap, move to question 12].**
9. In your opinion, what can be done to bridge the gap between the provided ecosystem services of urban green spaces and the ecosystem services of urban green spaces that residents need in Ayigya Zongo and Dakodwom?
10. What kind of measures has your department taken to help bridge the gap?
11. Do you know of other measures taken by other departments to help bridge the gap? **[If yes, please what are they] [If no, move to question 12]**
12. Is there anything you would want to add?

D. Questions for the Senior Lecturers of the Department of Planning, Kwame Nkrumah University of Science and Technology (KNUST), Kumasi

1. How long have you been working in this department?
2. For my study I have chosen to focus on Ayigya Zongo and Dakodwom. Have you conducted any research related to ecosystem services of urban green spaces in Ayigya Zongo and Dakodwom?
3. What was the research about and its main findings?
4. Urban green spaces provide various ecosystem services such as cooler temperatures, erosion control, recreation, noise reduction, quality air, and food. What ecosystem services are provided by the available urban green spaces in Ayigya Zongo and Dakodwom?
6. In your view as a researcher, are the provided ecosystem services enough in Ayigya Zongo and Dakodwom?
7. In your views as a researcher, do residents need more of such ecosystem services in Ayigya Zongo and Dakodwom?
8. In your view as a researcher, is there a gap between the provided ecosystem services of urban green spaces and the ecosystem services of urban green spaces that residents need in Ayigya Zongo and Dakodwom? **[If no gap, move to question 12].**
9. In your opinion as a researcher, what can be done to bridge the gap between the provided ecosystem services of urban green spaces and the ecosystem services of urban green spaces that residents need in Ayigya Zongo and Dakodwom?
10. Is there anything you would want to add?

Thank you very much for your time

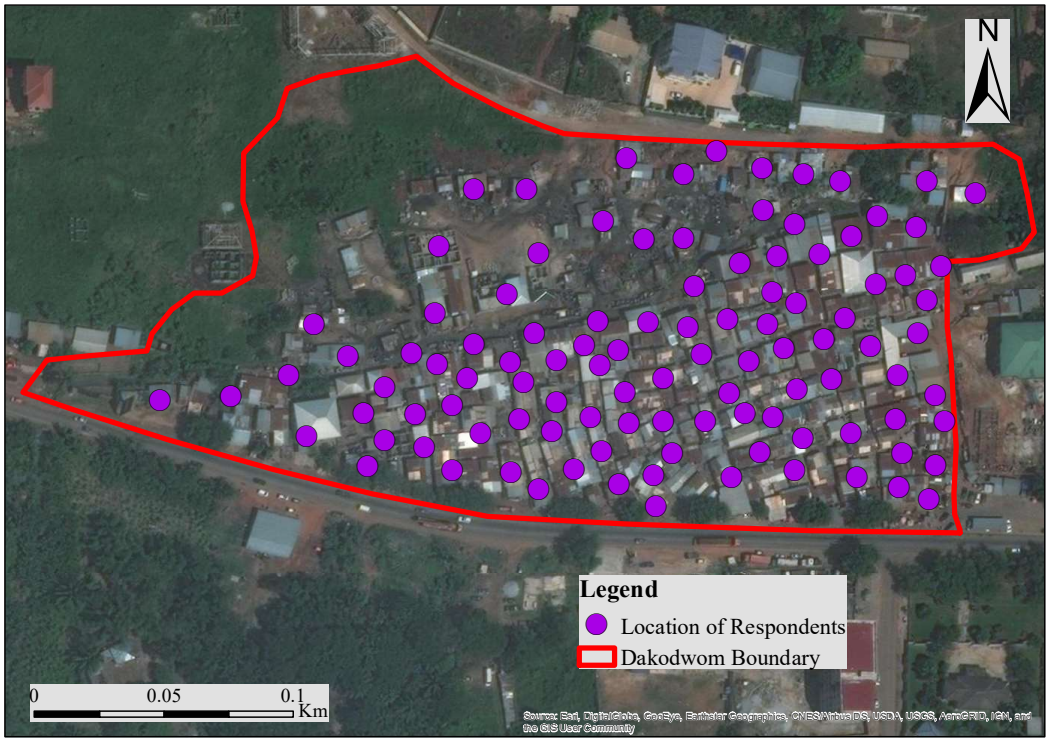
Appendix 3: Research matrix of the study

Research Questions	Methods of Data Collection	Software & Tools	Methods of Data Analysis	Anticipated Results
Overall Research Objective: To analyse the match between supply of and demand for ES of UGS in selected deprived urban areas of Kumasi				
Sub-objective 1: To assess the level of supply of ES of UGS in the selected deprived urban areas of Kumasi				
✓ What type of green spaces are available in the selected deprived urban areas of Kumasi?	Household Survey, Key Informants Interviews ArcGIS online basemap (World imagery)	KoBoToolbox, KoBocollect App, Zoom Video Conference, ArcGIS 10.8.1, ATLAS.ti, SPSS, Excel	Spatial Analysis, Descriptive Statistics, Content Analysis	Different types of UGS available in the selected deprived urban areas
✓ What ES are provided by these urban green spaces in the selected deprived urban areas of Kumasi?	Household Survey, Key Informants Interviews	KoBoToolbox, KoBocollect App, Zoom Video Conference, ATLAS.ti, SPSS, Excel	Descriptive Statistics, Content Analysis	The types of ES provided by the available UGS in the selected deprived urban areas
✓ What is the current state of the available UGS for the provision of ES in the selected deprived urban areas of Kumasi?	Household Survey, Key Informants Interviews	KoBoToolbox, KoBocollect App, Zoom Video Conference, ATLAS.ti, SPSS, Excel	Descriptive Statistics, Content Analysis	The state of the available UGS for the provision of ES in the selected deprived urban areas of Kumasi
Sub-objective 2: To assess the level of demand for ES of UGS in the selected deprived urban areas of Kumasi				
✓ What is the level of satisfaction on the available UGS for ES provision by residents in the selected deprived urban areas of Kumasi?	Household Survey, Key Informants Interviews	KoBoToolbox, KoBocollect App, Zoom Video Conference, ATLAS.ti, SPSS, Excel	Descriptive Statistics, Content Analysis	The satisfaction levels of residents on the size, number, and location of UGS for Es provision in the selected deprived urban areas (very good, good, neutral, bad, very bad)
✓ Who is demanding for ES of UGS in the selected deprived urban areas of Kumasi?	Household Survey, Key Informants Interviews	KoBoToolbox, KoBocollect App, Zoom Video	Descriptive Statistics, Content Analysis	The characteristics of people demanding for ES of UGS in the selected deprived urban areas of

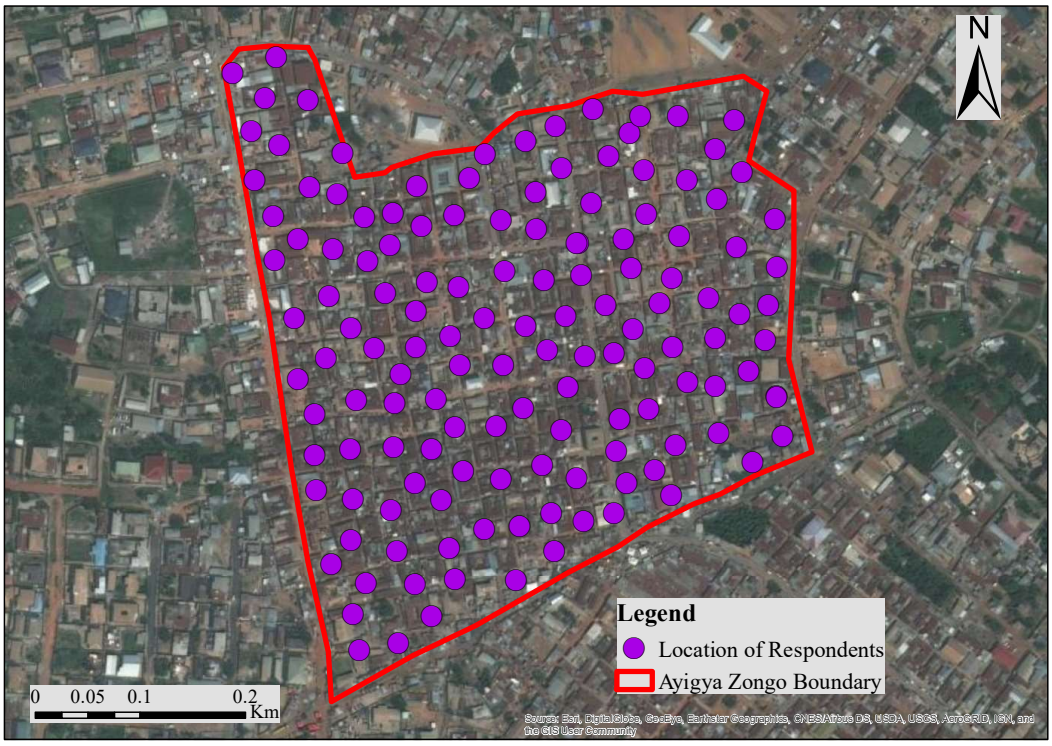
		Conference, ATLAS.ti, SPSS, Excel		Kumasi
✓ What kind of ES of UGS are being demanded for in the selected deprived urban areas of Kumasi?	Household Survey, Key Informants Interviews	KoBoToolbox, KoBocollect App, Zoom Video Conference, ATLAS.ti, SPSS, Excel	Descriptive Statistics, Content Analysis	The kind of ES of UGS that are being demanded for by residents of the selected deprived urban areas
✓ How do residents of the selected deprived urban areas of Kumasi value the state of UGS for the provision of ES?	Household Survey, Key Informants Interviews	KoBoToolbox, KoBocollect App, Zoom Video Conference, ATLAS.ti, SPSS, Excel	Descriptive Statistics, Content Analysis	The value of that the residents attached to on the state of UGS for the provision of ES in the selected deprived urban areas
Sub-objective 3: To assess the gap between the level of supply of and demand for ES of UGS in the selected deprived urban areas of Kumasi				
✓ Does the supply of ES of UGS meet the demand in selected deprived urban areas of Kumasi?	Results of sub-objective 1 and 2, Key Informants Interviews		Content Analysis	Yes or No
✓ What potential gap can be identified between the level of supply of and demand for ES of UGS in the selected deprived urban areas of Kumasi?	Results of sub-objective 1 and 2, Key Informants Interviews		Content Analysis	The level of supply exceeds demand/ the level demand exceeds supply
Sub-objective 4: To determine how the identified gap can be used to inform decision making in the selected deprived urban areas of Kumasi				
✓ How can the identified gap be used to inform spatial planning decisions of UGS in the selected deprived urban areas of Kumasi?	Key Informants Interviews	Zoom Video Conference, ATLAS.ti	Content Analysis	The way forward with regard to spatial planning of UGS in the selected deprived urban areas of Kumasi
✓ How can identified gap be used to inform management decisions of UGS in the selected deprived urban areas of Kumasi?	Key Informants Interviews	Zoom Video Conference, ATLAS.ti	Content Analysis	The way forward for the management of UGS in selected deprived urban areas of Kumasi

Appendix 4: Locations of the respondents

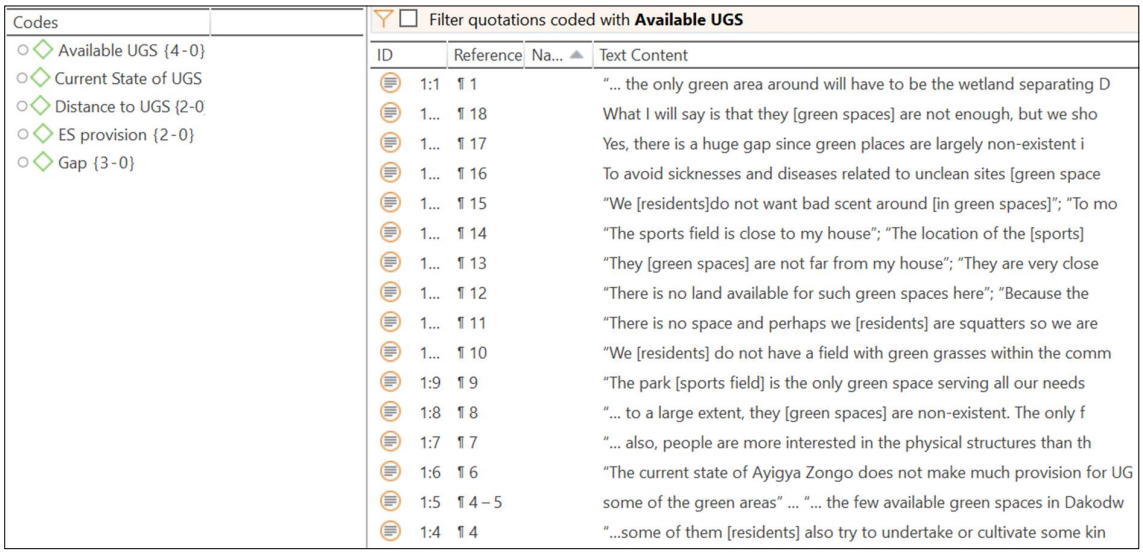
Appendix 4a: Location of the respondents in Dakodwom



Appendix 4b: Location of the respondents in Ayigya Zongo



Appendix 5: Quotations generated from the transcripts in ATLAS.ti



Codes

- Available UGS {4-0}
- Current State of UGS
- Distance to UGS {2-0
- ES provision {2-0}
- Gap {3-0}

Filter quotations coded with **Available UGS**

ID	Reference	Na...	Text Content
1:1	¶ 1		"... the only green area around will have to be the wetland separating D
1...	¶ 18		What I will say is that they [green spaces] are not enough, but we sho
1...	¶ 17		Yes, there is a huge gap since green places are largely non-existent i
1...	¶ 16		To avoid sicknesses and diseases related to unclean sites [green space
1...	¶ 15		"We [residents]do not want bad scent around [in green spaces]"; "To mo
1...	¶ 14		"The sports field is close to my house"; "The location of the [sports]
1...	¶ 13		"They [green spaces] are not far from my house"; "They are very close
1...	¶ 12		"There is no land available for such green spaces here"; "Because the
1...	¶ 11		"There is no space and perhaps we [residents] are squatters so we are
1...	¶ 10		"We [residents] do not have a field with green grasses within the comm
1:9	¶ 9		"The park [sports field] is the only green space serving all our needs
1:8	¶ 8		"... to a large extent, they [green spaces] are non-existent. The only f
1:7	¶ 7		"... also, people are more interested in the physical structures than th
1:6	¶ 6		"The current state of Ayigya Zongo does not make much provision for UG
1:5	¶ 4 – 5		some of the green areas" ... "... the few available green spaces in Dakodw
1:4	¶ 4		"...some of them [residents] also try to undertake or cultivate some kin

Appendix 6: Results of the Chi-square test

Appendix 6a: Results of the Chi-square test between perception on the current state of UGS and other variables

	Dakodwom		Ayigya Zongo	
Variable	**Statistic value**	**sig.**	**Statistic value**	**sig.**
Freedom from Garbage				
Gender	11.184*	0.025**	3.910	0.418
Age	18.344	0.565	27.348	0.126
Education Level	9.657	0.884	19.594	0.239
Estimated distance to available UGS	17.258	0.140	21.241	0.169
Perceived type of available UGS	1.166	0.273	50.948*	0.005**
Freedom from Crime				
Gender	1.959	0.743	4.690	0.321
Age	23.712	0.255	19.645	0.480
Education Level	21.852	0.148	21.733	0.152
Estimated distance to available UGS	28.041*	0.005**	20.191	0.212
Perceived type of available UGS	147.190	0.173	35.674	0.151
Availability of Vegetation Cover				
Gender	1.054	0.902	3.209	0.523
Age	18.407	0.561	17.138	0.644
Education Level	21.327	0.166	23.013	0.113
Estimated distance to available UGS	31.646*	0.002**	18.131	0.316
Perceived type of available UGS	167.119*	0.021**	38.857	0.083

*Likelihood ratio value considered when more than 20% of cells have expected count less than 5
**Statistical significance at 0.05 level

Appendix 6b: Results of the Chi-square test between satisfaction with UGS availability and location and other variables

	Dakodwom		Ayigya Zongo	
Variable	**Statistic value**	**sig.**	**Statistic value**	**sig.**
UGS Availability				
Gender	2.460	0.652	4.344	0.362
Age	15.509	0.707	16.967	0.655
Education Level	27.728*	0.034**	24.184	0.086
Estimated distance to available UGS	36.927*	0.000**	46.453*	0.000**
Perceived type of available UGS	140.818	0.707	59.892*	0.002**
UGS Location				
Gender	2.699	0.609	2.173	0.704
Age	23.002	0.289	26.639	0.146
Education Level	18.695	0.285	19.814	0.229
Estimated distance to available UGS	13.285	0.349	54.148*	0.000**
Perceived type of available UGS	123.232	0.695	46.445*	0.016**

*Likelihood ratio value considered when more than 20% of cells have expected count less than 5
**Statistical significance at 0.05 level

Appendix 7: Relationship between demographic characteristics of respondents and demand aspects

Appendix 7a: Type of UGS demanded for considering demographic characteristics of respondents

Dakodwom

	Gender						Age												Highest Level of Education Attained											
Type of UGS	**M**	**%**	**F**	**%**	**∑**	**%**	**18-25**	**%**	**26-35**	**%**	**36-45**	**%**	**46-55**	**%**	**56-65**	**%**	**66+**	**%**	**∑**	**%**	**N**	**%**	**B**	**%**	**PM**	**%**	**S**	**%**	**T**	**%**	**∑**	**%**
ST	8	18.2	11	18.0	19	18.1	0	0.0	9	23.7	1	4.2	4	22.2	4	36.4	1	20.0	19	18.1	2	11.8	11	22.4	0	0.0	6	16.7	0	0.0	19	18.1
SF	23	52.3	25	41.0	48	45.7	4	44.4	20	52.6	10	41.7	8	44.4	5	45.5	1	20.0	48	45.7	7	41.2	24	49.0	0	0.0	17	47.2	0	0.0	48	45.7
G	8	18.2	16	26.2	24	22.9	2	22.2	11	28.9	5	20.8	5	27.8	1	9.1	0	0.0	24	22.9	5	29.4	10	20.4	0	0.0	10	27.8	0	0.0	24	22.9
W	0	0.0	1	1.6	1	1.0	0	0.0	1	2.6	0	0.0	0	0.0	0	0.0	0	0.0	1	1.0	0	0.0	1	2.0	0	0.0	0	0.0	0	0.0	1	1.0

Ayigya Zongo

	Gender						Age												Highest Level of Education Attained											
Type of UGS	**M**	**%**	**F**	**%**	**∑**	**%**	**18-25**	**%**	**26-35**	**%**	**36-45**	**%**	**46-55**	**%**	**56-65**	**%**	**66+**	**%**	**∑**	**%**	**N**	**%**	**B**	**%**	**PM**	**%**	**S**	**%**	**T**	**%**	**∑**	**%**
ST	14	25.5	24	27.9	38	27.0	10	37.0	10	24.4	6	17.6	6	28.6	5	38.5	1	20.0	38	27.0	5	16.1	16	29.6	1	20.0	14	31.8	2	28.6	38	27.0
SF	26	47.3	42	48.8	68	48.2	14	51.9	23	56.1	12	35.3	9	42.9	8	61.5	2	40.0	68	48.2	15	48.4	29	53.7	3	60.0	18	40.9	3	42.9	68	48.2
G	11	20.0	26	30.2	37	26.2	7	25.9	13	31.7	10	29.4	5	23.8	1	7.7	1	20.0	37	26.2	5	16.1	14	25.9	3	60.0	13	29.5	2	28.6	37	26.2
W	3	5.5	2	2.3	5	3.5	1	3.7	2	4.9	2	5.9	0	0.0	0	0.0	0	0.0	5	3.5	0	0.0	2	3.7	0	0.0	2	4.5	1	14.3	5	3.5

Gender
Male (M); Female (F)

Highest level of education attained
None (N); Basic (B); Post middle (PM); Secondary (S); Tertiary (T)

Type of UGS
Street trees (ST); Sports field (SF); Garden (G); Wetland (W)

Appendix 7b: Size of UGS demanded for considering demographic characteristics of respondents

Dakodwom

	Gender						Age												Highest Level of Education Attained											
UGS Size	**M**	**%**	**F**	**%**	**∑**	**%**	**18-25**	**%**	**26-35**	**%**	**36-45**	**%**	**46-55**	**%**	**56-65**	**%**	**66+**	**%**	**∑**	**%**	**N**	**%**	**B**	**%**	**PM**	**%**	**S**	**%**	**T**	**%**	**∑**	**%**
1	15	34.1	15	24.6	30	28.6	1	11.1	17	44.7	5	20.8	4	22.2	3	27.3	0	0.0	30	28.6	5	29.4	14	28.6	0	0.0	11	30.6	0	0.0	30	28.6
2	7	15.9	13	21.3	20	19.0	2	22.2	6	15.8	6	25.0	4	22.2	1	9.1	1	20.0	20	19.0	4	23.5	11	22.4	0	0.0	5	13.9	0	0.0	20	19.0
3	3	6.8	6	9.8	9	8.6	1	11.1	3	7.9	2	8.3	1	5.6	1	9.1	1	20.0	9	8.6	1	5.9	4	8.2	0	0.0	4	11.1	0	0.0	9	8.6
4	1	2.3	1	1.6	2	1.9	0	0.0	0	0.0	0	0.0	0	0.0	2	18.2	0	0.0	2	1.9	0	0.0	0	0.0	0	0.0	2	5.6	0	0.0	2	1.9
5	0	0.0	1	1.6	1	1.0	0	0.0	1	2.6	0	0.0	0	0.0	0	0.0	0	0.0	1	1.0	0	0.0	1	2.0	0	0.0	0	0.0	0	0.0	1	1.0

Ayigya Zongo

	Gender						Age												Highest Level of Education Attained											
UGS Size	**M**	**%**	**F**	**%**	**∑**	**%**	**18-25**	**%**	**26-35**	**%**	**36-45**	**%**	**46-55**	**%**	**56-65**	**%**	**66+**	**%**	**∑**	**%**	**N**	**%**	**B**	**%**	**PM**	**%**	**S**	**%**	**T**	**%**	**∑**	**%**
1	14	25.5	22	25.6	36	25.5	8	29.6	11	26.8	7	20.6	6	28.6	2	15.4	2	40.0	36	25.5	8	25.8	14	25.9	2	40.0	10	22.7	2	28.6	36	25.5
2	11	20.0	20	23.3	31	22.0	6	22.2	14	34.1	5	14.7	2	9.5	4	30.8	0	0.0	31	22.0	5	16.1	18	33.3	0	0.0	7	15.9	1	14.3	31	22.0
3	6	10.9	15	17.4	21	14.9	4	14.8	7	17.1	4	11.8	3	14.3	3	23.1	0	0.0	21	14.9	2	6.5	5	9.3	1	20.0	11	25.0	2	28.6	21	14.9
4	3	5.5	3	3.5	6	4.3	2	7.4	0	0.0	1	2.9	2	9.5	0	0.0	1	20.0	6	4.3	2	6.5	1	1.9	1	20.0	2	4.5	0	0.0	6	4.3
5	0	0.0	3	3.5	3	2.1	1	3.7	0	0.0	2	5.9	0	0.0	0	0.0	0	0.0	3	2.1	1	3.2	2	3.7	0	0.0	0	0.0	0	0.0	3	2.1

Gender
Male (M); Female (F)

Highest level of education attained
None (N); Basic (B); Post middle (PM); Secondary (S); Tertiary (T)

Distance
Less than the size of a sports field (1)
Equal to the size of a sports field (2)
Twice the size of a sports field (3)
Thrice the size of a sports field (4)
Four times the size of a sports field (5)

Appendix 7c: Preferred distance to the nearest UGS from residential houses considering demographic characteristics of respondents

Dakodwom

	Gender						Age												Highest Level of Education Attained											
Distance	**M**	**%**	**F**	**%**	**∑**	**%**	**18-25**	**%**	**26-35**	**%**	**36-45**	**%**	**46-55**	**%**	**56-65**	**%**	**66+**	**%**	**∑**	**%**	**N**	**%**	**B**	**%**	**PM**	**%**	**S**	**%**	**T**	**%**	**∑**	**%**
1	16	36.4	18	29.5	34	32.4	0	0.0	16	42.1	7	29.2	7	38.9	3	27.3	1	20.0	34	32.4	8	47.1	13	26.5	0	0.0	13	36.1	0	0.0	34	32.4
2	5	11.4	10	16.4	15	14.3	1	11.1	6	15.8	4	16.7	1	5.6	2	18.2	1	20.0	15	14.3	1	5.9	9	18.4	0	0.0	5	13.9	0	0.0	15	14.3
3	2	4.5	7	11.5	9	8.6	1	11.1	5	13.2	0	0.0	1	5.6	2	18.2	0	0.0	9	8.6	1	5.9	5	10.2	0	0.0	3	8.3	0	0.0	9	8.6
4	2	4.5	1	1.6	3	2.9	1	11.1	0	0.0	2	8.3	0	0.0	0	0.0	0	0.0	3	2.9	0	0.0	3	6.1	0	0.0	0	0.0	0	0.0	3	2.9
5	1	2.3	0	0.0	1	1.0	1	11.1	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	1.0	0	0.0	0	0.0	0	0.0	1	2.8	0	0.0	1	1.0

Ayigya Zongo

	Gender						Age												Highest Level of Education Attained											
Distance	**M**	**%**	**F**	**%**	**∑**	**%**	**18-25**	**%**	**26-35**	**%**	**36-45**	**%**	**46-55**	**%**	**56-65**	**%**	**66+**	**%**	**∑**	**%**	**N**	**%**	**B**	**%**	**PM**	**%**	**S**	**%**	**T**	**%**	**∑**	**%**
1	19	34.5	24	27.9	43	30.5	9	33.3	15	36.6	6	17.6	5	23.8	6	46.2	2	40.0	43	30.5	9	29.0	20	37.0	0	0.0	12	27.3	2	28.6	43	30.5
2	9	16.4	25	29.1	34	24.1	9	33.3	7	17.1	9	26.5	5	23.8	3	23.1	1	20.0	34	24.1	6	19.4	13	24.1	1	20.0	12	27.3	2	28.6	34	24.1
3	5	9.1	13	15.1	18	12.8	3	11.1	9	22.0	3	8.8	3	14.3	0	0.0	0	0.0	18	12.8	3	9.7	7	13.0	2	40.0	5	11.4	1	14.3	18	12.8
4	1	1.8	1	1.2	2	1.4	0	0.0	1	2.4	1	2.9	0	0.0	0	0.0	0	0.0	2	1.4	0	0.0	0	0.0	1	20.0	1	2.3	0	0.0	2	1.4
5	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0

Gender
Male (M); Female (F)

Highest level of education attained
None (N); Basic (B); Post middle (PM); Secondary (S); Tertiary (T)

Distance
Less than 100 m (1)
101-300 m (2)
301-600 m (3)
601-900 m (4)
901 m and above (5)

Appendix 7d: ES of UGS demanded for considering demographic characteristics of respondents

Dakodwom

	Gender						Age														Highest Level of Education Attained											
ES	**M**	**%**	**F**	**%**	**∑**	**%**	**18-25**	**%**	**26-35**	**%**	**36-45**	**%**	**46-55**	**%**	**56-65**	**%**	**66+**	**%**	**∑**	**%**	**N**	**%**	**B**	**%**	**PM**	**%**	**S**	**%**	**T**	**%**	**∑**	**%**
PS																																
M	5	11.4	8	13.1	13	12.4	1	11.1	5	13.2	2	8.3	3	16.7	1	9.1	1	20.0	13	12.4	2	11.8	6	12.2	0	0.0	5	13.9	0	0.0	13	12.4
F	7	15.9	8	13.1	15	14.3	0	0.0	8	21.1	2	8.3	4	22.2	1	9.1	0	0.0	15	14.3	2	11.8	6	12.2	0	0.0	7	19.4	0	0.0	15	14.3
W	1	2.3	2	3.3	3	2.9	0	0.0	1	2.6	0	0.0	1	5.6	1	9.1	0	0.0	3	2.9	0	0.0	2	4.1	0	0.0	1	2.8	0	0.0	3	2.9
L	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
∑	**13**	**41.9**	**18**	**58.1**	**31**	**10.7**	**1**	**3.2**	**14**	**45.2**	**4**	**12.9**	**8**	**25.8**	**3**	**9.7**	**1**	**3.2**	**31**	**10.7**	**4**	**12.9**	**14**	**45.2**	**0**	**0.0**	**13**	**41.9**	**0**	**0.0**	**31**	**10.7**
RS																																
T	10	22.7	12	19.7	22	21.0	3	33.3	11	28.9	2	8.3	3	16.7	3	27.3	0	0.0	22	21.0	2	11.8	14.0	28.6	0	0.0	6	16.7	0.0	0.0	22	21.0
WF	1	2.3	4	6.6	5	4.8	0	0.0	2	5.3	1	4.2	0	0.0	1	9.1	1	20.0	5	4.8	1	5.9	3.0	6.1	0	0.0	1	2.8	0.0	0.0	5	4.8
E	4	9.1	3	4.9	7	6.7	0	0.0	3	7.9	1	4.2	3	16.7	0	0.0	0	0.0	7	6.7	1	5.9	4.0	8.2	0	0.0	2	5.6	0.0	0.0	7	6.7
AR	9	20.5	13	21.3	22	21.0	2	22.2	9	23.7	2	8.3	5	27.8	3	27.3	1	20.0	22	21.0	2	11.8	11.0	22.4	0	0.0	9	25.0	0.0	0.0	22	21.0
N	3	6.8	1	1.6	4	3.8	0	0.0	2	5.3	2	8.3	0	0.0	0	0.0	0	0.0	4	3.8	2	11.8	1.0	2.0	0	0.0	1	2.8	0.0	0.0	4	3.8
WB	3	6.8	3	4.9	6	5.7	0	0.0	3	7.9	0	0.0	2	11.1	1	9.1	0	0.0	6	5.7	1	5.9	3.0	6.1	0	0.0	2	5.6	0.0	0.0	6	5.7
∑	**30**	**45.5**	**36**	**54.5**	**66**	**22.8**	**5**	**7.6**	**30**	**45.5**	**8**	**12.1**	**13**	**19.7**	**8**	**12.1**	**2**	**3.0**	**66**	**22.8**	**9**	**13.6**	**36.0**	**29.8**	**0**	**0.0**	**21**	**31.8**	**0.0**	**0.0**	**66**	**22.8**
CS																																
R	20	45.5	25	41.0	45	42.9	3.0	33.3	18	47.4	11	45.8	6	33.3	5.0	45.5	2	40.0	45	42.9	6	35.3	24.0	49.0	0	0.0	15	41.7	0.0	0.0	45	42.9
AE	12	27.3	8	13.1	20	19.0	1.0	11.1	12	31.6	4	16.7	3	16.7	0.0	0.0	0	0.0	20	19.0	5	29.4	6.0	12.2	0	0.0	9	25.0	0.0	0.0	20	19.0
SC	15	34.1	9	14.8	24	22.9	0.0	0.0	11	28.9	5	20.8	3	16.7	4.0	36.4	1	20.0	24	22.9	4	23.5	12.0	24.5	0	0.0	8	22.2	0.0	0.0	24	22.9
SP	4	9.1	4	6.6	8	7.6	0.0	0.0	1	2.6	1	4.2	3	16.7	2.0	18.2	1	20.0	8	7.6	0	0.0	5.0	10.2	0	0.0	3	8.3	0.0	0.0	8	7.6
H	9	20.5	15	24.6	24	22.9	2.0	22.2	10	26.3	7	29.2	2	11.1	2.0	18.2	1	20.0	24	22.9	5	29.4	8.0	16.3	0	0.0	11	30.6	0.0	0.0	24	22.9
∑	**60**	**49.6**	**61**	**50.4**	**121**	**41.7**	**6.0**	**5.0**	**52**	**43.0**	**28**	**23.1**	**17**	**14.0**	**13.0**	**10.7**	**5**	**4.1**	**121**	**41.7**	**20**	**16.5**	**55.0**	**45.5**	**0**	**0.0**	**46**	**38.0**	**0.0**	**0.0**	**121**	**41.7**

Ayigya Zongo

	Gender						Age														Highest Level of Education Attained											
ES	**M**	**%**	**F**	**%**	**∑**	**%**	**18-25**	**%**	**26-35**	**%**	**36-45**	**%**	**46-55**	**%**	**56-65**	**%**	**66+**	**%**	**∑**	**%**	**N**	**%**	**B**	**%**	**PM**	**%**	**S**	**%**	**T**	**%**	**∑**	**%**
PS																																
M	3	5.5	15	17.4	18	12.8	4	14.8	4	9.8	6	17.6	3	14.3	1	7.7	0	0.0	18	12.8	3	9.7	7	13.0	1	20.0	7	15.9	0	0.0	18	12.8
F	4	7.3	16	18.6	20	14.2	4	14.8	5	12.2	5	14.7	4	19.0	1	7.7	1	20.0	20	14.2	3	9.7	9	16.7	1	20.0	7	15.9	0	0.0	20	14.2
W	1	1.8	3	3.5	4	2.8	0	0.0	2	4.9	1	2.9	1	4.8	0	0.0	0	0.0	4	2.8	0	0.0	2	3.7	0	0.0	2	4.5	0	0.0	4	2.8
L	2	3.6	4	4.7	6	4.3	2	7.4	3	7.3	1	2.9	0	0.0	0	0.0	0	0.0	6	4.3	1	3.2	2	3.7	0	0.0	3	6.8	0	0.0	6	4.3
∑	**10**	**20.8**	**38**	**79.2**	**48**	**17.8**	**10**	**20.8**	**14**	**29.2**	**13**	**27.1**	**8**	**16.7**	**2**	**4.2**	**1**	**2.1**	**48**	**17.8**	**7**	**14.6**	**20**	**41.7**	**2**	**4.2**	**19**	**39.6**	**0**	**0.0**	**48**	**17.8**
RS																																
T	7	12.7	15	17.4	22	15.6	6	22.2	5	12.2	4	11.8	2	9.5	4	30.8	1	20.0	22	15.6	3	9.7	8	14.8	1	20.0	9	20.5	1	14.3	22	15.6
WF	2	3.6	2	2.3	4	2.8	1	3.7	0	0.0	2	5.9	0	0.0	1	7.7	0	0.0	4	2.8	0	0.0	1	1.9	0	0.0	3	6.8	0	0.0	4	2.8
E	4	7.3	12	14.0	16	11.3	5	18.5	4	9.8	2	5.9	1	4.8	3	23.1	1	20.0	16	11.3	3	9.7	5	9.3	0	0.0	7	15.9	1	14.3	16	11.3
AR	12	21.8	18	20.9	30	21.3	9	33.3	10	24.4	6	17.6	2	9.5	3	23.1	0	0.0	30	21.3	4	12.9	12	22.2	2	40.0	11	25.0	1	14.3	30	21.3
N	4	7.3	9	10.5	13	9.2	2	7.4	7	17.1	4	11.8	0	0.0	0	0.0	0	0.0	13	9.2	2	6.5	8	14.8	2	40.0	1	2.3	0	0.0	13	9.2
WB	7	12.7	10	11.6	17	12.1	4	14.8	3	7.3	3	8.8	4	19.0	3	23.1	0	0.0	17	12.1	2	6.5	7	13.0	0	0.0	7	15.9	1	14.3	17	12.1

∑	**36**	**35.3**	**66**	**64.7**	**102**	**37.9**	**27**	**26.5**	**29**	**28.4**	**21**	**20.6**	**9**	**8.8**	**14**	**13.7**	**2**	**2.0**	**102**	**37.9**	**14**	**13.7**	**41**	**40.2**	**5**	**4.9**	**38**	**37.3**	**4**	**3.9**	**102**	**37.9**
CS																																
R	24	43.6	55	64.0	79	56.0	16	59.3	26	63.4	16	47.1	10	47.6	9	69.2	2	40.0	79	56.0	15	48.4	36	66.7	4	80.0	21	47.7	3	42.9	79	56.0
AE	7	12.7	14	16.3	21	14.9	5	18.5	10	24.4	5	14.7	0	0.0	0	0.0	1	20.0	21	14.9	4	12.9	8	14.8	1	20.0	7	15.9	1	14.3	21	14.9
SC	19	34.5	28	32.6	47	33.3	6	22.2	16	39.0	10	29.4	7	33.3	7	53.8	1	20.0	47	33.3	11	35.5	25	46.3	2	40.0	6	13.6	3	42.9	47	33.3
SP	10	18.2	17	19.8	27	19.1	8	29.6	8	19.5	6	17.6	3	14.3	1	7.7	1	20.0	27	19.1	2	6.5	13	24.1	2	40.0	9	20.5	1	14.3	27	19.1
H	16	29.1	24	27.9	40	28.4	7	25.9	15	36.6	8	23.5	4	19.0	5	38.5	1	20.0	40	28.4	9	29.0	16	29.6	2	40.0	10	22.7	3	42.9	40	28.4
∑	**76**	**35.5**	**138**	**64.5**	**214**	**79.6**	**42**	**19.6**	**75**	**35.0**	**45**	**21.0**	**24**	**11.2**	**22**	**10.3**	**6**	**2.8**	**214**	**79.6**	**41**	**19.2**	**98**	**45.8**	**11**	**5.1**	**53**	**24.8**	**11**	**5.1**	**214**	**79.6**

Gender
Male (M); Female (F)

Highest level of education attained
None (N); Basic (B); Post middle (PM); Secondary (S); Tertiary (T)

Ecosystem Services (ES)

Provisioning Services (PS)
Medicinal plants (M)
Food (F)
Wood Fuel (W)
Livestock grazing and fodder (L)

Regulating Services (RS)
Temperature regulation (T)
Water flow and runoff regulation (WF)
Erosion prevention (E)
Air quality regulation (AR)
Noise reduction (N)
Windbreak (WB)

Cultural Services (CS)
Recreation (R)
Aesthetics (AE)
Social cohesion (SC)
Sense of place (SP)
Heritage, cultural and historical values (H)

Appendix 7e: Value of the state of UGS with regard to demographic characteristics of respondents

Dakodwom

	Gender						Age												Highest Level of Education Attained											
UGS Value	**M**	**%**	**F**	**%**	**∑**	**%**	**18-25**	**%**	**26-35**	**%**	**36-45**	**%**	**46-55**	**%**	**56-65**	**%**	**66+**	**%**	**∑**	**%**	**N**	**%**	**B**	**%**	**PM**	**%**	**S**	**%**	**T**	**%**	**∑**	**%**
FFG																																
1	0	0.0	3	4.9	3	2.9	0	0.0	0	0.0	2	8.3	1	5.6	0	0.0	0	0.0	3	2.9	1	5.9	1	2.0	0	0.0	1	2.8	0	0.0	3	2.9
2	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
3	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
4	7	15.9	13	21.3	20	19.0	0	0.0	10	26.3	4	16.7	3	16.7	3	27.3	0	0.0	20	19.0	3	17.6	10	20.4	0	0.0	7	19.4	0	0.0	20	19.0
5	19	43.2	20	32.8	39	37.1	4	44.4	17	44.7	7	29.2	5	27.8	4	36.4	2	40.0	39	37.1	6	35.3	19	38.8	0	0.0	14	38.9	0	0.0	39	37.1
FFC																														0.0		
1	0	0.0	3	4.9	3	2.9	0	0.0	0	0.0	2	8.3	1	5.6	0	0.0	0	0.0	3	2.9	1	5.9	1	2.0	0	0.0	1	2.8	0	0.0	3	2.9
2	0	0.0	1	1.6	1	1.0	0	0.0	1	2.6	0	0.0	0	0.0	0	0.0	0	0.0	1	1.0	0	0.0	1	2.0	0	0.0	0	0.0	0	0.0	1	1.0
3	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
4	5	11.4	14	23.0	19	18.1	0	0.0	9	23.7	4	16.7	4	22.2	1	9.1	1	20.0	19	18.1	3	17.6	11	22.4	0	0.0	5	13.9	0	0.0	19	18.1
5	21	47.7	18	29.5	39	37.1	4	44.4	17	44.7	7	29.2	4	22.2	6	54.5	1	20.0	39	37.1	6	35.3	17	34.7	0	0.0	16	44.4	0	0.0	39	37.1
AVC																														0.0		
1	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
2	1	2.3	1	1.6	2	1.9	0	0.0	0	0.0	2	8.3	0	0.0	0	0.0	0	0.0	2	1.9	2	11.8	0	0.0	0	0.0	0	0.0	0	0.0	2	1.9
3	2	4.5	3	4.9	5	4.8	0	0.0	3	7.9	1	4.2	1	5.6	0	0.0	0	0.0	5	4.8	2	11.8	2	4.1	0	0.0	1	2.8	0	0.0	5	4.8
4	5	11.4	13	21.3	18	17.1	0	0.0	11	28.9	3	12.5	2	11.1	1	9.1	1	20.0	18	17.1	2	11.8	9	18.4	0	0.0	7	19.4	0	0.0	18	17.1
5	18	40.9	19	31.1	37	35.2	4	44.4	13	34.2	7	29.2	6	33.3	6	54.5	1	20.0	37	35.2	4	23.5	19	38.8	0	0.0	14	38.9	0	0.0	37	35.2

Ayigya Zongo

	Gender						Age												Highest Level of Education Attained											
UGS Value	**M**	**%**	**F**	**%**	**∑**	**%**	**18-25**	**%**	**26-35**	**%**	**36-45**	**%**	**46-55**	**%**	**56-65**	**%**	**66+**	**%**	**∑**	**%**	**N**	**%**	**B**	**%**	**PM**	**%**	**S**	**%**	**T**	**%**	**∑**	**%**
FFG																																
1	4	7.3	5	5.8	9	6.4	3	11.1	2	4.9	0	0.0	1	4.8	3	23.1	0	0.0	9	6.4	3	9.7	4	7.4	0	0.0	1	2.3	1	14.3	9	6.4
2	2	3.6	1	1.2	3	2.1	1	3.7	0	0.0	0	0.0	2	9.5	0	0.0	0	0.0	3	2.1	1	3.2	1	1.9	0	0.0	1	2.3	0	0.0	3	2.1
3	2	3.6	5	5.8	7	5.0	2	7.4	1	2.4	0	0.0	1	4.8	2	15.4	1	20.0	7	5.0	1	3.2	5	9.3	0	0.0	1	2.3	0	0.0	7	5.0
4	10	18.2	25	29.1	35	24.8	10	37.0	11	26.8	11	32.4	1	4.8	1	7.7	1	20.0	35	24.8	4	12.9	12	22.2	3	60.0	14	31.8	2	28.6	35	24.8
5	16	29.1	27	31.4	43	30.5	5	18.5	18	43.9	18	52.9	8	38.1	3	23.1	1	20.0	43	30.5	9	29.0	18	33.3	1	20.0	13	29.5	2	28.6	43	30.5
FFC																																
1	3	5.5	4	4.7	7	5.0	1	3.7	3	7.3	0	0.0	0	0.0	3	23.1	0	0.0	7	5.0	2	6.5	4	7.4	0	0.0	0	0.0	1	14.3	7	5.0
2	1	1.8	2	2.3	3	2.1	1	3.7	2	4.9	0	0.0	0	0.0	0	0.0	0	0.0	3	2.1	0	0.0	2	3.7	0	0.0	1	2.3	0	0.0	3	2.1
3	2	3.6	10	11.6	12	8.5	4	14.8	2	4.9	4	11.8	0	0.0	2	15.4	0	0.0	12	8.5	2	6.5	4	7.4	0	0.0	6	13.6	0	0.0	12	8.5
4	8	14.5	20	23.3	28	19.9	7	25.9	5	12.2	6	17.6	7	33.3	1	7.7	2	40.0	28	19.9	7	22.6	11	20.4	2	40.0	7	15.9	1	14.3	28	19.9
5	20	36.4	27	31.4	47	33.3	8	29.6	20	48.8	9	26.5	6	28.6	3	23.1	1	20.0	47	33.3	7	22.6	19	35.2	2	40.0	16	36.4	3	42.9	47	33.3
AVC																																
1	3	5.5	11	12.8	14	9.9	4	14.8	2	4.9	3	8.8	2	9.5	2	15.4	1	20.0	14	9.9	1	3.2	9	16.7	0	0.0	4	9.1	0	0.0	14	9.9
2	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
3	2	3.6	10	11.6	12	8.5	4	14.8	3	7.3	4	11.8	1	4.8	0	0.0	0	0.0	12	8.5	1	3.2	6	11.1	1	20.0	3	6.8	1	14.3	12	8.5
4	9	16.4	16	18.6	25	17.7	9	33.3	6	14.6	4	11.8	3	14.3	1	7.7	2	40.0	25	17.7	4	12.9	8	14.8	1	20.0	10	22.7	2	28.6	25	17.7
5	20	36.4	26	30.2	46	32.6	4	14.8	21	51.2	8	23.5	7	33.3	6	46.2	0	0.0	46	32.6	12	38.7	17	31.5	2	40.0	13	29.5	2	28.6	46	32.6

Gender
Male (M); Female (F)

Highest level of education attained
None (N); Basic (B); Post middle (PM); Secondary (S); Tertiary (T)

Level of UGS Importance
Very low (1); Low (2); Neutral (3); High (4); Very high (5)

Appendix 8: Variation in the state of vegetation cover availability and value attached to it by respondents

Dakodwom							
		Value of UGS State (Demand)					
		0.00	**Low**	**Neutral**	**High**	**Very high**	**Total**
Current State of UGS (Supply)	**0.00**	0	0	0	0	1	**1**
	Bad	9	0	0	0	6	**15**
	Very bad	16	2	3	4	15	**40**
	Neutral	8	0	1	2	7	**18**
	Good	2	0	1	9	5	**17**
	Very good	8	0	0	3	3	**14**
	Total	**43**	**2**	**5**	**18**	**37**	**105**
Ayigya Zongo							
		Value of UGS State (Demand)					
		0.00	**Low**	**Neutral**	**High**	**Very high**	**Total**
Current State of UGS (Supply)	**0.00**	0	0	0	0	3	**3**
	Bad	3	13	1	3	6	**26**
	Very bad	11	1	2	2	6	**22**
	Neutral	15	0	5	8	16	**44**
	Good	11	0	3	9	14	**37**
	Very good	4	0	1	3	1	**9**
	Total	**44**	**14**	**12**	**25**	**46**	**141**