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Climate Change Resilience

Exploring socio-ecological system resilience for livelihood effects of climate change in peri-urban areas

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Cover: Bee keepers towards attending a bee hive at Kazimzumbwi forest reserve.
(photo: Lazaro Eliyah Mngumi, Feb. 2018)

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Abstract

Ecosystem services are increasingly regarded as having the potential for building resilience to the effects of climate change in urban and peri-urban areas. Despite this, the knowledge of ecosystem services typologies aligned with analysis of how they might contribute in building resilience for specific effects of climate change is largely lacking, especially in peri-urban areas in Sub-Saharan Africa. This lacuna explains in part the limited mainstreaming of ecosystem services into climate change resilience pathways.

The overarching aim of this Thesis is to investigate the potential contribution of cultural and provisioning ecosystem services in building resilience for the livelihood effects of climate change in peri-urban areas in Sub-Saharan Africa from a socio-ecological perspective. The Thesis analyses two progressive case studies, which have been complementing each other at different levels of both empirical and theoretical analysis. Empirical data was collected via a systematic literature review, key informant interviews, focus group discussions and household surveys. The results were analysed following socio-ecological system resilience thinking, using adaptive capacity as the analytical frame.

The results show that literature is largely silent on the contribution of the cultural and provisioning ecosystem services in building resilience for climate change effects in peri-urban areas, especially in Sub-Saharan Africa. In the investigated case for socio-ecological system adaptive capacities it was revealed that the case has considerable resilience-building potential aligned to cultural and provisioning ecosystem services. These include: ecological knowledge (ethnic diversity, promising literacy rates, and diverse age cohorts), economic diversity (bee keeping industry, tourism industry in its multiple forms i.e. food tourism, arts and crafts tourism and nature tourism). It also showed that social milieu constitutes an important adaptive capacity towards building socio-ecological system resilience for the livelihood effects of climate change in peri-urban areas in Sub-Saharan Africa. This is substantiated by the analysed synergies between bonding and bridging social capital on the one hand and the identified cultural and provisioning ecosystem services based adaptive capacities towards building win-win-win resilience for the livelihood effects of climate change.

The Thesis contributes to knowledge on the potential contribution of cultural and provisioning ecosystem services in building effective resilience for livelihood effects of climate change in peri-urban areas. The results are revelatory and thus will invoke similar research elsewhere.

Keywords: Ecosystem services, peri-urban areas, socio-ecological system resilience, adaptive capacities, climate change, Sub-Saharan Africa

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Ustahimilivu wa mabadiliko ya hali ya hewa. Kuchunguza ustahimilivu wa mfumo wa kijamii na kiikolojia kwa athari za mabadiliko ya hali ya hewa katika kupata riziki kwenye maeneo ya pembezoni mwa miji

Ikisiri

Lengo kuu la Tasnifu hii ni kuchunguza mchango unaoweza kuwepo wa ikolojia-tamaduni na utoaji wa huduma za mfumo wa ikolojia katika kujenga ustahimilivu wa athari za mabadiliko ya hali ya hewa katika kupata riziki kwenye maeneo ya pembezoni mwa miji barani Afrika-Kusini mwa Jangwa la Sahara kwa kuangalia mtazamo wa kijamii na kiikolojia. Tasnifu hii inachambua mifano hai miwili, ambayo imekuwa ikisaidiana katika viwango tofauti vya uchambuzi wa hali halisi na nadharia. Takwimu za hali halisi zilikusanywa kupitia mapitio ya kimfumo ya marejeo, mahojiano na wahojiwa muhimu, majadiliano katika makundi na hojaji kwenye kaya. Matokeo yalichambuliwa kwa kufuata mtazamo wa ustahimilivu wa mfumo wa kijamii na kiikolojia, kwa kutumia uwezo wa kubadilika kama msingi wa uchambuzi.

Matokeo yanaonyesha kuwa maandishi yapo kimya kwa kiasi kikubwa kuhusu utamaduni na utoaji wa huduma za mfumo wa ikolojia katika kujenga ustahimilivu wa athari za mabadiliko ya hali ya hewa kwenye maeneo ya pembezoni mwa miji, hasa barani Afrika-Kusini mwa Jangwa la Sahara. Katika suala lililochunguzwa ili kuona uwezo wa kubadilika wa mfumo wa kijamii ilifahamika kuwa suala hilo lina uwezekano mkubwa wa kujenga uwezo wa ustahimilivu unaoshikanama na utamaduni na utoaji wa huduma za mfumo wa ikolojia. Hii ni pamoja na: maarifa ya kiikolojia (tofauti ya kikabila, viwango vizuri vya kujua kusoma na kuandika, na makundi ya umri tofauti), tofauti ya kiuchumi (tasnia ya ufugaji nyuki, tasnia ya utalii katika namna zake kadhaa, yaani utalii wa chakula, utalii wa sanaa na ufundi na utalii wa mazingira ya asili). Pia, ilionekana kuwa mtaji wa kijamii unajumuisha uwezo muhimu wa kubadilika kuelekea kujenga ustahimilivu wa mfumo wa kijamii na kiikolojia kwa athari za mabadiliko ya hali ya hewa katika kupata riziki kwenye maeneo ya pembezoni mwa miji barani Afrika-Kusini mwa Jangwa la Sahara. Hii inathibitishwa na muunganiko uliochambuliwa kati ya kuweka pamoja na kuunganisha mtaji wa kijamii kwa upande mmoja na utamaduni na utoaji wa huduma zilizobainishwa za mfumo wa ikolojia kulingana na uwezo wa kubadilika kuelekea kujenga ustahimilivu unaonufaisha pande zote kwa ajili ya athari za mabadiliko ya hali ya hewa katika kupata riziki.

Tasnifu hii inatoa mchango katika maarifa kuhusu mchango unaoweza kuwepo wa ikolojia-tamaduni na utoaji wa huduma za mfumo wa ikolojia katika kujenga ustahimilivu wenye ufanisi wa athari za mabadiliko ya hali ya hewa katika kupata riziki kwenye maeneo ya pembezoni mwa miji. Matokeo yake yanaibua mambo, kwa hiyo yataibua utafiti kama huu kwingineko

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Preface and acknowledgements

This Thesis has been a long time in the making. Trained as a statistician by default, I was steered into contemporary natural resource assessment and management.

It all started when I joined the Institute of Human Settlements Studies (IHSS) at Ardhi University (ARU) way back in 2010. Thanks to Prof. Shemdoe Riziki Silas, who inspired me to do my master studies in natural resource management. As part of my master Thesis at the Institute of Resource Assessment (IRA) at the University of Dar es Salaam (UDSM), I had an opportunity to do three months of field work at the Pugu and Kazimzumbwi forest reserves, exploring community perceptions and willingness to accept and execute REDD+ initiatives. I became fascinated by the gravity of climate change impacts amidst enormous ecosystem services. Also I came to understand that ecosystem services in these peri-urban forest reserves have been declining, partly due to climate change.

Back home, as part of my course work, I took a University course in climate change by Prof. Pius Yanda and Prof. Amos Majule. Part of the take home message from the course was on the interdependence between climate and natural resources. Additionally, I took a course on ecosystem services by Prof. Kangalawe Richard and another on ecology by Prof. Maganga Faustin. I was fascinated by the intricate connection existing between climate change and ecosystem services on one hand and ecology on the other. After completing my master studies, I went back to my working place. I participated in various research and consultancy projects, including landscape scale consultancy at Masito Ugalla ecosystem services before I got an opportunity for pursuing doctoral studies. Embarking on PhD studies was therefore an imperative opportunity for me to explore the interlinkages inherent between climate change and ecosystem services and in particular the contribution of

peri-urban ecosystem services in building socio-ecological resilience for the effects of climate change.

This Thesis evolved as part of the urban governance and municipal services project under partnership between the Department of Urban and Rural Development of the Swedish University of Agricultural Sciences (SLU) in Uppsala, Sweden and the Institute of Human Settlements Studies (IHSS) of Ardhi University in Dar es Salaam, Tanzania. As my PhD studies were jointly administered between the two above mentioned universities under a double degree scheme, I have also been privileged to have had several supervisors, which have guided me along the way. At SLU, I had several supervisors who played different roles at different stages of my PhD journey. I am especially thankful to Prof. Matthew Cashmore, who was my first main supervisor. He played an indispensable guiding role in the first half of my PhD training. His inquisitive and open-minded attitude towards research helped me learn how research might be approached from different viewpoints. Your questions and suggestions inspired me, directed my PhD work and gave me the impetus to move forward. I appreciate your routine - close follow ups and meetings, which constantly gave me a sense of being a doctoral student. Thank you also for taking care of my practical issues. I would like to thank the late Prof. Zeinab Tag-Eldeen in a special way. She played an invaluable role as a coordinator on the SLU side and she acted as the main supervisor towards the third quarter of my studies. As a coordinator, she always intervened to make things happen. As a supervisor, I will always remember her high level of constructive critique on my Thesis work. I will have to spend some quality time reflecting upon her insights until I realise their invaluable input to my Thesis.

I am very grateful for Dr. Antoienette Warnback's tremendous support and assistance as co-supervisor and later as coordinator. You are the only supervisor who has been persistently working with me, from the time I began my PhD to date. Your mult-layered critical comments and suggestions have been of great use in improving my work, both on Articles and the Kappa. You also took good care of my practical issues. I cannot forget the winter jacket you gave me on my first visit to Sweden and the bicycle promise. We had a nice moment when visited at your place and I greatly enjoyed the barbeque in the forest. It was both pleasing and rewarding to work with you. Many thanks also to Prof. Madeleine Granvik. She joined the supervisory team as the co-supervisor during the last half of my PhD training and later

stepped in as the main supervisor after the demise of Zeinab. You timely joined the supervisory team, which paved the way for a swift forward move following the death of Zeinab. Your humble but critical inquiries helped me to shape my work especially Article III and the Kappa.

At ARU, I was supported by Prof. Riziki Shemdoe, who was my first main supervisor on the ARU side during the initial stages of my Thesis. Dr. Makarius Victor Mdemu joined the supervisory team as the co-supervisor and later played the main supervisory role on the ARU side. He has remained with me to this day. You provided continuous mentorship, flexibility, optimism and encouragement that I needed. Your gentle but scientific inquisition provided me with invaluable input to my Thesis. I also want to thank my IHSS colleagues who have been of great support in different ways during my PhD studies.

My sincere thanks are given to Prof. Kjell Hansen from SLU and Prof. Wiebren Boonstra from Uppsala University for being my opponents in my 90% seminar. You provided me with invaluable comments, which helped me to make substantial improvement in my Thesis, especially on the readability of the Kappa. In the same spirit, I thank Sara Borgstrom, a Professor in Sustainable Urban Development at the Royal Institute of Technology (KTH), for being my opponent in my 50% seminar. Your comments were crucial, as they gave me confidence on the theoretical underpinnings as well as on the future trajectory of my Thesis.

I was grateful to have good PhD colleagues both at SLU and ARU. I would like to express my gratitute to Edson Sanga, Happiness Mlula, Maglan Sang'enoi, Said Nuhu and Stanslaus Butungo whom we have had similar experiences in our PhD Journey. I would also want to extend my heartful thanks to Linda Engstrom, Dil Khatri, Amalia Engstrom, Fengping Yang, Linus Karlsson, Andrea Cont, Paola Ledo, Daniel Valentini, Iddi Mwanyoka, Fares Kemwita, Modest Mourus, Hossein Kahyera, Martin Mpandikizi, Egino Milanzi, Jenista Urassa, Frank Nyanda, Valentine Luvara, Merezia Wilson, Juma Hossein, Redempta Athanas and Mesia Ilomo for your support and care. I am also grateful for both SLU and ARU management for taking care of the administrative issues across this training. At ARU special thanks are due to the SIDA-SAREC Project Management Committee (PMC) and on behalf of the PMC I wish to appreciate the vital role played by Prof. Gabriel Kassenga, Prof. Wilbard Kombe and Dr. Hidaya Kayuza.

On SLU side, I appreciate the invaluable role by Dr. Kristina Marquart, Bruno Santesson, Dr. Antoienette Warnback and the late Prof. Zeinab Tag-Eldeen.

I want to thank the Uppsala Seventh Day Adventist Church (Uppsala Advent Kyrkan) for naturing me spiritually during my stay in Sweden while pursuing my PhD studies. In particular Iam compelled to mention Ljubica Lindholm, Willy Palm, Yanick Munezero, Sadrick Kaneza as well as Noah Ncube for their support and fellowship. In the same spirit, I thank the University Seventh Day Adventist Church for taking care of me and naturing me spiritually during my stay in Tanzania while carrying out my studies.

My family has been of invaluable support and inspiration in my work. Therefore, I want to heartly thank my father the late Mr. Eliyah Mngumi, my mother Stella, and my brothers, Pr. Hudson, Fue, Mhando and Hon. Msumba for their continued love and for always believing in my ability to accomplish things in life. “Navahachenisha, mfumwa amufwie mbonea”. Finally, I thank my wife, Herieth, who throughout this journey has been of considerable support and care. You provided a good care to our children in my absence, thank you very much. No words can well express how grateful Iam of your help and support.

Dedication

To my wife, Herieth, who has held my hand throughout this journey; and to my children, Brighton, Brightness and Bennett, who missed my presence and fatherly touch and care while undergoing this training, and lastly to my dad the late Mr Eliyah Mngumi and my mother Stella Eliyah Mngumi, whose love, care, support and passion for life has been always a source of inspiration.

A revelatory case is a case by which a researcher has an access to explore a situation which has not been previously explored empirically!

Robert Yin

Contents

List of publications

This Thesis is based on the work contained in the following articles, referred to by Roman numerals in the text:

I. Mngumi, L.E. 2020. Ecosystem services potential for climate change resilience in peri-urban areas in Sub-Saharan Africa: Landscape and ecological engineering journal (2020). https://rdcu.be/b1pop.

II. Mngumi, L.E. 2019. Socio-ecological resilience to climate change effects in peri-urban areas: Insights from the Pugu and Kazimzumbwi forest reserves of Dar es Salaam, Tanzania. GeoJournal (2019). https://doi.org/10.1007/s10708-019-10071-9.

III. Mngumi, L. E. 2020. Exploring the contribution of social capital in building resilience for climate change effects in peri-urban areas, Dar es Salaam, Tanzania. Geojournal (2020). https://rdcu.be/b4jGL:

I’m the sole author of Articles I, II and III, and am therefore fully responsible regarding both the concepts and the empirical materials they contain.

List of tables

List of figures and images

Abbreviations

ACC DAR	Adapting to Climate Change in Coastal Dar es Salaam
CCIAM	Climate Change Impacts, Adaptation and Mitigation
CDM	Clean Development Mechanism
CIUP	Community Infrastructure Upgrading Programme
MEA	Millennium Ecosystem Assessment
IPCC	Intergovernmental Panel on Climate Change
NAMAS	Nationally Appropriate Mitigation Actions
NAPA	National Adaptation Plan of Action
PKFR	Pugu and Kazimzumbwi Forest Reserves
REDD	Reducing Emissions from Deforestation and Degradation
SPSS	Statistical Package for Social Sciences
SES	Socio-Ecological System
SESR	Socio-Ecological System Resilience
SUDP	Strategic Urban Development Plan
TEEB	The Economics of Ecosystems and Biodiversity
UNFCCC	United Nations Framework Convention on Climate Change
URT	United Republic of Tanzania

1 Introduction

This Chapter provides an overarching background of the topic studied in this Thesis. This background is clearly articulated in Section 1.1 which analyses scholarly and policy discourses aligned to this Thesis as well as articulation of the fields to which the outcomes of this research intends to contribute. Section 1.2 presents the context for the study and the definition of the problem that is explored. Section 1.3 subsequently presents the aim of the research followed by the description of the research questions that guided its theoretical and empirical exploration in Section 1.4. The Chapter ends with Section 1.5 outlining the structure and organisation of the Thesis which includes explaining the relation between the different Chapters, Sections as well as the appended peer reviewed Articles.

1.1 Background

There are a host of benefits that humans derive from nature, either directly or indirectly. On the one hand, direct benefits include fruit, fire wood, timber, water and enhancing traditional value practices. On the other hand, indirect benefits include air purification and climate regulation. The benefits define and shape human-nature relations. While, the benefits are largely natural, they have increasingly attracted the attention of both scholars and policy makers across different scales. This has resulted in their diverse conceptualisations, thereby increasing applications in varied development discourses. At the same time, scholars broadly describe the bundle of benefits derived from nature as 'ecosystem services'. Whilst the scholarship on ecosystem services has been growing generally, the potential contribution of cultural and provisioning ecosystem services in building resilience for

livelihood effects of climate change in peri-urban areas of Sub-Saharan Africa, has not been adequately explored. On the other hand, the claim that ecosystem services generally provide low-cost opportunities for building resilience to the effects of climate change in urban landscapes is increasingly favoured amongst the scientific community (Rosenzweig et al., 2018, Jones et al., 2012), and global policy cycles (UNHABITAT, 2015, UNFCCC, 2017). This chapter introduces the subject of this Thesis: the contribution of ecosystem services in climate change resilience building discourses in peri-urban areas of Sub-Saharan Africa. The next paragraphs substantiate the topicality and the relevance of this inquiry by critically reviewing literature from scholarly and policy cycles alike.

In the scholarly paradigm, there has been an increasing understanding that ecosystem services can potentially contribute to building resilience against the effects of climate change in cities (TEEB, 2012, McPhearson et al., 2015, Rosenzweig et al., 2018). According to TEEB (2012), the role of ecosystem services in climate change resilience in urban areas has been progressively surfacing, given the growing awareness of their provisioning, regulating, supporting and cultural benefits (details on these benefits are provided for in Section 3.1). Despite growing research on this subject (as hinted earlier), it can be argued that the focus has been skewed in at least three areas intrinsic to this Thesis. The first disparity is in regards to the skewed attention into some ecosystem service typologies (for details on ecosystem service typologies see Section 3.1). The richly researched services are discussed in the context of how they might generally contribute to climate change resilience and are supporting and regulating ecosystem services. The provisioning ecosystem services are discussed but not compared to the aforementioned. For instance, the supporting ecosystem services, such as wetlands, are argued to have the potential for reducing the physical exposure to floods by forming a natural protective barrier which acts as a buffer zone and thus mitigates the hazardous impacts of climate change (Sudmeier-Rieux et al., 2008, Barbier, 2006, Abramovitz et al., 2001). On the other hand, regulating services have largely been discussed in terms of climate change mitigation, (i.e. potential for carbon storage and sequestration) (Bolund and Hunhammar, 1999, Locatelli, 2016). Provisioning ecosystem services are largely analysed in the context of the potential for socio-economic resilience through the provision of essential services such as food, clothing, and construction materials (Abramovitz et al., 2001). On the other hand, whilst

cultural ecosystem services are included in all prominent ecosystem services typologies (Costanza et al., 1997, Daily, 1997, De Groot et al., 2002, MEA, 2005b), they have generally received little attention in the growing body of empirical ecosystem services research (Chan et al., 2012b, Locatelli, 2016). This partly explains why literature is largely silent on the potential contribution of cultural ecosystem services for climate change resilience (see also Section 3.1) (Locatelli, 2016). Another reason for slight attention to cultural ecosystem services is the focus on economic valuation. These services are particularly difficult and contentious to value in monetary terms (Chan et al., 2012a). In other words, the dominance of monetary analysis into ecosystem services research explains, to some extent, the limited understanding of values of cultural ecosystem services as compared to other ecosystem service typologies. According to Chan et al. (2012a), specific cultural ecosystem services, with limited focus on ecosystem services research include those associated with social cohesion, heritage values and recreation. This analysis indeed suggests deploying more social approaches into ecosystem services research, so as to unearth values often sidelined by monetary lenses. It is on this preface that this Thesis is in part emphasising exploring cultural ecosystem services, particularly the potential contribution to climate change resilience building-pathways.

A second gap in research regards how ecosystem services are potentially deployed in building resilience for the effects of climate change, which has a skewed focus towards the Global North. The research and literature is relatively skewed towards the Global North (McPhearson et al., 2016, Zasada, 2011), while the gap is relatively large in the Global South (Muthee et al., 2017). Muthee and coleagues further argue that the need for research on climate change resilience in the Global South is owing to the reality that the region is in multiple respects weakly positioned to adapt to climate change effects, particularly compared to the Global North. Indeed, the region claims to be characterised by less flexible systems (Kiunsi, 2013, Ricci, 2012), meaning social, economic, and infrastructure systems, which further places it on relatively unfavorable ground for deploying effective adaptation options. Given the context-laden nature of ecosystem services (Meli et al., 2014), what works in the Global North should not necessarily appeal in the Global South. This warrants the need for more research on the subject in the Global South.

Another important disparity in ecosystem services research regards to the rural-urban bias. Whilst research and policy on ecosystem services is generally on the rise, the emphasis on the urban and peri-urban areas has been largely limited (Gómez-Baggethun and Barton, 2013), especially in Sub-Saharan Africa (Costanza and Kubiszewski, 2012, McPhearson et al., 2016). Little attention from scholars in ecosystem services research in the urban and the peri-urban areas explains why the concept is largely perceived as abstract (Niemelä et al., 2010, Luederitz et al., 2015). This partly explains why it has been limitedly applied to climate change resilience, land use planning and other sustainable development discourses in the urban and the peri-urban contexts. At the same time, (Munroe et al., 2012, McPhearson et al., 2015), argue that peri-urban ecosystem services-based solutions offer potential for building resilience for climate change effects. Yet, this is happening in an era when the understanding that urban and peri-urban areas are increasing, is regarded as important for global policy responses to climate change (Habitat, 2011, Hoornweg et al., 2010, Dodman, 2009, McPhearson et al., 2015). As the foregoing discussion substantiates the importance of the subject of this Thesis from the scholarly milieu, the next paragraph discusses its relevance in the policy context.

This Thesis is intrinsic to a number of global policies articles including the Sustainable Development Goals (SDGs) and the New Urban Agenda 2030 (NUA). Regarding the SDGs, the subject of this research is complementary to Goal 11 (i.e. to 'make cities and the human settlements inclusive, safe, resilient and sustainable). Yet, despite focusing on Goal 11 amongst the 17 SDGs, NUA is increasingly regarded as an ideal framework for the implementation of the Sustainable Development Policies. This is premised by the reality that the world is becoming increasingly more urban, as nearly 55% of the world's population resides in urban settings (Ritchie and Roser, 2018). It follows, therefore, that cities should not only constitute the attention of the global climate change adaptation options, but also form the nucleus for realising other SDGs (UNHABITAT, 2013, UNHABITAT, 2017). It can be argued that in a broad perspective, this Thesis feeds into both ecosystem-based adaptation (EbA)[1] and urban climate change resilience policy discourses. Broadly, the United Nations Framework Convention on

[1] Ecosystem-based adaptation (EbA) involves safeguarding or restoring ecosystems as a means of helping human communities respond to the adverse effects of climate change (JONES, H. P., HOLE, D. G. & ZAVALETA, E. S. 2012. Harnessing nature to help people adapt to climate change. Nature Climate Change, 2**,** 504-509.

Climate Change (UNFCCC), acknowledges the imperatives of ecosystems to climate change resilience efforts. According to UNFCCC (2017),

> .... healthy ecosystems play an essential role in increasing the resilience of people to climate change. Climate change, however, can damage the ability of ecosystems to provide life-supporting services and to protect society from climate-related stressors. Adaptation to climate change therefore needs to strengthen the resilience of both communities and ecosystems... (p.23)

The UNFCCC underlines two crucial points aligned with this Thesis. Firstly, it highlights the intertwined relationship between ecosystem services and climate change effects. Indeed, it underscores the notion that ecosystem services might potentially contribute towards building community resilience to climate change effects. Secondly, UNFCCC posits that climate change might potentially damage ecosystem's ability to produce services that can protect society from climate change. This Thesis primarily deals with the first part of the notion, exploring how ecosystem services may potentially contribute to climate change resilience-pathways. Yet, as stated earlier, this Thesis stresses cultural and provisioning ecosystem services. The latter part of the notion (i.e. ecosystem services degradation triggered in part by climate change) has been a partial lived reality in most urban and peri-urban areas in Sub-Saharan Africa. This establishes an intrinsic preamble to this Thesis as substantiated in Section 2.2. Moreover, the description of the *win-win-win* phrase in Section 3.4, and that of the resilience of *what, to what and for whom*, addresses in part the issue of ecosystem welfare and implicitly contributes to halting ecosystem service degradation. At the same time, UNFCCC is in part shedding light on the red thread of this Thesis's theoretical framework. This is the systems 'thinking' perspective to resilience. The perspective is indeed a holistic view of resilience, which takes on board both social (social-economic) realities and ecological (ecosystem services) attributes as further clarified in Section 3.3. In ecosystem studies, this perspective is increasingly recognised as 'socio-ecological system resilience' and is clearly articulated in Section 3.4. This theoretical milieu (i.e. socio-ecological system resilience) is suitable for exploring the potential contribution of cultural and provisioning ecosystem services towards building resilience for livelihoods. Moreover, the theoretical milieu fuses well with adaptive capacity – an analytical frame of the Thesis (for details see Section 3.3 and 4.3.2). After an overall analysis of the relevance of the

subject of this Thesis, in both scholarly and policy contexts, the next Section contextualises the topic in a geographical study setting. This is coupled with the definition of the research issue engaged in this Thesis.

1.2 Context and problem definition

This Section contextualises the subject of this research to Dar es Salaam city in Tanzania, focusing to the peri-urban areas of Pugu and Kazimzumbwi socio-ecological systems. The explanations for the imperatives of the Pugu and Kazimzumbwi socio-ecological systems for this study are provided for in Section 2.4 and Section 4.2. Dar es Salaam is among the fastest growing cities in Sub-Saharan Africa (Roy et al., 2017). Its current population is estimated above 6.5 million, subject to a 2012 baseline (URT, 2012a). Moreover, statistical projections indicate that in the coming decades, the city is likely to grow at even higher rates and that by 2034 it is estimated to turn into a mega city (UNHABITAT, 2014). Subject to this trend, it is very likely that the rapid urbanisation rate will put pressure on green infrastructure, as well as on ecosystem services (Kiunsi, 2013), in peri-urban areas. The current urbanisation in Sub-Saharan Africa largely leads to urban sprawl into peri-urban areas (Lupala, 2016). However, whilst it is true that the rapid urbanisation poses potential challenges to both local and national government's development realisations, climate change reality (see Section 2.4) adds another equally substantial pressure. Despite attempts to address both causes and effects of climate change through mitigation and adaptation initiatives, studies (PASTART, 2017, Lupala and Maglan, 2015, IPCC, 2007), substantiate its continued existence and further project its uncertain future.

As noted earlier, there are enormous efforts in both policy and practice geared towards addressing the increasing threats of climate change in the city. However, it can be argued that there have been skewed resilience building interventions in urban areas at the expense of peri-urban areas. Research increasingly shows considerable interventions in urban areas as compared to peri-urban areas. This is argued in Article III and largely attributable to the growing infrastructure deficit challenge[2] in urban areas. In addition, the kind of resilience interventions in urban areas has primarily

[2] Infrastructure deficits refers to the inadequate infrastructure services. For instance, water supply, sanitation, solid and liquid waste management, roads, bridges and storm water drainage systems (Kiunsi, 2013).

been in the context of engineering parameters at the expense of social and ecological aspects (Aldrich and Meyer, 2015). For instance, the engineering related intervention programmes include the Community Infrastructure Upgrading Programme (CIUP) and the Strategic Urban Development Plan (SUDP). Others includes the Programme to Formalize Unplanned Areas through Residential Licenses (PFUARL), the 20,000 Plots Project, the Water and Sanitation Improvement Programme (WIP), and the City Wide Action Plan for Upgrading Unplanned Settlements in Dar es Salaam (PASTART, 2017, Kiunsi, 2013). These interventions have been prioritised to contribute to reducing the growing infrastructure deficit, whilst indirectly contributing to engineering resilience against climate change. This is further argued to be a common characteristic feature of urban areas across cities in Sub-Saharan Africa (Kiunsi, 2013). Yet, this is taking place despite the increasing evidence and understanding that it is largely social and ecological attributes and not merely physical infrastructure (engineering) that builds resilience (Adger, 2010). This is shedding some light on the potential need for exploring more social and ecological resilience building blocks in urban and peri-urban areas in Sub-Saharan Africa.

On another scale, climate change is no longer an abstract situation but a lived experience in Dar es Salaam, which harbours enormous impacts and effects on both urban and peri-urban areas. However, given the contrasting levels of infrastructure development between urban and peri-urban areas, the impacts and effects of climate change are crucially different. On the one hand, notable impacts of climate change in urban areas include frequent flooding and sea level rise (PASTART, 2017). As articulated in Article I, flooding is an increasing experience not only in Dar es Salaam, but also in cities across Sub-Saharan Africa. On the other hand, dominant climate change impacts in peri-urban areas in Sub-Saharan Africa include a change in rainfall and temperature patterns (Lupala and Maglan, 2015, Kiunsi, 2013) (see also Article I). At Pugu and Kazimzumbwi, a change in rainfall and temperature patterns are argued to lead to decreased crop yields and increased encroachment of largely provisioning ecosystem services (Lupala and Maglan, 2015). Moreover, the increasing encroachment of the provisioning ecosystem services forms part of the autonomous adaptation strategies to climate change effects by the adjacent communities (see Section 2.4). However, these strategies consequently result in counterproductive effects towards efforts levelled against climate change in the area. It is

against this backdrop that studies at the Pugu and Kazimzumbwi socio-ecological systems (Kashaigili et al., 2013a, Mngumi et al., 2014, Lupala, 2016), suggest the exploration of ecosystem services options for building win-win-win resilience for the livelihood induced effects of climate change in these peri-urban areas. The first win references community wellbeing and livelihoods based on ecosystem services. The second win owes to ecosystem services welfare, whereas the third win focusses on climate change friendly options (i.e. both mitigative and adaptive ones). In other words, the overarching issue is exploring ecosystem services in these peri-urban areas with potential to positively contribute to community livelihoods, enhancing ecosystem services welfare and subsidising both climate change adaptation and mitigation options.

1.3 Research aim

The overarching aim of this Thesis was to investigate the potential contribution of cultural and provisioning ecosystem services in building resilience for livelihood effects of climate change in peri-urban areas in Sub-Saharan Africa from a socio-ecological perspective. It also addresses the context knowledge gap regarding the *what* and *how* of the cultural and provisioning ecosystem services deployment for building a win-win-win resilience-pathway in peri-urban areas. This research as well contributes to this knowledge by using the Pugu and Kazimzumbwi socio-ecological systems as a revelatory case. This Thesis achieves its aim through the following objectives:

- Maps the potential of ecosystem services for building resilience for climate change effects in peri-urban areas in Sub -Saharan Africa
- Typifies cultural and provisioning ecosystem services and explores their potential for building resilience for livelihoods induced effects of climate change at Pugu and Kazimzumbwi socio-ecological system

These objectives are realised through conceptual and empirical explorations of the potential nexus between cultural and provisioning ecosystem services and the livelihood-induced effects of climate change. Two case studies are complimentarily engaged to establish and develop the research focus, determine conceptual domains and discuss and analyse the central concepts engaged in this Thesis. The two case studies are involved progressively at

different levels of both empirical and theoretical analysis (full detail provided in Section 4.2). Socio-ecological systems thinking is deployed to understand the empirical material from the case studies. At the same time, adaptive capacity is deployed as an analytical frame for analysing socio-ecological systems resilience-pathways. Through exploratory, iterative, reflective and progressive research approaches, the empirical material contributes to understanding the conceptual milieu of building socio-ecological system resilience for the livelihood effects of climate change in peri-urban areas

1.4 Research questions

The main research question guiding this Thesis is: How might the cultural and provisioning ecosystem services potentially contribute in building socio-ecological system resilience for livelihood induced effects of climate change in Sub-Saharan African peri-urban areas?

1.4.1 Specific research questions

RQI: What is the potential contribution of peri-urban ecosystem services for climate change resilience in Sub-Saharan Africa according to research?

RQII: How might the identified adaptive capacities in Pugu and Kazimzumbwi socio-ecological systems contribute in building resilience for livelihood induced effects of climate change?

RQIII: How might bonding and bridging social capital contribute in building resilience for livelihood induced effects of climate change in Pugu and Kazimzumbwi socio-ecological systems?

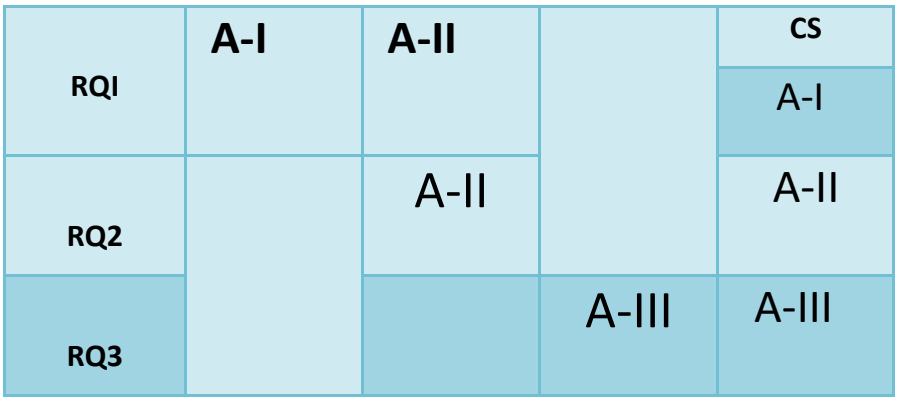

Figure 1. Research Questions (RQs) in relation to the Thesis Articles.

Each row represents a research question and the respective Articles that contributes in responding to that particular research question are shown on the columns. A-I: Article I; A-II: Article II; A-III: Article III: CS: Cover Story.

1.5 Structure of the Thesis

This Thesis consists of a cover essay composed of seven chapters and three appended yet published peer-reviewed scientific Articles (I-III). Article I formed the entry premise of the research topic explored in this Thesis (Case I). The Article responds to RQI, thereby situating the Thesis in the wider context of ecosystem services research delimited to a climate change-resilience building discourse in urban and peri-urban areas in Sub-Saharan Africa. Article II and III constitute the pinnacle of the Thesis (Case II). Article II is largely responding to RQII and in part to RQI by exploring the adaptive capacities of the Pugu and Kazimzumbwi socio-ecological systems. Article III responds to RQIII, exploring the contribution of bonding and bridging social capital towards building resilience for livelihood effects of climate change in the Pugu and Kazimzumbwi socio-ecological systems.

Chapter 1 provides an overarching introduction to the field that is studied. This includes a critical analysis of scholarly as well as policy positions on the topic of this Thesis. Included is an outline of the overarching background of the topic (Section 1.1), the context and problem definition (Section 1.2), research aim (Section 1.3), together with the research questions guiding the study (Section 1.4). Chapter 1 ends with this very Section (1.5), providing an

overall structure of the Thesis. Chapter 2 sets the context for the study for both Case I and II. The chapter provides imperative background information for the study by describing characteristics of cities in Sub-Saharan Africa, analysing policy environments intrinsic to this Thesis in Tanzania and socio-economic realities. The latter part, Section 2.4, describes Case II, a preamble on the geographic, ecosystem services and livelihood conditions of the Pugu and Kazimzumbwi socio-ecological systems. Chapter 3 provides the theoretical milieu of the Thesis. This includes a detailed theoretical analysis of various concepts engaged in this Thesis, the peri-urban discourse (Section 3.1), cultural and provisioning ecosystem services (Section 3.2), socio-ecological system (Section 3.3), and socio-ecological system resilience (Section 3.4). These concepts are critically analysed and later defined as they are deployed in this Thesis. Moreover, the Thesis' analytical frame, adaptive capacity, is discussed and contextualised on the basis of the deployed analytical lenses (social capital, economic diversity and ecological knowledge). Chapter 4 presents the methodological paths undertaken in this Thesis. The chapter starts by discussing the iterative, reflective progressive research approach engaged followed by a description of the research process. Selection criteria for the engaged study cases (i.e. Case I and Case II) is provided, followed by a detailed description of the data collection and analysis methods. Chapter 4 ends by presenting validity and reliability as reflected in this Thesis. The summary of the Articles chapter (Chapter 5) provides a brief outline of the appended scientific Articles (I-III) amalgamated with some reflections. Chapter 6 is designated to provide detailed discussions of the Thesis findings, which are aligned to the appended Articles. Three sub-themes are discussed: the ecosystem services and climate change resilience nexus, socio-ecological system's adaptive capacities and climate change resilience- building discourses, and the contribution of bonding social capital and bridging social capital in building resilience against climate change effects. Chapter 7 provides a conclusion to the Thesis, which includes summarised discussions of the Thesis' empirical and theoretical contribution as well as its implication to policy circles.

2 Setting the context

This chapter describes the context of the study for both Case I and II. On the one hand, the chapter is characterising the urban and peri-urban conditions in Sub-Saharan Africa, whereas on the other hand, it describes the policy context, social-economic, as well as environmental realities in Tanzania. Moreover, the latter part of the chapter focuses on contextualising an ecosystem services stance joined with the climate change reality in the Pugu and Kazimzumbwi socio-ecological systems, where the Thesis's empirical information is largely drawn from.

2.1 Characterising cities in Sub-Saharan Africa

Cities in Sub-Saharan Africa have many features in common in terms of social, economic, demographic and infrastructure conditions (Kiunsi, 2013). Yet, most of these cities are experiencing both infrastructure and climate change adaptation deficits (Kiunsi, 2013, Roberts et al., 2012). This is happening despite recent efforts to improve infrastructure and housing conditions for low-income groups (Kiunsi, 2013). On the one hand, the infrastructure deficit challenge (see also Section 1.2), in Sub-Saharan Africa cities results partly from inadequate human and capital resources to cope with rapid growth (Kiunsi, 2013). However, as expounded upon in Section 1.2, the infrastructure deficit challenge rationalises the engineering resilience dominance against climate change effects, at the expense of socio-ecological system pathways. The situation is further worsened by the unparalleled levels of population growth (Maconachie, 2016), which is closely linked to urbanisation. Nearly 90% of the world's urban population currently resides in low- and middle-income countries, mainly in Africa and Asia (Laros and

Jones, 2014, Birch, 2016). At the same time, rapid urbanisation is already occurring in Sub-Saharan Africa (Radford and James, 2013, Güneralp et al., 2017). Moreover, some cities in East Africa have already reached a population doubling time of 10-15 years (UNECA, 2014). As will be clarified later in Section 3.1, the population growth and urbanisation coupled with planning dilemmas leads to urban sprawl into peri-urban areas. On the other hand, there are multiple factors behind climate change adaptation deficits in Sub-Saharan Africa, including the destruction of green infrastructure (e.g. wetlands, forests, grasslands, productive soils) and inadequate capacity resulting from poverty, poor governance and lack of skills (Roberts et al., 2012, Maconachie, 2016). However, Sub-Saharan Africa's emerging urban and peri-urban areas are largely unplanned, which is closely associated with the growth of informal settlements, inadequate housing and basic services, and urban poverty (Yuen and Kumssa, 2010, Kombe, 2005). These characteristic features make urban and peri-urban dwellers in Sub-Saharan Africa susceptible to the effects of climate change. Moreover, risks, in a rapidly urbanising Sub-Saharan Africa, are increasingly associated with the effects of climate change on urban and peri-urban areas, given the massive ecosystem services degradation resulting from rapid peri-urban sprawl (IPCC, 2014). IPCC, argues that climate change impacts in urban and peri-urban areas threaten long-term economic development and human wellbeing. Moreover, climate change further complicates and challenges the realisations of the global imperatives of sustainable development and the new urban agenda in Sub-Saharan Africa (UNHABITAT, 2017). Yet, as discussed in Chapter 1, ecosystem services have the potential for building resilience to climate change in peri-urban areas. Subject to the previously discussed situation, the following Section presents a policy background intrinsic to this Thesis in the context of Tanzania.

2.2 Climate change and environmental policy context

As articulated in Section 1.3, this Thesis will explore the potential contribution of cultural and provisioning ecosystem services towards building socio-ecological system resilience for livelihood effects of climate change in peri-urban areas. Yet, this Section presents the policy setting in the context of Tanzania linked to this Thesis. As elucidated in Chapter 1 and Article I, climate change is a lived reality, with its far-reaching impacts being evident

in most parts of the world. It is further claimed to pose serious risks to poverty reduction and threatens to undo decades of development efforts. Moreover, the impacts are more pronounced in poor countries, such as Tanzania, with the least adaptive capacity (URT, 2012b). However, ecosystem services offer enormous cost-effective potential for building resilience against the effects of climate change. In other words, ecosystem services claim to inhabit adaptive capacities for building resilience against climate change, which constitutes a foci inquiry of this Thesis. Moreover, risks associated with climate change are already evident in various economic sectors essential to Tanzania's livelihood and provisions, including water resources, energy generation, food security, ecosystems and human health.

Overall, Tanzania is supportive of global climate change mitigation and adaptation initiatives. This is evidenced by its ratification of the UNFCCC and Kyoto Protocol in 1996 and 2002, respectively. In this regard, Tanzania has developed a National Adaptation Plan of Action (NAPA), National Adaptation Plans (NAPs) and the National Climate Change Strategy (NCCS). Moreover, subject to NAPA, NAPs and NCCS, climate change adaptation and mitigation concerns have been increasingly mainstreamed across other sector's policies, strategies, programmes and projects. Yet, this Thesis focuses on adaptation strategies, which according to (URT, 2012b), are of the highest priority for Tanzania. The primacy of adaptation, in lieu of mitigation, is owing to the fact that the country is not obliged to reduce greenhouse gas (GHGs) emissions, since it contributes minimally to global GHG concentrations. Notwithstanding, Tanzania is participating in a number of mitigation initiatives including the Clean Development Mechanism (CDM), Nationally Appropriate Mitigation Actions (NAMAs), Reducing Emissions from Degradation and Deforestation (REDD), and other carbon markets or trading activities (URT, 2012b). More intrinsic to this Thesis is the government commitment (as part of its climate change strategy) to:

I Build the capacity of Tanzania to adapt to climate change impacts and their effects
II Enhance the resilience of ecosystems to the challenges posed by climate change
III Support alternative livelihood initiatives for forest ecosystem services dependent communities.

Other policy articles intrinsic to this Thesis include National Forest Policy (1998), National Forest Act No. 14 (2002), Environmental Management Act No. 20 (2004) and the Land Use Planning Act No. 6 (2007). The National Forest Policy (1998) provides guidance on the management of forest reserves in Tanzania. The act gives mandates to the forest minister to designate forest reserves and hence publish in the national gazette and propose boundaries for forest reserves. The Land Use Act No 6 (2007) similar to the National Forest Act No 14 (2002) has provisions for protecting the environment and its ecosystems via effective and orderly land use planning. The act has provisions that prohibit land development in environmentally sensitive areas, such as forest reserves. It also protects their associated ecosystem services. Simultaneously, Section 49 of the Environmental Management Act No. 20 (2004) provides guidance for the management of national protected areas, including Pugu and Kazimzumbwi Forest Reserves, herein referred as Pugu and Kazimzumbwi socio-ecological systems (Case II). The act further recommends the preparation of environmental protection plans for identified areas of biological diversity, associated communities and other users and institutions. The Act also provides for earmarking the boundaries of the protected areas and prescribing measures against encroachment. However, despite well-articulated policy articles on both appropriate land use planning and the safeguarding and protection of sensitive ecosystems, such as protected areas and forest reserves, the lived reality suggests the opposite. Pugu and Kazimzumbwi socio-ecological systems reveal a decline in ecosystem services (as discussed in Section 2.4), which suggests questionable policy enforcement mechanisms.

2.3 The socio-economic background of Tanzania

The socio-economic condition constitutes an imperative prelude towards understanding the entry points of the socio-ecological system's resilience against the livelihoods effects of climate change (Section 2.4). Statistics increasingly show that Tanzania has made marked progress in development, evidenced by various indices. One of the crucial measures of development is the improvement in the Human Development Index (HDI[3]), whereby the index

[3]A composite index measuring average achievements in three basic dimensions of human development: a decent standard of living, a long and healthy life, and knowledge. The values of the index range from zero (low) to one (high).

shows an increase of 43.1% over the last 30-year period, giving Tanzania a score of 0.371 in 1985 and 0.531 in 2015. Based on its 2015 score, Tanzania ranks above the Sub-Saharan Africa average of 0.518 (ESRF, 2017). The country has shown considerable growth as viewed through other indices as well. For instance, according to the Multidimensional Poverty Index (MPI[4]), the country has significantly declined in poverty from 64 percent in 2010 to 47.7 percent in 2015 (ESRF, 2017). Further, results show a significant decline in severe poverty from 31.3 % in 2010 to 17.7 % in 2015 (Ibid). Yet, according to the income poverty index[5], income poverty has declined from 34.9 percent in 2010 to 30.4 percent in 2015. Accordingly, there was a decline in severe poverty[6] from 11.7 percent in 2010 to 10.8 percent in 2015 (Ibid). These findings correspond with that of the WorldBank (2015), suggesting that early signs of the emergence of the pro-poor growth are beginning to unfold in Tanzania (ESRF, 2017). This might explain in part why the country has recently been put under the category of middle income economies. Nevertheless, poverty remains widespread in the country and it is still categorised amongst countries with low levels of human development (ESRF, 2017, WorldBank, 2015). The increase in Tanzania's macroeconomic growth rate has disproportionately benefited its population and has further increased longstanding comprehensive inequality quagmire (Cleaver et al., 2010). This is in part explained by the heavy reliance on rain fed agriculture, while its contribution to the national economy is only around 26% (Chongela, 2015, Cleaver et al., 2010). Table 1 further shows an indicative percentage of poverty by varied income sources, of which the majority are agriculture related. Moreover, in spite of the promising macroeconomic growth, many households remain highly vulnerable to the frequent, yet growing climatic and economic shocks bearing deadly implications to crop yields and thereby food security (Cleaver et al., 2010). This has been typified at the Pugu and Kazimzumbwi socio-ecological systems, whereby it is increasingly claimed that climate change has contributed to rainfall variability and consequently a decrease in crop yields. The increasing variability is felt by a substantial amount of the population, owing to the continued reliance on rain fed agriculture (Arndt et

[4]A measure designed to capture the extent of deprivation that individuals face with respect to their standard of living, education and health.

[5] Proportion of people living below basic needs poverty line.

[6] Proportion of people living below the food poverty line.

al., 2012, Swai et al., 2012), which is highly susceptible to growing climate vagaries (Swai et al., 2012).

Table 1. Distribution of poverty by main source of income in Tanzania.

Cash income source	Percentage of the poor (%)
Sales of food crops	49.6
Sales of livestock	7.2
Sales of livestock products	1.4
Sales of cash crops	20.5
Wages and salaries in cash	3.6
Other casual cash earnings	4.9
Cash remittances	2.3
Fishing	1.5
Other	3.3

Source. Social and demographic statistics (URT, 2014).

On another account, 70.4% of the Tanzanian population is rural and resides in rural areas (URT, 2014). This indicates the percentage of the population that relies upon agriculture for survival. URT further reports the rapid increase in urbanisation, as the 2012 census has shown. The urban population grew by 67.5% from the 2002 census. There is, however, marked regional differences in the urbanisation rate across the country. The Coast region, where the Pugu and Kazimzumbwi reserves are located, has one of the highest urbanisation rates in the country, with an increase of the urban population by 92.9% in 2012, compared to 2002. Yet, in urban areas such as the Pugu and Kazimzumbwi socio-ecological systems, poverty is less pronounced compared with their rural counterparts. However, these statistics are highly aggregated. If such statistics are disaggregated to display urban against peri-urban, it is very likely that peri-urban areas would constitute a large portion of the poverty, which is at present aggregately claimed as urban.

2.4 Description of the Pugu and Kazimzumbwi socio-ecological systems

The Pugu and Kazimzumbwi socio-ecological systems (Figure 2) are composed of two adjacent peri-urban forest ecosystems (i.e. Pugu and Kazimzumbwi forest reserves). The two forest reserves and their adjacent communities form part of the case study area (see Section 3.1.2 and 4.2).

Yet, administratively, the Pugu and Kazimzumbwi socio-ecological systems are under the jurisdiction of the Kisarawe District Council (KDC) in the Coast Region of Tanzania. Moreover, these forest reserves are located along the border, separating the two regions (i.e. Dar es Salaam and Coast Regions) in Ilala and Kisarawe Districts, respectively. While Pugu forest reserve, gazetted in 1954, lies in the north-eastern part of the Pugu Hills, it is about 25 km southwest of Dar es Salaam and 20 km from the Indian Ocean. In addition, the forest is adjacent to the Kazimzumbwi Forest Reserve, gazetted in 1936 (Clarke and Dickinson, 1995).

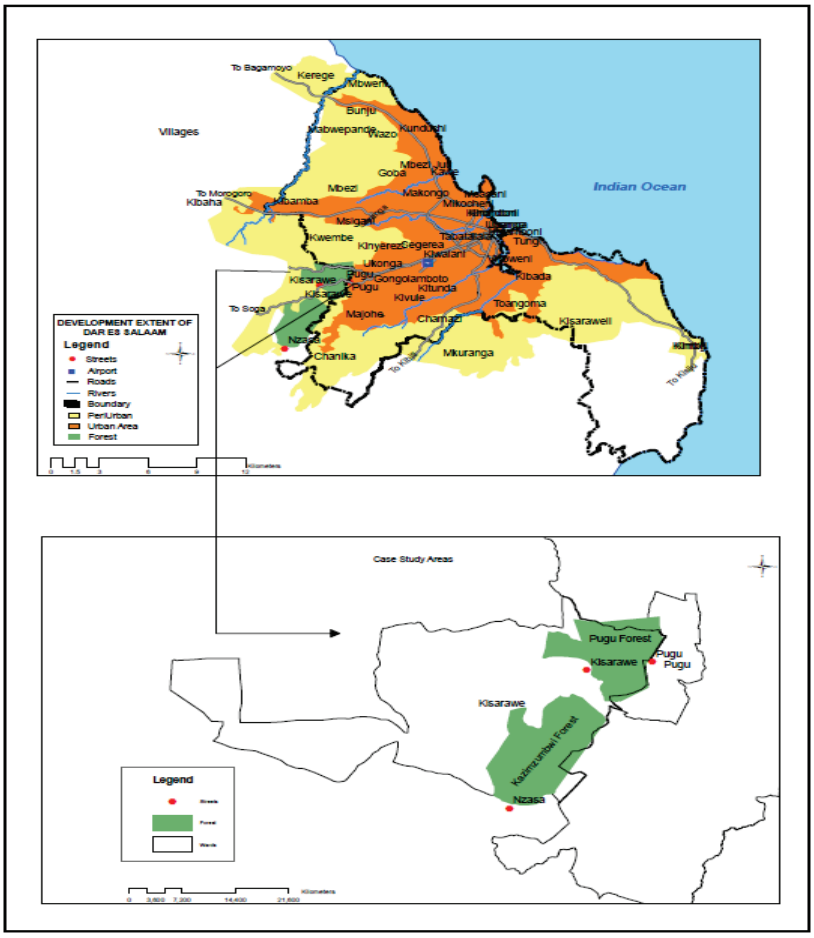

Figure 2. The Pugu and Kazimzumbwi socio-ecological systems. Source. Erimina Massawe; Ardhi University (2019).

However, the two forest reserves that form the Pugu and Kazimzumbwi socio-ecological systems are among few peri-urban forests in the world, which contain rich ecosystem services (Gwegime et al., 2013). It is due to the area's unique richness of both fauna and flora, that this Thesis argues of its potential for cultural ecosystem services tourism. Yet, as elucidated in Chapter 1 and later in Chapter 3 and 6, the potential for cultural ecosystem service tourism is discussed in the context of building resilience against livelihood effects of climate change. Notwithstanding such unique history, ecosystem services in these forest reserves have been rapidly declining in recent decades (Lupala, 2016). However, a number of factors behind the decline of ecosystem services are discussed. Yet, intrinsic to this Thesis two factors are elaborated upon (i.e. increasing anthropogenic activities and climate change). On the one hand, the diminishing ecosystem services in the Pugu and Kazimzumbwi socio-ecological systems are largely attributable to the increase in anthropogenic activities leading to deforestation and forest degradation (Lupala et al., 2014, Kashaigili et al., 2013b). However, historically, the increase in anthropogenic activities in these reserves is associated with the early 1970s villagilisation programme by the late Mwalimu Julius Nyerere, the first President of Tanzania (Burgess and Dickinson, 1993). The programme triggered rapid population growth, which led to the clearing of forests and substantial land use change. The rapid population growth is both a historic yet contemporary driver of declining peri-urban ecosystem services. This has led to a high demand for land for residential purposes (Burgess and Dickinson, 1993, Lupala et al., 2014). According to Lupala et al. (2014), the population in settlements surrounding the Pugu and Kazimzumbwi socio-ecological systems grew more than 39 times in 2012 from 1967. Moreover, population increase in these peri-urban areas puts pressure on resources, due to a high demand for land for settlements, farming, etc. This in turn leads to forest encroachment, and thereby a decline of ecosystem services. Lupala and colleagues further associate the rapid population growth with the increasing encroachment of nearby forest reserves and the decline of ecosystem services in both quality and quantity. Notable ecosystem services declined overtime in Pugu and Kazimzumbwi socio-ecological systems includes the number of plant and animal species, a decline in water quality, and the quantity of water in dams (Minaki) and rivers (Msimbazi, Mambizi, Mzumbwi, Kimani, Vikongoro, Nzasa and Nyeburu), and a decline in honey production. In addition, crop yields have been declining, which led to the reduction of the livelihood options for peri-urban dwellers.

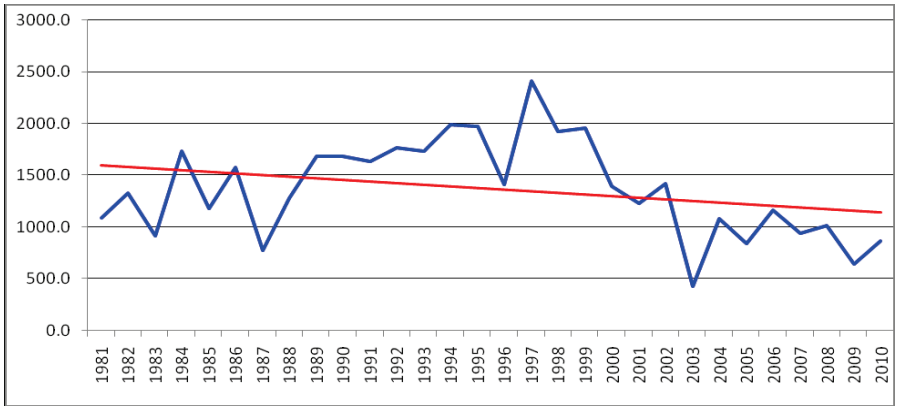

Figure 3: Trends in rainfall amount for Kisarawe in millimetres (1981-2010).*Source.*Lupala and Maglan (2015).

Yet, imperative to this Thesis, climate change is also argued to be another driver for the decline of provisioning ecosystem services in the Pugu and Kazimzumbwi socio-ecological systems (Lupala and Maglan, 2015). This is further argued to impose negative effects on community livelihoods (Kashaigili et al., 2013a, Lupala and Maglan, 2015). A thirty-years rainfall and temperature analysis illustrates the decreasing rainfall and increasing temperature trends (Figure 3 and 4 respectively). These trends have negatively affected rain fed agriculture, which constitutes the main livelihood activity for the majority of the community members (Lupala and Maglan, 2015). Yet, these trends in rainfall and temperature echo perceptions by community representatives. Studies at the Pugu and Kazimzumbwi socio-ecological systems increasingly show community understanding of the climate change reality in their locality. Explicitly, community representatives in the Pugu and Kazimzumbwi socio-ecological systems mentioned decreasing rainfall, unpredictable rainfall patterns, decreasing water amounts in water sources, increasing temperatures, increasing drought incidents, disappearance of wetlands, heavy storms, increasing sediment in rivers and disappearing plant and animal species as some of the indicators of climate change (Kashaigili et al., 2013a, Lupala and Maglan, 2015, Lupala et al., 2014). Others noted a late onset of rainfall, which has a direct effect on crop yield. Community members contrasted the current rainfall situation and that of previous years (about 20 years) and found that they used to have longer rainy seasons (famously *known as Masika*) of nearly three months (starting

from March until late June). Lupala and Maglan argue that rainfall is not reliable and in most of the seasons it falls within a period of two months. Furthermore, community members mention the livelihood-related effects of climate change as diminishing food crop production leading to food shortage and the eventual decreasing saving propensity (Kashaigili et al., 2013a, Mngumi et al., 2014). Consequently, as noted earlier, encroaching the Pugu and Kazimzumbwi socio-ecological systems for accessing provisioning ecosystem services as a coping strategy for livelihood effects triggered partly by climate change has been increasing at an alarming rate. The increasing forest encroachment leads to the diminishment of provisioning ecosystem services, with counterproductive effects on climate change adaptation and mitigation efforts (Kashaigili et al., 2013a). The foregoing analysis substantiates three issues aligned to this Thesis at Pugu and Kazimzumbwi socio-ecological systems. First, it explains an increasing decline of provisioning ecosystem services, triggered in part by climate change. Second, it shows a decrease in the livelihood effects in surrounding communities, which are again fuelled in part by climate change. Lastly, it shows the increased encroachment of provisioning ecosystem services and this further leads to counterproductive effects on climate change mitigation and adaptation efforts. This rationalises the urgency of exploring win-win-win ecosystem services-based climate change resilience. The win-win-win livelihood resilience options are explored through socio-ecological systems resilience thinking, which constitutes the focus of the next chapter.

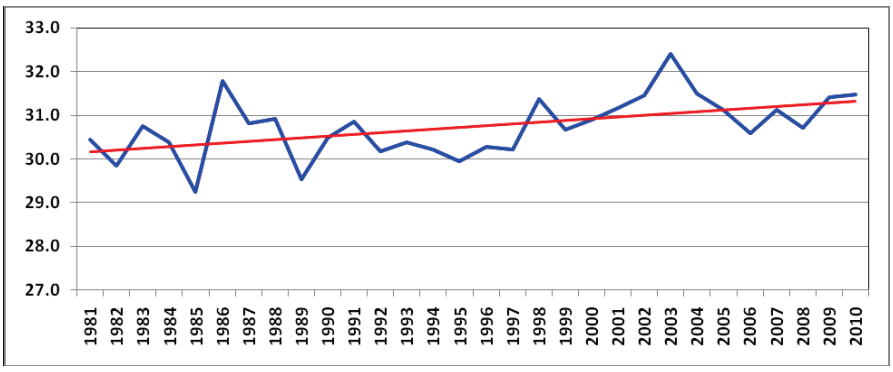

Figure 4: Temperature trend for Kisarawe in Centigrade (1981-2010). *Source.* Lupala and Maglan (2015).

3 The theoretical milieu

A theory is a predictive mirror of what is anticipated in a given empirical analysis. Indeed, it provides us with analytical concepts that will help us understand the phenomena we are interested in on a deeper level. However, there are diverse approaches to engaging theory in scientific inquiry. These includes theory developing (grounded theory), theory critique (theory falsification) and theory application (Yin 2014). In this Thesis, the engagement of theory falls under the latter category (i.e. theory application) whereby diverse theoretical concepts are mirrored through empirically grounded information. This chapter provides the theoretical analysis on the topic of this research work: socio-ecological system resilience for livelihood induced effects of climate change in peri-urban areas. The Thesis explores adaptive capacities within a socio-ecological system, thereby emphasising socio-ecological systems thinking. This chapter further provides definitions of the main concepts as deployed in this Thesis; these are peri-urban discourse, cultural and provisioning ecosystem services, socio-ecological systems, and socio-ecological system resilience. Moreover, the chapter provides an elucidated discussion of the Thesis's analytical frame (i.e. adaptive capacity) in line with its respective analytical concepts engaged, economic diversity, ecological knowledge, and social capital. The chapter concludes by synthesising adaptive capacity attributes imperative for building socio-ecological system resilience for livelihood induced effects of climate change in peri-urban areas in the context of the Global South.

3.1 The peri-urban discourse

Situating the peri-urban concept is largely a daunting endeavour. This owes to its increasingly contested milieu by both academia and development practitioners (Thuo, 2013, Forsyth, 2012). Yet, the deployment of the peri-urban concept in this Thesis, as part of its theoretical background, is not in the sense of engaging in the debate of its contestations. Its conceptual contestation is reviewed for understanding the potential contribution of ecosystem services into the climate change resilience building discourse in peri-urban areas. In other words, the peri-urban in this Thesis is serving as the laboratory for exploring the potential nexus between ecosystem services and climate change resilience building. The remaining parts of this Section therefore provide the contested environment and deployed discussion of the peri-urban concept, thereby its linkage to ecosystem services and to the wider landscape planning discourse.

Broadly, the peri-urban concept is variously viewed and conceptualised across both the geographical and disciplinary contexts. Arguments behind the multiple conceptions of the peri-urban include lack of scientific definition (Forsyth (2012), diversity of engaged disciplinary perspectives (Thuo (2013), the difficulties associated with delimiting the spatial extent of this dynamic region (Brook (2001) and the equivocation of the concept itself. However, scholars increasingly argue that rural, peri-urban and urban environments operate as a system rather than independent entities (Allen, 2006, Wandl and Magoni, 2016). Moreover, the peri-urban area is increasingly claimed to constitute the intersection point between urban and rural areas (Olujimi and Gbadamosi, 2007, Birkmann et al., 2010). In sum, there are increasingly converging understandings within academia on the lived reality of the diverse and context-laden definitions of the peri-urban concept (Salem, 2015). Another converging understanding linked to peri-urban is the co-existence of urban and rural features within cities and beyond their limits (Allen, 2006, Salem, 2015). Yet, inspired by both the converging understandings and the context of this research, this Thesis conceives the peri-urban as a city transitional zone, amalgamating both urban and rural landscape functions and features. Explicitly, in addition to the conceptual definition, pragmatically, in this Thesis peri-urban is used to connote the Pugu and Kazimzumbwi socio-ecological systems (see Section 3.3). This region is along the outskirts of Dar es Salaam, among the most rapidly growing cities in Africa and currently the business capital of Tanzania.

Similar to other peri-urban areas in Sub-Saharan Africa (Roy et al., 2017), ecosystem services in these peri-urban forest reserves are increasingly argued to deteriorate (see Section 2.3).

There is, however, a growing consensus in the literature that the quantity and quality of ecosystems and their associated services are deteriorating in urban and peri-urban areas, particularly in Sub-Saharan Africa (MEA, 2005a, Roy et al., 2017). On one hand, the ongoing urbanisation increasingly results in the expansion of the built environment on ecologically sensitive land, especially in peri-urban areas (Kombe, 2005, Marshall, 2009, Radford and James, 2013). On the other hand, the rapid urbanisation due to poverty is one of the increasingly popular explanations for the degradation of ecosystem services in urban and peri-urban areas in Sub-Saharan Africa (Kestemont et al., 2011, Niemelä et al., 2010). Yet, there is a host of other contributing factors to the decline of provisioning ecosystem services in Case II, the Pugu and Kazimzumbwi socio-ecological systems. These include climate change, the increase of anthropogenic activities and the expansion of the city's built area to the peri-urban areas as explicitly discussed in Section 2.4. The foregoing discussion justifies the relevance of this Thesis beyond climate change resilience and ecosystem services discourses to urban landscape planning and sustainable development.

3.2 Cultural and provisioning ecosystem services

Whilst ecosystem services are reviewed broadly in this Section, this Thesis stresses cultural and provisioning services. The imperativeness of the cultural and provisioning ecosystem services to this Thesis follows their meagre attention in research in urban landscapes and the peri-urban areas, particularly in Sub-Saharan Africa. This is further substantiated in Section 1.1, which describes their emptiness in literature broadly and especially so in Sub-Saharan Africa. The later parts of this Section provide an overview of the theoretical conception of ecosystem services broadly coupled with an analysis of how the concept is engaged in this Thesis.

The concept of ecosystem services dates back to the early 1980's. Yet, the increasing application of the concept started after publications by (Daily, 1997), Costanza et al. (1997), and the Millennium Ecosystem Assessment (MEA, 2005b). Since then, research on ecosystem services has become prolific, substantially increasing in publications (Martínez-Harms and

Balvanera, 2012). To date, the debate on the concept, frameworks, and classification systems is on the rise (Hermann et al., 2011), which has resulted in the emergence of varied sister concepts, frameworks and assessment approaches. Some of the concepts that have emerged, owing to the growing debate on ecosystem services concepts include environmental services, landscape services and ecological services (Lamarque et al., 2011), which have often been interchangeably used with the ecosystem services concept. The later parts of this Section are devoted to giving a brief overview of the theoretical basis of the ecosystem services concept, its typologies as well as how it is contextualised in this Thesis.

The ecosystem services concept represents an application-oriented framework ideal for analysing social-ecological systems (Beichler, 2017). This is because it comprises both social and ecological (or natural) attributes and is inherently interdisciplinary. In its simplistic or generic description, ecosystem services refer to the benefits people obtain from ecosystems (MEA, 2005b). Yet, like other evolving concepts, ecosystem services are variously defined and categorised. Contextual differences partly explain the variations in conception regarding typologies of ecosystem services. This is in partly subject to the context-laden nature of ecosystem services. This Thesis is, however, confined to urban landscapes and particularly peri-urban spaces, therefore articulation of urban ecosystem services is of imperative concern.

Nowadays, ecosystem services studies have been increasingly performed in urban landscapes (Haase et al., 2014). Yet, there are ongoing disputes as to what constitutes urban ecosystem services. This partly results from the spatial and temporal incongruities existing between the physical boundaries of urban areas and the resources drawn from elsewhere and used within them (Ramalho and Hobbs, 2012). At the same time, land use in urban landscapes possesses unique characteristics, which according to (Haase et al., 2014) includes a) high share of artificial surfaces, which are unlikely to revert back to pre-urban conditions, b) a high degree of and variability in imperviousness and c) a high degree of multifunctionality that varies across both vertical and horizontal dimensions. Therefore, the definition and the application of the ecosystem services concept in urban contexts needs to be critically articulated (Beichler et al., 2017), to suit the particular context in which the concept is deployed. Yet, this Thesis does not intend to venture into the debate of defining nor re-categorising urban ecosystem services, but deploying the concept in an endeavour to understand the potential contribution of

cultural and provisioning ecosystem services for climate change resilience building in peri-urban areas. This Thesis therefore defines urban ecosystem services as services or benefits accruing to humans that are either directly or indirectly produced by the ecological structures within urban landscapes. It is on this basis that this Thesis stresses on ecosystem services conception that acknowledges but excludes the services consumed by urban dwellers whilst exploited elsewhere. This definition and understanding of urban ecosystem services is adopted and modified from the definition by (Luederitz et al., 2015). As presented in Article I, II and III ecosystem services within urban landscapes and largely the peri-urban areas (i.e. Case I and Case II, see Section 4.1) are analysed and discussed.

Another equally imperative account intrinsic to this Thesis regards ecosystem service typologies. Similar to the conception of ecosystem service, there have been increasing proposals on ecosystem service classification systems in the past two decades (e.g. (De Groot et al., 2002); MEA (2005b). Yet, in an attempt to integrate the growing classification perspectives, the Common International Classification of Ecosystem Services (CICES), has been proposed (Haines-Young and Potschin, 2013). Broadly, the three main typologies are provisioning, regulating[7], and cultural ecosystem services are prominent (Martínez-Harms and Balvanera, 2012, Crossman et al., 2013). Additionally, the supporting services, which largely maintain the generation of the other aforementioned ecosystem services, are often added to the list (MEA, 2005b). However, as articulated in Chapter 1, this Thesis stresses cultural and provisioning ecosystem services. Next paragraphs provide an elaborate description of the cultural and provisioning ecosystem services, as well as how they are engaged in this Thesis.

Provisioning ecosystem services refers to the products accruing from ecosystems, such as wood, fibre, fresh water, and agricultural goods (MEA, 2005b). The benefits obtained can be easily perceived through the value of the goods or services in question. Yet, for studies at the local scale it has to be acknowledged that urban landscapes depend on worldwide transport connections (Seto et al., 2012). This may allow movement of provisioning ecosystem services from one location to another. However, as stated earlier, this Thesis is delimited to provisioning ecosystem services produced within the urban landscape and specifically the peri-urban areas in the Pugu and

[7] Regulating ecosystem services refer to benefits obtained through the regulation of ecosystem processes, such as air quality, climate, and water regulation (MEA, 2005b).

Kazimzumbwi socio-ecological systems (see Section 4.2). This is crucial given the niche of this Thesis (Sections 1.3 and 1.4). Another important concept commonly discussed in line with provisioning ecosystem services regards community dependence. According to Maida (2007), the ecosystem services dependence concept is applicable to place-based communities, and less relevant to communities where people derive their living outside their locale. Although expressed generically, ecosystem services dependence implicitly connotes dependence on the provisioning services. This is partly because, unlike other ecosystem service typologies (i.e. cultural, regulating and supporting), the provisioning services have direct and or tangible benefits. The Pugu and Kazimzumbwi socio-ecological systems are characterised by a mixture of both those who derive their living outside their locality and those who derive their living within their vicinity (see Section 2.3). This is a typical manifestation of the peri-urban reality (i.e. harbouring features of both urban and rural areas). Yet, originating in rural sociology (Humphrey et al., 1993, Freudenburg and Gramling, 1994), ecosystem services dependency is strongly linked to the extraction and processing of the provisioning ecosystem services (i.e. tangible raw materials such as forest products and fishery resources) (Tidball and Stedman, 2013). However, as discussed in Section 2.3, the increasing dependence on provisioning ecosystem services is highly attributable to the prevalence of climate change effects on community livelihoods. As discussed in Article II, and as will be explained later in Chapter 6, this Thesis argues that the provisioning ecosystem services (bee keeping) at Pugu and Kazimzumbwi socio-ecological systems has enormous potential for climate change resilience building.

As highlighted previously (see Chapter 1), this Thesis stresses on cultural ecosystem services as well. However, this Thesis defines cultural ecosystem services as the nonmaterial benefits derived from the relationship between humans and ecosystems. These benefits may include recreation, education, knowledge systems (social-ecological knowledge/memory), cultural diversity, aesthetic values and eco-tourism. This conception of cultural ecosystem services is adopted from the definition by (MEA, 2005b). Broadly, cultural ecosystem services have been studied less frequently compared to other ecosystem services (Haase et al., 2014, Martínez-Harms and Balvanera, 2012). Nowadays, research on cultural ecosystem services has been growing, particularly on recreation potential (Beichler, 2017). Studies including

services that involve attributes such as cultural identity and spiritual values are largely absent (Chan et al., 2012a). However, fundamental to this Thesis is the absence of studies and literature on the cultural ecosystem services potential in the climate change resilience building discourse, broadly and specific to the peri-urban areas in Sub-Saharan Africa (see Article I and Section 1.1). This Thesis contributes in filling this knowledge gap and furthering understandings in this growing research field. Yet, the popular explanation given to the insufficient research on cultural ecosystem services is largely associated with difficulties in evaluation and their intangible and subjective nature (Chan et al., 2012a, Daniel et al., 2012). This explanation is delimited into the monetary and econometric modelling thinking (see also Section 1.1). This in turn delimits deploying more social and participatory approaches into cultural ecosystem services research. However, exploring cultural ecosystem services through a social lens enables social-ecological system linkages to be identified and so partly bridge the gaps between disciplines (Milcu et al., 2013). This may further surface and appreciate values of cultural ecosystem services, which have largely been sidelined. Moreover, surfacing and appreciating the value of cultural ecosystem services will likely trigger their wider potential contribution to development discourses including landscape planning, poverty reduction, and climate change resilience building. This Thesis argues that the cultural ecosystem services (local food, arts and crafts tourism, wild mammal and antiquities tourism) have considerable potential in building resilience for livelihoods in peri-urban areas. These services are discussed in different focus in Article II and III, as will be clarified further in Chapter 6.

Another equally imperious account of cultural ecosystem services regards the question of dependence. This is an inquiry that eventually unfolds the paradox regarding the nature of interaction amongst the social and the ecological constituents of the socio-ecological system in question. However, the nature of interaction largely depends upon both the social and the ecological environment surrounding a given socio-ecological system. By social milieu, this Thesis refers to the social-economic realities in a given peri-urban area. These realities, as discussed in Section 2.3, have considerable implications in shaping the social and ecological relations in a given peri-urban socio-ecological system, especially in the context of the developing world (see Chapter 5, 6 and Article III). At the same time, by ecological milieu, this Thesis refers to ecosystem services (cultural and

provisioning), which partly determine and shape the nature of interactions and relations in a socio-ecological system. However, it is increasingly understood that, inhabitants of urban landscapes associate more with cultural ecosystem services as compared to other ecosystem services, as opposed to their rural counterparts. Moreover, urbanites generally behave differently from rural inhabitants in that their direct dependence on tangible ecosystem services is relatively weaker and they have heterogeneous ways of using land (Ernstson, 2008). Yet, it is further argued that urban systems not only depend less on tangible products but may depend more on intangible components of ecosystem services, distinctively categorised as cultural ecosystem services (MEA, 2005a). Yet, as articulated in Article II and as would be elucidated later in Chapter 6, at the Pugu and Kazimzumbwi socio-ecological systems the degree of cultural dependence (the way community members relate culturally with cultural ecosystem services) is not very pronounced, as compared to how they affiliate themselves with provisioning ecosystem services. This position is again subscribing to the previously discussed premise of the context-laden reality of ecosystem services. After the analysis of ecosystem services, the next Section discusses the socio-ecological systems concept, which articulates the human-nature relationship in a defined location.

3.3 The social-ecological system

There is an ongoing debate within the social sciences, on the value and meaning of 'system' and on how to understand social resilience. This Thesis explores social-ecological systems' adaptive capacities in order to understand peri-urban resilience building-pathways for climate change effects. Explicitly, this Section is devoted to providing the broad understanding of socio-ecological systems, their constituents and inherent interlinkages. Furthermore, the review of the situation in which the concept is applied is discussed. This is followed by an elaborate analysis that contextualises the deployment of socio-ecological systems' concepts in this Thesis, including a pragmatic definition of how social-ecological systems are deployed in this research.

Socio-ecological systems have been diversely defined. Lu (2010), defines them as a resource-dependent community or an indigenous community that affiliates culturally with a local environment and depends heavily on local

resources. The defining feature of the social-ecological system definition by (Lu) (2010), is the question of community dependence on local resources. On the other hand, (Adger, 2000), defines social-ecological systems as a set of critical resources (natural, socio-economic, and cultural) whose flow and use is governed by an interplay of both social and ecological systems. However, the distinctive feature of a socio-ecological system as defined by Adger, 2000 is on the resource governance interplay by both social and ecological attributes. Inspired by the previously discussed concepts, and the focus of this research (Section 1.4), this Thesis defines socio-ecological systems as an ecosystem service (*largely provisioning ecosystem service*)-dependent community whereby the flow and use of the services are mediated by both the social and the ecological attributes.

The confluence between social system and ecological system resilience has been expounded across disciplines, including ecological, economic, human ecology, and human geography (Gunderson, 1997, Zimmerer, 1994). This in part justifies the inherent interdisciplinary nature of social-ecological systems' inquiry. Indeed, the confluence between social and ecological resilience is well illustrated in a social system, which is interwoven within a single ecosystem or single resource (Adger, 2000). In addition, the social and ecological systems are increasingly argued to be linked in synergistic yet co-evolutionary relationships (Norgaard, 1994). It follows therefore that the resilience of social systems is related in some ways to the resilience of the ecological systems on which social systems depend (Adger, 2000). Yet, there are principles to be adhered to when deploying resilience concepts from ecology to social institutions, owing to the fact that there are differences in behaviour and structure between socialised institutions and ecological systems (Adger, 2000). An imperative principle pertains to the question of the dependency of social systems on the ecosystem services under consideration. Yet, a pivotal issue is whether communities directly depending on ecosystem services themselves linked to the resilience of the ecosystems in question. Moreover, this tenet posits that there should be direct linkages between ecosystem services and social resilience for deploying analogies of ecological resilience into the resilience of social systems. Socio-ecological system approaches emphasise the reality that human actions and social structures are integrated into the ecological system. The Thesis's revelatory case (Case II, see Section 4.2), is imperative to this research, as community livelihoods are intricately interwoven within the forest

ecosystem services, as discussed in Section 2.4 and later in Chapter 6. Subject to this understanding, this Thesis designates Case II as Pugu and Kazimzumbwi social-ecological systems in lieu of Pugu and Kazimzumbwi forest reserves (PKFRs). Whilst, the Pugu and Kazimzumbwi social-ecological systems constitute the two peri-urban forest reserves entailing forbidden access, the lived experience is contrary as would be clarified latter in Chapter 6.

However, social-ecological systems are complex and hard to assess, owing to their inherent overlapping and nested scales (Holling and Gunderson, 2002). The practical challenge is to analyse the dynamics between and within both systems in a rather simple way, while making sure that the complexity of the overall system is not compromised. Defining socio-ecological system boundaries is part of addressing the aforementioned challenge. However, the geographical boundaries of the Pugu and Kazimzumbwi socio-ecological systems span those of the PKFRs and their adjacent communities. The inclusion of forest reserves (forest ecosystem services) and their surrounding communities (settlements) boils down to the pinnacle of the socio-ecological system concept (i.e. the co-existing of social and ecological systems). Moreover, intrinsic to this Thesis is the material boundary in the Pugu and Kazimzumbwi socio-ecological systems. As pinpointed in Chapter 1 and Section 3.2, the system has social and ecological components. Social components connote the social and livelihood realities, which contribute to shaping the relations between peri-urban dwellers and ecosystem services in the face of climate change. Explicitly, social constituents are discussed in this Thesis in terms of the livelihood effects to peri-urban dwellers, which are in part subsidised by climate change (for details see Section 2.4). On the other hand, social components are discussed in terms of social and cultural relations. These are analysed in terms of how they might be deployed as entry points in building socio-ecological system resilience for the livelihood induced effects of climate change (for details see Section 3.5.1, 3.5.3 and Chapter 6). At the same time, ecological components of the Pugu and Kazimzumbwi socio-ecological systems are herein delimited to cultural and provisioning ecosystem services. These ecological constituents (i.e. cultural and provisioning ecosystem services) are well explored and analysed in terms of how they might potentially contribute to building socio-ecological system resilience. An explicit account of the potential ecological (i.e. cultural and provisioning ecosystem services)

adaptive capacities are provided in Section 3.5.2 and further explained in Chapter 6. After analysing the social and ecological constituents of the Pugu and Kazimzumbwi socio-ecological systems, the next Section takes a step further by discussing resilience. It in part attempt to unfold the pertinent questions on resilience (i.e. resilience of what, to what and for whom).

3.4 Socio-ecological system resilience

The concepts of resilience and adaptation are interrelated and increasingly and interchangeably used in climate change and related studies. Both concepts are flanked with numerous definitions, partly due to contextual differences. Arguably, it is the indirectness of the concept(s) that have been part of the attraction for discussion in academic and policy circles alike (Pelling, 2010). On the one hand, Brooks (2003) defines adaptation as adjustments in a system's behaviour and characteristics that influence the ability to cope with external stress. On the other hand, Pielke Jr (1998) defines adaptation as adjustments in individual groups and institutional behaviour in order to reduce society's vulnerability to climate change. Nevertheless, scholars have increasingly levelled some critique to the discourse of adaptation. An imperative critique lies in the reality that adaptation is often outcome-based and tends to exclude the social milieu (O'brien and Leichenko, 2007, O'brien et al., 2007). The exclusion of the social context in adaptation analysis has in part triggered the emergence and preference of other sister concepts that encompass more imperative attributes. Some of the increasingly preferred concepts in lieu adaptation include sustainable adaptation (O'brien et al., 2007, Eriksen and O'brien, 2007), and resilience. In addition, an imperative attribute that contrasts adaptation from resilience regards the question of one being an outcome and another being a process. According to Norris et al. (2008), resilience is better articulated as a process that yields an adaptation outcome. This seemingly trivial contrast between adaptation and resilience explains in part why the two concepts are often used interchangeably. However, in terms of articulation and analysis, such contrast ought not to be assumed, as it connotes wider outcome implications in both scholarly analysis and policy intervention. In lieu of adaptation, this Thesis is aligned with resilience as a distinctive perspective.

On another account, the resilience concept has been defined across disciplines. Originating from the physical sciences, resilience used to describe the capacity of materials or systems to return to a normal state or equilibrium after displacement (Norris et al., 2008, Bodin and Wiman, 2004). In the original usage of the concept, a material is said to be resilient or to have resilient properties when it bends and bounces back instead of breaking when subjected to stress (Bodin and Wiman, 2004). System resilience, for instance, depends upon one constituent of a system being able to change or adapt in response to changes in other constituents; without such resilience the system would fail to function (Adger, 2000). This type of resilience is known as engineering resilience (Norris et al., 2008, Gunderson, 2000). This approach to resilience has been predominant in a climate change context in Sub-Saharan Africa cities, including Dar es Salaam, as expounded in Section 1.1. However, like adaptation, the approach is increasingly challenged, partly due to the exclusion of the imperative social milieu (see also Article III). As noted earlier, owing its origin to physical science, the resilience theory has been conceptualised and so applied in diverse knowledge strands. However, for the sake of this Thesis, two strands (i.e. biophysical and social science) are imperative.

In the biophysical strand, the resilience concept was initially introduced by Holling (1973), through his cutting edge Thesis on "ecological resilience". Yet, Holling's intriguing work, triggered the application of the resilience concept to adaptive capacities of individuals, human communities, and larger societies (Norris et al., 2008, Yhdego, 1995, Sonn and Fisher, 1998, Adger, 2000). In addition, the biophysical strand originates from ecology addresses, the resilience of ecosystems or integrated socio-ecological systems (Holling, 1973, Chapin III et al., 2009). Further, in ecological studies (i.e. biophysical strand), resilience is conceptualised more as adaptability,[8] as opposed to stability (Norris et al., 2008). Indeed, in some scenarios, stability (i.e. failure to change) could infer a lack of resilience (Ibid). This type of resilience (i.e. ecological resilience) does not necessarily assume disturbance as a reference point but is rather centred on envisaging the desirable future trajectory.

[8] In ecology or socio-ecological system 'adaptability' refers to many potential desirable environmentally friendly states NORRIS, F. H., STEVENS, S. P., PFEFFERBAUM, B., WYCHE, K. F. & PFEFFERBAUM, R. L. 2008. Community resilience as a metaphor, theory, set of capacities, and strategy for disaster readiness. *American journal of community psychology,* 41**,** 127-150, GUNDERSON, L. H. 2000. Ecological resilience—in theory and application. *Annual review of ecology and systematics,* 31**,** 425−439.

On the other hand, the social science strand, originating in the psychology of personal development and mental health, typically deals with an individual (Berkes and Ross, 2013). The basis of the social science strand is on identifying and building upon an individual's or community's socio-ecological system capacities, rather than focusing primarily on identifying and overcoming inherent vulnerabilities (Luthar, 2006, Buikstra et al., 2010). In other words, the strand is focusing primarily on identifying factors involved, resilience development processes and upon identifying evidences for intervention (Luthar and Cicchetti, 2000, Buikstra et al., 2010). Whilst there are multiple disciplinary conceptions on resilience, there is a growing scholarly consensus on two critical points. First, resilience is better conceptualised as a process or an ability rather than as an outcome or an end result (Pfefferbaum et al., 2008, Brown and Kulig, 1996). Second, resilience is better conceptualised as adaptability rather than stability (Waller, 2001).

This Thesis does not intend to engage in the debate of what resilience is. The engagement of resilience in this Thesis is aimed at understanding socio-ecological system resilience for the livelihood effects of climate change. In this regard, this Thesis holds the understanding of resilience as premised by two ideas. Firstly, the converging understanding of resilience, meaning resilience is articulated as a process rather than an end and the notion is better conceptualised as adaptability as opposed to stability. Secondly, borrowing insights from both the biophysical strand and the social science strand, resilience is conceived as adaptability, identifying and developing resilience building factors (adaptive capacity). On this basis, this Thesis defines socio-ecological system resilience as a process whereby a socio-ecological system navigates its adaptive capacities towards a positive future trajectory after being subjected to climate change stress.

Articulating the questions, *resilience of what?* and *to what and for whom?* (Meerow et al., 2016), in part rationalises the deployment of socio-ecological system resilience as a central concept in this Thesis. On the *resilience of what* inquiry, as discussed in Section 3.3, this Thesis stresses the resilience of both social and ecological systems of the Pugu and Kazimzumbwi socio-ecological systems. Moreover, Chapter 2 discusses the social and ecological milieu in the face of climate change in the Pugu and Kazimzumbwi socio-ecological systems. This is the livelihood effects on peri-urban dwellers on the one hand and largely on provisioning ecosystem services on the other. In other words, given that climate change has in part affected both people's

livelihoods and is a result that has led to the decline of provisioning ecosystem services, this Thesis analyses the potential resilience of both livelihoods and ecosystem services. The second pertinent resilience question is, *resilience to what?* However, as discussed in Chapter 1, 2 and Articles II and III, climate change is in part serving as a causative factor of the livelihood effects for the people of the Pugu and Kazimzumbwi socio-ecological systems. This is further argued to contribute to the decline in ecosystem services (largely provisioning ecosystem services). In sum, this Thesis analyses resilience to the livelihood effects of climate change at Pugu and Kazimzumbwi socio-ecological systems. Yet, as noted earlier, *resilience to whom* is another pivotal resilience issue worth appropriate articulation in resilience inquiry. However, as clarified in Chapter 1, and in particular with the win-win-win phrase, resilience in this Thesis is due to community livelihoods, provisioning and cultural ecosystem services, and consequently both climate mitigation and adaptation options. Overall, the three imperative resilience questions (i.e. *resilience of what, to what, and for whom)* are discussed from different stand points in Articles II and III. Moreover, these questions will be further elucidated on in Chapter 6. This Section has justified the deployment of socio-ecological system resilience as a central concept in this Thesis. The latter parts of this chapter aim to discuss and synthesise the climate change resilience building discourse in the context of adaptive capacities as an analytical frame of this Thesis.

3.5 Adaptive capacity

This Section aims to discuss the adaptive capacities explored in this Thesis as discussed in both Article II (i.e. economic diversity and the socio-ecological memory) and Article III (i.e. bonding and bridging social capital). Yet, the interlinkages amongst the explored adaptive capacities are critically discussed. This in turn produces the framework for exploring socio-ecological systems resilience against climate change effects in peri-urban areas (Figure 5).

Adaptive capacity is similar or closely related to a host of other commonly used concepts in resilience and the related discourses, including adaptability, coping ability, management capacity, stability, robustness and flexibility (Tompkins and Adger, 2004, Füssel and Klein, 2006). The fact that the concept is used synonymously with other concepts indicates a lack of conceptual clarity. However, there is a converging understanding amongst scholars on

what constitutes adaptive capacity. In a nutshell, adaptive capacity is increasingly conceived as context-dependent resources with dynamic attri-butes influencing resilience building processes (Norris et al., 2008, Walker and Salt, 2012, Smit and Wandel, 2006). This converging understanding fits well in this Thesis, which deploys adaptive capacity as its analytical lens in understanding socio-ecological system resilience building discourse in peri-urban areas, against the effects of climate change. Explicitly, in this Thesis, adaptive capacity serves as social-ecological systems inherent resources upon which resilience is built as the system responds to the effects of climate change. After this broad focus on adaptive capacities, the following parts provide a detailed account of specific adaptive capacity lenses deployed in this Thesis.

3.5.1 Economic diversity

Being one of the critical factors for building social-ecological system resilience (Folke et al., 2003), economic diversity concept is closely linked to dependency metaphors. The more diversified economies the ecosystem-dependent communities have, the more resilient they are (Gunderson and Holling, 1995, Yhdego, 1995, Biggs et al., 2015). Functional diversity, or the presence of multiple components that can perform the same function, can provide issuance within a system by allowing some components to compensate for loss or failure by others (Biggs et al., 2015). The availability of a range of economic opportunities is one of the critical diversity aspects in resilience discourse (Berkes, 2007, Ullsten et al., 2004). The primary idea behind a diverse economy is that it offers a foundation for new opportunities in resilience building (Ullsten et al., 2004). It hence increases options for coping with shocks and stresses, making the system more resilient (Berkes, 2007, Ullsten et al., 2004). Diversity is even more imperative if its component parts react differently to changes and disturbances. This is famously known as *response diversity*, which is necessary for ensuring that a particular shock are unlikely to present the same risk to all components (Biggs et al., 2015). The diversity and innovative economy tenet is well embodied in the saying “don’t put all your eggs in one basket”. Contrary to conventional economic thinking promoting maximum efficiency, resilience discourse encourages policies that can enable coping with ecological, climate, market or conflict-related shocks (Biggs et al., 2015). Biggs and colleagues (2015) provide a typical example of a viable response to livelihood diversity in a farming community. There must be “options dissimilar to farming, such as

eco-tourism and related activities instead of alternative ways of farming" (p.12). Such diversity ought to provide a wider response assortment and hence resilience to shocks. Dependence on limited ecosystem services increases income variance and risks failure of particular resources, as a result decreasing economic stability. This is further discussed in Chapter 6 combined with insights from the field.

3.5.2 Ecological knowledge

Metaphorically, social-ecological memory can be perceived as a library, whereby ecological and practical knowledge provide guidance in how to deal with environmental shocks (Barthel et al., 2010). Further, it is believed that such memory is one of the critical socio-ecological system's adaptive capacities, for building resilience when the system is subjected to changes (Barthel et al., 2010, Folke et al., 2003). The social-ecological memory of communities constitutes a variety of approaches upon which behaviours of people are shaped by the past. It functions as collectively shared mental maps for dealing with a complex world (Olick and Robbins, 1998, North, 2005). Day to day memories are therefore frequently forgotten. However, traumatic memories, or so called 'light bulb' memories, such as of environmental crises, are likely to preserve details (Schacter, 1995). The social memory available to constitute a practice is thus both emergent and persistent, a shared source of resilience for the community in question (Wenger, 1999, Folke et al., 2003). Social-ecological memory normally constitutes part of any socio-ecological system, whether a traditional ecological knowledge system or a contemporary natural resource management system (Berkes et al., 2000). For instance, elders in traditional societies (even to date in some societies) often serve as stewards of ecological knowledge intermingled with practice and beliefs, including knowledge of long-term and large scale changes transmitted across generations (Berkes, 2002).

In this Thesis, some ecological knowledge enhancers (i.e. both traditional and contemporary natural resource management knowledge) are explored. These are discussed in Article II and later in Chapter 6 as knowledge transfers from the elderly to young, cultural diversity and literacy rates.

3.5.3 Bonding and bridging social capital

Whilst understanding the applications of social capital has been growing across disciplines and contexts, their cruciality in climate change resilience building discourses has not attracted due attention. However, the first scholar (Bourdieu, 1986), to define social capital defined it as the sum of actual or potential resources linked to possession of a durable network of relationships. He argued further that social networks are not given, but rather constructed through investment strategies oriented to the institutionalisation of group relations, usable as a reliable source of benefits. The notion that social capital is not given on a silver platter, but is rather created, was echoed by (Woolcock and Narayan, 2006), who devised that social capital is built up by norms and networks that enable people to act collectively. Yet, the definition of social capital, as argued by Bourdieu, is aligned to this Thesis. Indeed, the imperativeness of this definition related to this Thesis lies in the fact that it encompasses the potential resources notion, which is part of this Thesis's red thread (see Section 1.4). However, (Lin, 2002), argues that the concept primarily connotes the individual's possibility of investing, accessing and using resources interwoven within social networks for gaining returns. However, one of the defining features of social capital is that it encompasses community sharing network links and routine supportive interactions overlapping with other networks (both internal and external), the ability to form new associations and cooperative decision making processes (Goodman et al., 1998). No wonder, analytically, social capital is largely captured through social support networks (Norris et al., 2008). Yet, social support refers to social interactions providing individuals actual assistance and incorporating them in the web of social relationships perceived to include those that are loving, caring and readily available in needy times (Barrera, 1986).

Despite being articulated differently across disciplines, the idea that social networks oil the wheels of collective action (Woolcock and Narayan, 2006), is intuitively appealing in resilience building discourses. In other words, the presence of social capital increases the capacity for action and realisation of the wider community ends. On the same account, (Adger, 2010) argues that social capital has the potential for serving as an essential glue for economic development. Meaning, the presence of social capital increases the capacity for action and realisation of the community development objectives. This connotes that social capital has the potential for contributing towards realising a myriad of development outcomes,

especially those executed at the community scale. However, it should be noted that social capital must be constantly reproduced through reciprocal actions. Though widely used in other development contexts in the past, social capital has not been very prominent in climate change studies. Yet, there is a growing understanding of the integral potential of social capital in building socio-ecological system resilience against livelihood effects of climate change. The increasing recognition of the potential contribution of social capital in climate change resilience owes its origins to its considerable input into economic development and wellbeing (Ostrom, 2000). The importance of social capital is even greater when socio-ecological system resilience building potential is explored in the context of the developing world. This is justified by the overarching poverty environment, which rationalises the imperatives of social capital (i.e. social connectedness), to help in times of need and social safety nets, especially when subjected to shocks and stresses such as climate change. In addition, social capital is increasingly regarded as a form of capital that serves as a platform upon which other forms of capital (for instance agency, and economic diversity) might effectively be developed (Agnitsch et al., 2006). Yet, despite the increasing understandings of the potential role of social capital in resilience building, its application in the urban climate change context is still negligible, as most interventions still invest heavily in physical infrastructures (Adger, 2010, Aldrich and Meyer, 2015). However, this type of resilience is famously known as engineering resilience and has been predominant in the climate change resilience context in cities across Sub-Saharan Africa, including Dar es Salaam (see Section 1.2). The dominance of engineering resilience in the region is in part rationalised by the infrastructure deficit. This has in turn jeopardised the deployment of the social lens in exploring and understanding social issues pertinent to resilience building discourse in urban, and more so in peri-urban contexts (see Section 1.1). Yet, this is happening during a time when resilience is increasingly understood to be a social phenomenon. The social notion of resilience is premised upon the idea that resilience is a process of navigating plausible potential options towards the foreseen positive future and not an end result in itself (see Section 3.4). Yet, at the core of the process lies the need to contextualise resilience (i.e. put resilience into context) thereby encompassing the social milieu.

Social capital is articulated differently across scholarship domains. Yet, two categories of social capital are intrinsic to this Thesis: bonding and

bridging (Aldrich and Meyer, 2015, Agnitsch et al., 2006, Putnam, 2000). On the one hand, bonding social capital looks inwards and emphasises identities and groups of a homogenous nature (Putnam, 2000). In addition, Putman (2000) explains further that bonding social capital thrives in established groups with strong, effective ties, linking group members to one another. Bonding social capital is crucial in providing social support and in cementing group solidarity and is usually also linked to naming an enemy. This type of social capital is particularly crucial in building socio-ecological system resilience in climate change affected communities in peri-urban areas of the developing world. As mentioned, social support and in-group solidarity is quite crucial, as it lays the foundation for other adaptive capacity attributes to act more effectively towards building resilience. On the other hand, bridging social capital links people or groups of different orientations. It also addresses how social capital facilitates resource acquisition (Putnam, 2000). This linking potential attribute of bridging social capital is central in negotiating feasible resilience-pathways in climate change affected socio-ecological systems. However, in contrast to bonding social capital, bridging social capital is crucial in acquiring a wide range of resources and facilitating information flow within and between groups (Ibid). Bridging social capital actually embodies the knowledge (i.e. the technical know-how) in terms of what is feasible and what are plausible potential options given the context under consideration. This category of social capital is again pivotal in building socio-ecological system resilience against climate change effects in peri-urban areas of the Global South. The crucialness of this category of social capital in the Global South lies upon its poverty-reality milieu, which is closely linked to resource scarcity. This reality renders the communities at odds when subjected to shocks and stresses, such as climate change. If left on their own, without synergies made possible by the bridging social capital, these communities would devise their own autonomous adaptation modalities. The self-sufficient modalities would in turn result in counterproductive results to the longstanding efforts geared at addressing climate change. Moreover, like other concepts, social capital has been criticised on different grounds, most of which are levelled against excessive bonding capital, unlike bridging social capital. Scholars have underscored the negative effects of close-knit, trusting groups. These include the exclusion of outsiders, excess claims on group members, restrictions on individual freedoms and downward levelling norms. At the same time, it is increasingly agreed that street

gangs, mafia groups, drug rings, and racial supremacy groups likely have high levels of social capital (bonding capital), yet their actions often lead to harmful ends (Agnitsch et al., 2006). Another problem with the bonding-bridging divide is that in practice most groups have a bit of both types of capital, and the social capital varies situationally. Drug rings of course have strong bonding social capital, but the 'goods' are distributed far outside the rings themselves.

3.6 Synthesis. Socio-ecological system resilience framework for the livelihood effects of climate change

This Section aims to discuss the adaptive capacities explored in this Thesis. The synergies amongst the explored adaptive capacities are critically reviewed. As a result, an analytical framework for exploring socio-ecological system resilience for the livelihood effects of climate change in peri-urban areas in the Global South is suggested (Figure 5).

Broadly, the attributes referred to as adaptive capacities have been differently articulated across disciplines. However, it can be argued that the context and the rationale in which they have been deployed differ considerably. Moreover, the combination of the adaptive capacities in one framework are largely different from others. These variations are partly the reality of the context-laden nature of adaptive capacities. The context-laden metaphor in this case has a double meaning. Firstly, it connotes the geographical contexts in which the study is undertaken, which in turn infers to differential sets of resources (adaptive capacity), which should not necessarily be the same in another geographical setting. On the other hand, the second context regards the disciplinary niche, which has an implication for the rationale and the focus of the analysis in question, given the differential approach and lens of analysis. This previous discussion justifies the non-uniform framework of analysis, especially in these transdisciplinary and contested concepts.

Analytically, this Thesis is exploring socio-ecological systems adaptive capacities' potential for building resilience for the livelihood induced effects of climate change in peri-urban areas. This Thesis is therefore suggesting a framework for exploring socio-ecological system resilience for livelihood effects of climate change in peri-urban areas. However, as discussed earlier,

the social constituents of the system connote the social-economic realities. Whereas the ecological component sees to the cultural and provisioning ecosystem services. This explains why the adaptive capacities are largely articulated through either cultural or provisioning ecosystem services. The framework is a product of what is herein referred to as an iterative, reflective and progressive research approach (see Section 4.1), amalgamating both theoretical analysis as well as empirical insights. Being a transdisciplinary inquiry, the suggested framework embodies concepts and insights from diverse knowledge strands (i.e. social and natural sciences). Yet, the proposed framework constitutes concepts that are synergistically interlinked, as summarised in the next paragraph.

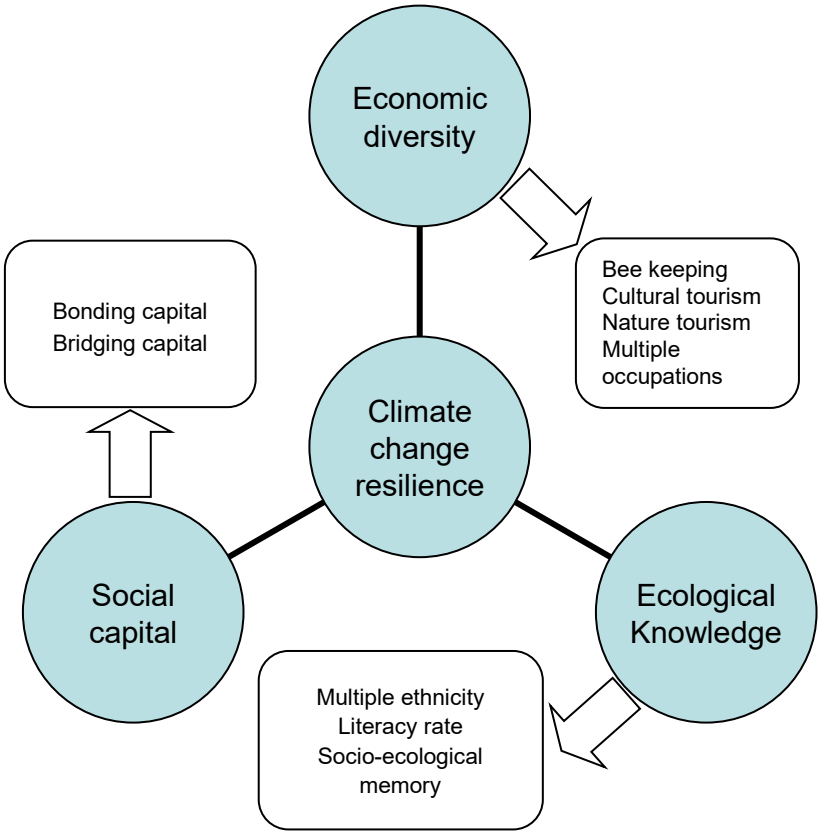

Figure 5. Framework for analysing socio-ecological system resilience for livelihood effects of climate change. Source: *Author's own construct (2020).*

As hinted at earlier, this Thesis is proposing a framework for exploring social-ecological system resilience against the livelihood effects of climate change in a peri-urban area in the Global South. The suggested framework is composed of three imperative adaptive capacity attributes (economic diversity, ecological knowledge and social capital), mutually influencing one another in the course of negotiating resilience against livelihood induced effects of climate change. Bonding social capital is claimed to create a platform upon which other forms of adaptive capacities (Agnitsch et al., 2006) such as agency and economic diversity can be effectively developed in negotiating resilience against climate change. It can be argued that social capital can facilitate or hinder deploying cultural and provisioning ecosystem services towards building resilience to the given effects of climate change. At the same time, social capital attributes, like social relations, are interlinked with the culture of a given community. It follows that the social conditions have a replicative effect on the culture of the community in question. In other words, social relations shape the culture and consequently affect the way community members culturally relate to ecosystem services. Indeed, this in turn shapes and defines the cultural ecosystem services in that community. However, the social conditions attributed by a myriad of drivers, such as poverty and livelihood hardships triggered in part by climate change (see Chapter 2), dictate the way the community relates to provisioning ecosystem services. On the other hand, economic diversity attributes mutual influence on the state of ecosystem services (herein largely expressed as cultural and provisioning ecosystem services). In other words, the socio-ecological system that portrays climate-friendly elements with the potential for revitalising the local economy is imbued within ecosystem services. Yet, as previously mentioned this Thesis stress on cultural and provisioning services. Hence, as will be discussed latter in Chapter 6, the explored and analysed adaptive capacities in the Pugu and Kazimzumbwi socio-ecological systems are largely cultural and provisioning ecosystem service-based.

4 Methodology

This chapter provides an elaborate description of the methodological paths undertaken in the research process, which led to the production of this Thesis. This includes a short description of the research approach followed by a brief account of study case selection. Moreover, the chapter provides an explicit account of the data collection methods deployed (i.e. systematic literature review, focus group discussions, key informant interviews and household surveys). The Section also presents the respective data analysis tools deployed (i.e. document analysis, content analysis and principal component analysis). The chapter concludes by providing a brief analysis of quality standards adhered to along the research journey.

4.1 Research approach and process

The foundation of the Thesis is the finding that there is a scarcity of context-laden peri-urban studies exemplifying the possibility of deploying ecosystem services in building resilience for climate change effects in Sub-Saharan Africa (see Article I). An exploratory, iterative and reflective yet progressive approach was employed in exploring and understanding the conceptual as well as contextual milieu for deploying ecosystem services in building resilience for climate change effects in peri-urban areas. It was exploratory in that it aimed at relating some unknowns on how might cultural and provisioning ecosystem services contribute in building resilience against the livelihood induced effects of climate change. It was both iterative and reflective as the conceptual and empirical analysis was not a one-off, but a repetitive process (see also Section 4.3.1). This involved forward and backward analysis, engaging both conceptual and empirical material, until

they made sense from each other. Explicitly, it involved an alteration between the research questions and the empirical data. This approach was deployed as it is suitable for studies involving conceptual exploration, whereby the research focus is progressively refined and established (Yin, 2017). Moreover, data collection and analysis in this Thesis were guided by three research questions, as presented in Section 1.4. However, through this approach, the research questions were progressively devised and refined as the research evolved. In responding to the three research questions, two distinctive, yet complimentary study cases (i.e. literature and a revelatory cases) (Case I and II respectively), were explored progressively. Yet, despite being deployed progressively and playing distinct roles, the two cases mutually reinforcing one another, thereby making imperative opportunities for both empirical and conceptual understanding of the subject of this Thesis (see Chapter 1). This enabled an in-depth understanding of the phenomenon in context, yet at multiple scales, which is the overall situation in Sub-Saharan Africa (Case I) and the context-based-revelatory case (Case II). At the same time, in the course of exploring the two study cases, a mixed-method research strategy was employed. While Case I deployed a qualitative method (i.e. systematic literature review, Case II complimentarily deployed both qualitative and quantitative methods (focus group discussion, key informant interviews and household surveys).

Regarding the research process, this Thesis is designated into three distinct phases, Phase I, II and III. Phase I, which is primarily a systematic literature review and document analysis. Phase I involved both Theoretical Tasks I and Empirical Task I (see Figure 6). This first phase is largely responding to the first research question (RQI) as described in Section 1.4.1. This includes intensive reading on the subject of this Thesis (see Section 1.3 and Article I), so as to acquire a wider understanding of the subject matter, solidify the lacuna and earmark areas for knowledge contribution. Moreover, Phase I represents the entire research work done in Case I (as described earlier) but in terms of phases of the research execution, it is designated as a distinct phase, which is summarised in Article I to this Thesis. Phase II constitutes the research work geared to responding to the second research question (RQII).

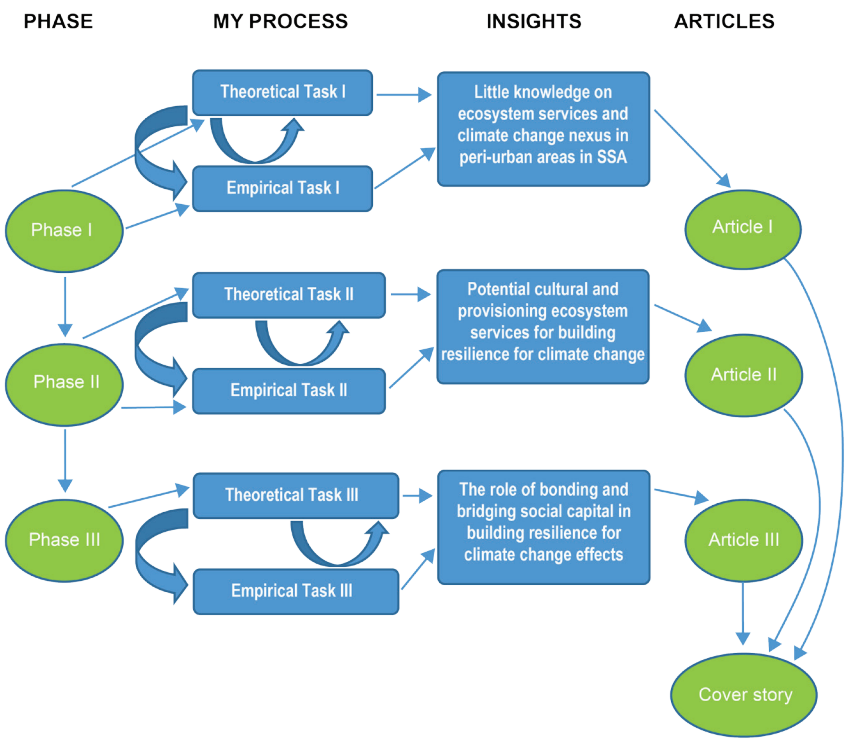

Figure 6. An overview of the iterative research process undertaken in this Thesis. Source: Author's own construct (2020).

Phase II involves Theoretical Task II and Empirical Task II (see Figure 6). In this second phase of the research execution, the second research question was distilled and established apart from setting the focus for Empirical Work II. However, Phase II marks the shift of the research focus from Case I to Case II (a revelatory case, see Section 4.2). Overall, Phase II constitutes part of Case II as summarised in Article II of this Thesis. On the other hand, Phase III was an extension of Phase II and was deployed in response to the third research question (RQIII). It stands as a distinct phase since there was a considerable lapse in time between the two phases. Moreover, like the previous phases, Phase III involves both the iterative reflective process between Theoretical Task III and Empirical Task III. Theoretical Task III was crucial for refining and distilling the third research question, thereby setting the direction of the research. The work in Phase III is summarised in

Article III. Moreover, the detailed account on what actually took place during field work aligned to the three phases of the research execution is provided for in Section 4.3.

4.2 Selection of case studies

As previously mentioned in Sections 1.3 and 4.1, this research deployed two case studies, which played two distinct yet complimentary roles in the research process. The two study cases were developed progressively at different times in the research process (Figure 6). Case I is a literature case (i.e. ecosystem services with a bias on building resilience) according to existing research. Drawing from Yin (2014), literature case studies can be on any topic but must have some empirical method and present some empirical data, either qualitative or quantitative. Indeed, Case I was designated to explore and understand the state-of-the-art research on the contribution of ecosystem services for climate change resilience in peri-urban areas in Sub-Saharan Africa. In other words, Case I was set to analyse, problematise and hence contextualise the subject of this research. However, owing to the exploratory underpinnings of this research, thereby its approach, Case Study I was deployed for developing and positioning the research in a scholarship lane. This exploratory undertaking was key, as it enabled narrowing down the research scope into a more concrete niche. Indeed, it is the output of Case I, which laid the foundation for the later empirical and theoretical work presented in this Thesis. However, pragmatically, selection of Case I came about through the literature review. Explicitly, thoughts of designating ecosystem services potential for climate change resilience in peri-urban areas of Sub-Saharan Africa as one of the study cases, evolved when I was doing the in-depth literature review in order to understand the subject of this Thesis. This included exploring the existing knowledge base around climate change effects in urban and peri-urban areas in Sub-Saharan Africa on the one hand and on the other hand the linkages existing between ecosystem services and climate change resilience in peri-urban areas. Consequently, I deduced the presence of systemic yet historic crosscutting characteristics across urban and peri-urban areas in Sub-Saharan Africa, intrinsic to this Thesis. Putting it in sampling terminologies, selection of Case I was through the snowball sampling approach, as it was progressively designated and adapted as the research was evolving. This entails that case I emerged as a suggestion

outcropped from the study objects-climate change effects in urban and peri-urban areas on the one hand and ecosystem services contribution to climate change resilience in peri-urban areas in Sub-Saharan Africa on the other. The previously highlighted common features across urban and peri-urban areas in Sub-Saharan Africa, intrinsic to this Thesis, suggested a deeper exploration of the potential nexus between climate change effects and ecosystem services in the region. This was realised through document analysis (for details on methods deployed in Case I see Section 4.3). Article I presents the pinnacle of Case I (i.e. ecosystem services potential for climate change resilience in peri-urban areas in Sub-Saharan Africa). Yet, as discussed in Section 1.1, ecosystem services have the potential for building resilience for climate change effects in peri-urban areas. This is partly explored and exemplified in the revelatory peri-urban socio-ecological system, which constitutes Case Study II, as described hereafter.

Case Study II, in contrast, was used in furthering the research, the pivotal exploratory work, of Case I. Moreover, Case II is a revelatory case (i.e. an exemplifying case) exploring context-laden empirical information on how cultural and provisioning ecosystem services might possibly serve as a laboratory for building socio-ecological system resilience for the livelihood effects of climate change in peri-urban areas. Yin (2014), describes a revelatory case as a case by which a researcher has an access to explore a situation which has not been previously explored empirically. Yin argues further that, descriptive information alone from such a case becomes revelatory. As will be discussed later in Section 6.4, such cases show how similar inquiry can be done and implicitly stimulate further research and consequently the development of needed policy actions. As discussed in Chapter 1, there is a knowledge gap in how cultural and provisioning ecosystem services might be deployed in building win-win-win resilience options for the livelihood induced effects of climate change in peri-urban areas of Sub-Saharan Africa. This knowledge gap is what warrants the Case II inquiry and constitutes the main focus of this Thesis.

Case II constitutes a peri-urban socio-ecological system in Sub-Saharan Africa selected via a series of sampling approaches. However, Case II, in the Pugu and Kazimzumbwi socio-ecological systems (for details see Section 2.4 and 3.3), which is the geographical focus for the revelatory case study is imperative. Firstly, the area is one of the few peri-urban that has rich ecosystems in the world (Gwegime et al., 2013). The area further supports

about 37 endemic vertebrate species and about 554 endemic plants (Burgess, 2000). Accordingly, this socio-ecological system offers crucial insights into this study, as the ecosystems inhibit enormous ecosystem services. As pointed out in Section 2.4, the area has several ecosystem services for cultural tourism, which might be deployed for building win-win-win resilience for the livelihood effects of climate change. Secondly, these forests are remnants of ancient forests (TFCG, 2013; Lupala et al., 2014). This presents another opportunity for developing tourism based on cultural ecosystem services, building win-win-win resilience against the livelihood effects of climate change. Thirdly, as hinted at earlier, the Pugu and Kazimzumbwi socio-ecological systems are said to suffer severe eco-system degradation, triggered by increased anthropogenic activities linked in part to climate change. Fourth, these places will be subject to a great deal of climate change (Lupala and Maglan, 2015, PASTART, 2017), and so more livelihood effects are anticipated to peri-urban poor communities. Fifth, the area is characterised by a growing population and thus the ecosystem services are under pressure. In addition, the communities adjacent to these peri-urban forest reserves claim to depend heavily on the forest reserves, by exploiting the forest-related provisioning ecosystem services, which are closely linked to climate change effects. On this basis, Case II presents an informative case for exploring the potential contribution of cultural and provisioning ecosystem services towards building win-win-win resilience. Selection of Case II was prompted by the conceptual insights, the understanding that the socio-ecological system represents an ideal environment characterising the phenomenon explored in this Thesis (see Sections 1.3 and 3.2.2). Overall, Case II involves four levels of sampling (i.e. multistage sampling) as explained hereafter.

4.2.1 First level sampling

The first level of sampling involved the selection of the urban study urban area amongst urban areas in Sub-Saharan Africa. At this stage, non-probability sampling (i.e. non-random sample selection technique) was deployed. The essence of using a non-probability sampling technique at this stage was to obtain rich information (Bernard, 2017) about urban areas in terms of spatial growth, thereby seasoned peri-urban areas. Dar es Salam city was thus selected purposefully, given its rapid urbanisation rate amongst cities in Sub-Saharan Africa. Furthermore, the city has a long-standing

history of urban growth and sprawl compared to other relatively young urban areas in Tanzania.

4.2.2 Second level sampling

The second level of sampling involved the selection of information rich peri-urban socio-ecological systems. To realise this aim, non-random sampling techniques were deployed. Contrary to the first level sampling, selection criterion was put forward in order to identify information-rich peri-urban socio-ecological systems of Dar es Salaam city. Table 2 presents selection criteria for Case II, assessed in the Likert scale of five scores (i.e. 5=strongly agree[9] 4=Agree[10] 3= Indifferent[11], 2=Disagree[12] 1=Strongly Disagree[13]).

Table 2. Matrix of peri-urban socio-ecological systems selection criteria.

Criteria	Description	Score scale
A	A PU-SES with high community dependence on ecosystem services	5= Strongly agree 4= Agree 3=Indifferent 2=Disagree 1=Strongly disagree
B	A PU-SES with conflicting land uses	
C	A PU-SES with rapid population growth	
D	A PU-SES with a diversity of ecosystem services	
E	A PU-SES at the interface of two jurisdictional mandates	

Source. Author's own construct.

However, before deploying the criteria set (Table 2), a scoping study was done to identify the peri-urban socio-ecological systems of Dar es Salaam. Yet, amongst four, two imperative peri-urban socio-ecological systems were identified (i.e. the Pugu and Kazimzumbwi and the Pande Game). The peri-urban socio-ecological systems were therefore assessed on the richness of information, using criteria in Table 2. The Pugu and Kazimzumbwi socio-ecological systems emerged as the systems that were more information-rich having the higher score (Table 3), relative to their counterpart Pande Game socio-ecological system, making them the focus for the study in Case II (see Sections 3.2.2 and 2.4).

[9] Fully comply.

[10] Comply to some extent.

[11] Status not clearly defined.

[12] Does not comply.

[13] Does not comply completely.

Table 3. Matrix showing scores for selecting peri-urban socio-ecological systems.

Criteria	Peri-urban SESs PK-SES	Pande-SES
A	5	4
B	5	4
C	5	4
D	4	4
E	5	1
Total	24	17

Source. Author's own construct.

4.2.3 Third and fourth sampling levels

The third level sampling was employed in order to select study hamlets within the Pugu and Kazimzumbwi-socio-ecological systems. At this stage, similar to previous stages, non-random sampling techniques were deployed. The techniques were chosen for obtaining diverse, information-rich hamlets and acquiring an extensive understanding of the confluence between social systems and ecological systems within the Pugu and Kazimzumbwi-socio-ecological systems. Consequently, three hamlets Nzasa, Pugu-Kibaoni and Kisarawe were purposively selected for the detailed study. The three study hamlets were selected in order to include a hybrid mix of peri-urban characteristics (i.e. the co-existence of urban and rural features). While, Pugu-Kibaoni lies close to the urban part of the city, Kisarawe and Nzasa hamlets are located in more rural areas and tend to display more rural than urban characteristics (Figure 4). Moreover, the fourth and the last level of sampling was done to find study respondents and informants. At this stage, both probability and non-probability sampling techniques were deployed. The former (i.e. probability/random sampling)[14] was deployed in selecting respondents for household surveys. Approximately 10% of the household heads were selected at random from the three study hamlets. Ten percent (10%) community representation is recommended as sufficient to derive meaningful and significant results (Kothari, 2004). As earlier hinted, this stage also involved non-probability sampling (i.e. purposive and snowball sampling techniques) in selecting respondents for key informant interviews and focus group discussions (for details see Section 4.3.2).

[14] Yet, the application of the probability sampling technique at this stage is not meant for yielding quantitative generalisation.

4.3 Data collection and analysis methods

Deploying multiple methods was useful in exploring ecosystem services and how they might be utilised in building socio-ecological system resilience for the livelihood effects of climate change. This enabled an in-depth understanding of the phenomenon in context at multiple scales, as explained in Section 4.1. It further served as a means of triangulating and validating data. This Section presents an overarching description of the data collection process, using the four methods deployed and their respective analytical tools. Whilst the systematic literature review was distinctively yet categorically deployed in collecting data for Case I, Case II deployed other data collection methods (focus group discussions, key informant interviews and household surveys) progressively yet complimentarily. In Case II, (which deployed multiple methods), the methods were sequentially arranged in the order that the preceding methods would provide additional information for effective deployment of the progressive method. Indeed, as hinted in Section 4.1, Case II had two phases, yet the sequence of deploying different data collecting methods was the same. While Phase II deployed all three methods in the forms of focus group discussions, key informant interviews and household surveys (see Article II), Phase III deployed the latter two methods in the sequence of key informant interviews followed by household surveys (see Article III). Overall, the qualitative methods were deployed first, followed by quantitative methods. As mentioned, the order of deploying the methods in collecting data was important. For instance, in Phase III (Case II), key informant interviews were undertaken first followed by household surveys. This sequence was important as key informant interviews laid the foundation for a deeper understanding of the broader social capital setting, with specific focus on socio-ecological system resilience for climate change effects. Moreover, the key informant interviews yielded information that enabled fine tuning of the household questionnaire, which was later deployed for the purpose of mapping social capital at Pugu and Kazimzumbwi socio-ecological systems. Whilst I was personally involved in moderating focus group discussions in Phase II and carrying out key informant interviews (in both Phase II and III), the household surveys in Phase II and III were conducted by three research assistants. The three enumerators were university graduates, which was necessary to ensure that they could understand and follow the data collection protocol and adhere to the prescribed ethical standards. Another driver that prompted deploying

graduates in collecting data was the fact that the household questionnaire was in English (see Appendix I and V), so it was essential to deploy enumerators who were fluent in both English and Kiswahili. This was again important as some respondents could not read or write well and therefore enumerators were responsible not only for asking the questions but also for filling in the responses, as the survey was done face to face. Conducting the survey face to face was also useful as it largely reduced the non-response rate for the entire study and the response rate was nearly 98%. Prior to the execution of the survey, I convened a two-day training to familiarise enumerators with the survey questions, and the survey protocol. Household surveys took place over two consecutive weeks, with one enumerator responsible for each of the three study hamlets (see Section 4.2). Every evening of the survey day, I convened a brief session with all the enumerators to cross check the completion of the questionnaires and receive feedback on the progress of the survey. This forum was used for discussing and deliberating upon any emerging anomalies from the survey work. This was crucial for ensuring data quality and consistency in the collection process, which is an integral part of the internal validity check for data quality in a case study inquiry. Once submitted, the completed questionnaires were kept in the case study database, pending further scrutiny and analysis. Moreover, an elaborate description of each method deployed in data collection and analysis is provided hereafter.

4.3.1 Systematic literature review and document analysis

As mentioned in Section 4.2, Case I was prompted by a general lack of literature on the contribution of ecosystem services in building resilience to climate change effects in Sub-Saharan Africa. This understanding through the literature review propelled deploying a tailored systematic literature review as a distinct data collection method for informing the scientific inquiry in Case I (Section 4.2). This Section elaborates on how the systematic literature review and consequent document analysis was deployed in responding to the first research question of this Thesis (referred as RQI in Section 1.4). In achieving this aim, I downloaded the research question (RQ1) into sub-components. Moreover, using the sub-components, I further devised a literature review guide consisting of specific sub-themes. I used a set of key search words per each sub-theme. Theoretical sampling (Bryman, 2016), was deployed as a guide in reaching a saturation point during the data

collection process via the systematic literature review. The sampling of empirical material in this case was guided by the already devised sub-themes as previously mentioned. This sampling procedure is an iterative, yet reflective and progressive process (Section 4.1) in the sense that it is not a one-off but rather an ongoing analysis entailing several stages. Indeed, it is a research process whereby an analytical lens is amalgamated with the data collection process to yield fruitful yet sound results. It is a data collection technique, which constitutes a built in reflective process, thereby analyses. Prior to reaching a saturation point in collecting data of a given concept, a data collector has to reflect as to whether the collected information has a satisfying threshold that warrants knowledge generation. Moreover, the number of peer reviewed articles per sub-theme was established after reaching the saturation point. However, the review cannot claim to be exhaustive as there are other terminologies or concepts synonymous with ecosystem services, such as environmental services, landscape services, ecological services and green infrastructure services (see Section 3.1 for details), which have not been included in the review. Nevertheless, the review of the state-of-the-art research on the contribution of ecosystem services to climate change effects in Sub-Saharan Africa (Case I), played a distinctive role in this Thesis by problematising the research subject and earmarking potential areas for knowledge contribution. However, Table 4 presents a summary of sub-themes, key search words and a number of peer reviewed articles per sub-them.

Table 4. Matrix details for systematic literature review deployed in Case I.

S/n	Sub-theme	Search words	Peer reviewed Literature
1	Urban development and perspectives on ecosystem services research in Sub-Saharan Africa	Ecosystem services research, urban, and Sub-Saharan Africa	22
2	What is peri-urban and what is the nexus between peri-urban and ecosystem services research?	Peri-urban, and ecosystem services	34
3	What are the specific country, urban and peri-urban climate change effects across Sub-Saharan Africa?	Climate change effects, urban, and Sub-Saharan Africa	15
4	Potential contributions of urban and peri-urban ecosystem services to climate change resilience	Provisioning, regulating and cultural services; urban and peri-urban, and climate change resilience services	26

Source. Author's own construct (2017).

4.3.2 Focus group discussion, key informant interviews and content analysis

This Section is set to describe focus group discussions, key informant interviews and consequently the content analysis as deployed in this Thesis. Focus group discussions and key informant interviews were both deployed in Case II. Yet, while focus group discussions were carried out only in Phase II, key informant interviews were carried out in both Phase II and III. Informants for both focus group discussions were selected by non-probability sampling procedures, an ideal approach for gaining information rich study subjects (Bernard, 2017). Moreover, subject to the research questions (RQII-III), selection of informants was skewed to individuals who engaged themselves with different ecosystem services in a given hamlet. Accordingly, village/hamlet environmental committee members composed the majority of the focus group discussion members, as they were well-informed of the discussion subjects (Appendix III). KII in Phase II was geared at capturing a deeper understanding of different cultural and provisioning ecosystem service based economic diversity options available at the Pugu and Kazimzumbwi socio-ecological systems (see Article II and Chapter 5 and 6. In Phase III, KII was tailored to capture detailed knowledge of how bridging social capital could be of use in building socio-ecological system resilience against livelihood effects of climate change.

Focus group discussion

Three focus group discussions were held, (one in each study hamlet and each was constituted of seven community members selected with the help of the hamlet chairman. In all three focus group discussions, consent was requested beforehand from all participants, so as to be able to take notes during the conversations. This was done in order to comply with ethical requirements and to ensure participants felt comfortable with tape recording the interviews. Participants in all three hamlets were not comfortable with tape recording the conversations and in turn they requested anonymity of responses. In this regard, I thought it wise not to record the conversations so as to make them feel at ease and be free in expressing their views. Responses were anonymous in order to create freedom of expression for interviewees. During the discussion, as a moderator, I first introduced ecosystem services to participants in locally relevant terms, based on how they have been used in their local environment in day to day livelihood cycles. This was possible as I was familiar with ecosystem services in the area and the way peri-urban dwellers interact with them, through my earlier research in the areas (for details see preface). Introducing the subject of ecosystem services in local approachable terms, for instance fire wood or wild fruits, was crucial in bringing focus group participants into the same 'lane'. This enabled us to bridge the conceptual gap between ecosystem services conception in academia and the local community. Interviews were anchored upon socio-ecological system adaptive capacities (ecological knowledge, and economic diversity) and how they might be enhanced towards building socio-ecological system resilience against the livelihood effects of climate change. Indeed, via Focus group discussion different cultural ecosystem services such as wild mammals, arts and crafts, traditional foods and nature tourism platform were deduced as potential for building resilience for livelihood effects of climate change. Similarly, ecological knowledge enhancers such as ecological memory via diversity of age cohorts, literacy rate and ethinic diversity were explored.

Key informant interviews

As explained in Section 4.3, focus group discussions preceded key informant interviews in Phase II. This was crucial as information obtained through focus group discussions served as the basis for identifying candidates for key informant interviews. Candidates for key informant interviews were obtained through snowball sampling. Similar to focus group discussions in Phase II, the questions for key informant interviews were based on the potential of the identified cultural and provisioning ecosystem services and how they might be used to build resilience to climate change effects. At the same time, key informant interviews in Phase III, were deployed to acquire a deeper understanding of the social capital milieu at Pugu and Kazimzumbwi socio-ecological systems, and were explicitly tailored to capture bridging social capital. The key informant interviews were geared towards exploring the links and networks involved in building socio-ecological system resilience within the peri-urban context of the Pugu and Kazimzumbwi, especially those related to cultural and provisioning ecosystem services. The interviews were focused specifically on social capital links and networks related to potential economic diversity options, (i.e. the bee keeping industry and multiple forms of tourism). Snowball sampling was once again deployed in selecting candidates for key informant interviews in Phase III. Moreover, the baseline for the snowball sampling at this juncture was information gathered in both focus group discussions and key informant interviews conducted in Phase II. A total of 27 interviews were undertaken amongst 20 social capital networks (or social capital nodes); yet in some social capital networks, more than one representative was interviewed.

Content analysis for the adaptive capacity narrative

Analysis of qualitative information gathered via focus group discussions and key informant interviews was largely done through content analysis. Content analysis enabled the identification of dominant themes from the research and relating them to the research questions. The analysis had no ready-made procedure, but rather adopted an iterative, reflective and pragmatic approach, open to suit a given research theme/question. The analytical process involved an iterative-reflective-pragmatic process of data collection and analysis. This process engaged both empirical information and theoretical concepts. This was done with an intent that the results of the analysis would help in guiding the progressive data collection (Walsham, 2006). While listening and

documenting narratives from interviews and discussions, I simultaneously noted contradictions rather than merely correct interpretations. The narratives were latter categorised based on content for a deeper understanding of the potential contribution of cultural and provisioning ecosystem services towards building win-win-win resilience options. The actual content analysis was done manually, without the aid of software. In this case, information collected was grouped into similar patterns or narratives. This was in turn realised through repeated review of the transcribed information from the focus group discussions and key informant interviews. However, as noted in Section 4.1, the empirical material was sieved through theoretical concepts until the point where they made sense from each other. This is why there is a parallel empirical and Theoretical Task across all phases of the research (see Figure 6). Moreover, the potential contribution of cultural and provisioning ecosystem services towards building socio-ecological system resilience was sieved through an adaptive capacity narrative. An adaptive capacity narrative was deployed in downloading and understanding the broad socio-ecological system resilience narrative. This resulted in unearthing multiple adaptive capacities inherent to the Pugu and Kazimzumbwi socio-ecological systems (i.e. economic diversity, ecological knowledge and bonding and bridging social capital) as elucidated in Section 3.3, 6.3 and 6.4 (see also Article II and III). In other words, the adaptive capacity narrative served as a frame of analysis for the second and third research questions. As mentioned earlier, the reflective analytical process helped in redefining the successive research questions. For instance, the reflective analysis of the second research question (Phase II) yielded insights that led to the refinement of the third research question (Phase III). The iterative-reflective-pragmatic analytic approach deployed helped to refine and redirect the research pathway (see Section 4.1).

4.3.3 Household surveys and principal component analysis

As argued in Section 4.3, household surveys were deployed in both Phase II and III (Case II). Household surveys in Phase II had the character of background information, for instance on community perception of ecosystem services and community dependency on ecosystem services (see Appendix II and Article II). The data obtained through household surveys in Phase II was analysed through descriptive statistics (i.e. simple graphs and charts through SPSS as appears in Article II). The second household survey in

Phase III (Case II), was deployed after iterative, reflective yet progressive analytical processes (see Section 4.1). This was important as it redefined the research focus and ascertained the theoretical niche of the Thesis. The redefinition of the research focus is partly reflected when comparing the household surveys in Phase II (Appendix II) and the one for Phase III (Appendix V). In Phase III (Case II, see Section 4.2), household surveys were largely deployed in gathering information for complementing information collected through key informant interviews. The household survey in Phase III deployed a structured questionnaire comprised of a variety of questions for capturing bonding and bridging social capital attributes. The questions that constituted the survey questionnaire were grouped into three categories: basic socio-economic information, social contact and social skills (referred as bonding social capital in Article III and Section 3.2.1) and bridging social capital attributes.

A total of 50 questionnaires were randomly administered in each of the study hamlets, totalling 150 for the study area. The sample size representation is approximately equivalent to 10 percent of households per hamlet, which is recommended for statistical analysis (see Section 4.2*).* Of those approached, just over 98 percent agreed to participate in the survey, resulting in 148 completed surveys. Of these 148 respondents, 57 were females and 91 were males, 48 were natives of the peri-urban area, 50 were migrants from Dar es Salaam and 50 were migrants from upcountry. As indicated in Section 4.2, the three hamlets were chosen for their slightly different socio-economic characteristics within the peri-urban setting of Pugu and Kazimzumbwi in order to assess the social capital of populations of diverse backgrounds. Study households were randomly selected from the residential areas and only one participant was involved per household. Participants ranged from 17 years up to 73 years of age; the average age was 37 with a standard deviation of 16. During the interview, priority was given to household heads. As noted earlier, analysis of household surveys in Phase III was realised through principal component analysis as elaborated next.

Principal component analysis

As noted earlier, analysis of information gathered through household surveys (Phase III), was carried out using principal component analysis, through the Statistical Package for Social Sciences (SPSS), Version 24. The household survey was used to assess social capital attributes (i.e. bonding and bridging capital), following the standard example questionnaire of (Chen et al., 2008).

The questionnaire consisted of ten scales/Cap[15] with 42 sub-items. The 42 sub-items were assessed in a five-point Likert scale, with one=none or a few and five=all or a lot. Scores for the individual 10 items were obtained by calculating the summary of constituent sub-item scores and then dividing by the number of sub-items in that particular scale. For instance, the first scale was composed of six sub-item scores for assessing the size of social network connections. The score of this scale was obtained by first taking the six sub-item scores and then dividing the subtotal by six *(*the number of sub-items). After the item scores were derived, bonding social capital was obtained by adding together the first five scales (one to five) and dividing by five (the number of items). Accordingly, bridging social capital was calculated by adding together the last five scales (six to ten) and dividing by five (the number of items). The total social capital score was then obtained by adding together the bonding social capital and bridging social capital scores. The findings originating from the principal component analysis on the potential contribution of bonding and bridging social capital towards building socio-ecological system resilience in peri-urban areas is discussed in Section 5.3 and Article III.

4.4 Validity and reliability

As stated earlier, the overarching aim of this Thesis was to investigate the potential contribution of cultural and provisioning ecosystem services towards building socio-ecological system resilience for the livelihood induced effects of climate change in peri-urban areas of Sub-Saharan Africa. In realising this aim, an iterative, reflective yet progressive approach was deployed, where three research questions guided the research process. In responding to the research questions, different internal and external validity checks were observed across research design, data collection and analysis stages (see Table 5). For instance, multiple methods were deployed in response to both the second and third research questions. This pertains to triangulation of evidence, which in part guarantees the internal validity of the results. At the same time, theoretical concepts were applied during the design stage and progressively during data analysis. They were subject to the iterative, reflective and progressive approach deployed. Deploying theory

[15] This refers to 10 items of the standard example questionnaire by Chen et al. The 10 items/Cap (identified as Cap 1–Cap 10) each comprise 42 sub-items, as presented in Appendix V.

takes care of the external validity of the results in the sense that the results, or rather the methods, can be useful in exploring similar studies in context.

The quest for reliability and whether another researcher deploying a similar approach would end up with similar results, is of intriguing concern in scientific inquiry. According to Burr (2015), no human being can step outside of themselves and view the world from another position. This is also true for scientists, as it is for everyone else. In other words, Burr argues that no matter how rigorous and replicable the approach may be, if the research is repeated by another person there must be slight differences owing to the individual's world view subjectivity. Indeed, the quest for reliability is largely subjective and depends on the researcher's pre-conception of the study object and his or her background. However, as noted earlier, in accordance with the internal and external validity instincts observed in this research, if one conducts similar research with the same focus and approach it is very likely that one would come up with findings close to what has been presented. In this regard, the results on the first research question (RQI), would to a large extent, be similar to the ones presented in this Thesis. Regarding the findings based on Case II (i.e. RQII and RQIII), the results would very likely be close to the ones presented here, if it happens that Pugu and Kazimzumbwi are selected as revelatory peri-urban socio-ecological systems for informing the inquiries. Moreover, data collection protocol (Appendix I and II) was devised and adhered to, which details the process undertaken during data collection (Table 5).

Table 5. Validity and reliability criteria observed.

S/n	Criteria	Technique deployed	Phase applied	Evidence
1	Construct validity	Multiple evidence	Data collection	Appendix II,III,V, VI
		Chain of evidence	Data collection and analysis	Appendix II, III and Article II
2	Internal validity	Pattern matching	Data analysis	Articles II and III
		Explanation building	Data analysis	Articles II and III
3	External validity	Applying theory	Research design	Chapter 3
4	Reliability	Using case study protocol	Data collection	Appendix I and IV
		Case study database	Data collection	Established

Source. Adopted and modified by the author from (Yin 2014).

5 Summary of Articles I-III

In this chapter, I share a brief review of the three Articles, which constitute the main results of this PhD Thesis. The Articles provide an in-depth analysis of both the theoretical and empirical work taken on during the three phases of the conducted research.

On the one hand, Article I based on Case I, capitalises on the review of ecosystem services research in peri-urban areas of Sub-Saharan Africa and further on the contribution of ecosystem services in building resilience to climate change effects in the region. It is therefore pivotal as it clarifies the gap of the study in the wider context of the Sub-Saharan Africa. On the other hand, Article II and III based on Case II, build on the socio-ecological system resilience-building discourse against the livelihood induced effects of climate change in peri-urban areas in Sub-Saharan Africa. Moreover, the two Articles are empirically focussing on the Pugu and Kazimzumbwi socio-ecological systems, thereby forming the core of the Thesis. Article II analyses the Pugu and Kazimzumbwi socio-ecological systems' cultural and ecological adaptive capacities and their potential contribution for building resilience for climate change effects. At the same time Article III analyses bonding and bridging social capital and their implications for socio-ecological resilience-building. Table 6 summarises the methods used in each of the three peer-reviewed Articles.

Table 6. Application of research methods and questions to peer reviewed publications.

Research Method/RQ	Article I	Article II	Article III
Document analysis	Applicable	Applicable	Applicable
Household surveys	Not applicable	Applicable	Applicable
Key informant interviews	Not applicable	Applicable	Applicable
Focus group discussions	Not applicable	Applicable	Not applicable
Research question (RQI)	Applicable	Applicable	Not applicable
Research question (RQII)	Not applicable	Applicable	Not applicable
Research question (RQIII)	Not applicable	Not applicable	Applicable

Source. Adopted and modified from Nagoli, 2016.

5.1 Article I: Ecosystem services potential for climate change resilience in peri-urban areas in Sub-Saharan Africa: Review article (published)

The work (see Figure 6, i.e. Phase I) that led to the writing of Article I was vital to this Thesis. It involved a rigorous literature review to widen knowledge and narrow the study focuses into more realistic and researchable inquiry. The Article responds to the first research question (i.e. *What is the potential contribution of peri-urban ecosystem services for climate change resilience in Sub-Saharan Africa according to research*?).

Table 7. Peri-urban ecosystem services that contribute to enhance climate change resilience.

Category	Ecosystem service	Service generating unit	Region	Reference
Provisioning services	Timber resources	Different tree species	Europe Sub-Saharan Africa Asia	Matero et al., 2003; Takasaki et al. (2004), (Enfors and Gordon, 2008) Gordon, 2008
	Game, berries, mushrooms,	Different species in land, fresh-water and sea ecosystems	Europe Sub-Saharan Africa	Matero et al. (2003); Enfors and Gordon, 2008
	Fresh water, soil	Groundwater infiltration, suspension and storage	America	Brauman et al. (2007)

Category	Ecosystem service	Service generating unit	Region	Reference
Regulating services	Micro-climate regulation	Green cover (vegetation)	Europe	Gill et al. (2007)
	Carbon sequestration	Vegetation	Asia America Europe	Ugle et al. (2010) Balvanera et al. (2005)
	Protection of coastal areas	Vegetation cover	Asia Sub-Saharan Africa	Das and Vincent (2009) Mustelin et al. (2010)
	Rain water absorption	Vegetation cover, sealed surface, soil	Europe	Bolund and Hunhammar (1999)
	Buffer to floods	Wetlands, vegetation	Asia-Pakistan Asia-Thailand	Sudmeier-Rieux et al. (2007) Barbier (2006)
Cultural services	Recreation of urban dwellers	Biodiversity, especially in parks, forests and water ecosystems	Europe	(Bolund and Hunhammar, 1999)
	Science education, research and teaching	Biodiversity	Europe	Matero et al. (2003) Bolund and Hunhammar (1999)

Source. Article I.

Article I problematises the research area under investigation and further positions the study in the wider region of Sub-Saharan Africa (see Case I in Section 4.2). The Article underscores the weakness of urban ecosystem services research in the Sub-Saharan African region relative to the northern hemisphere despite the fact that the region is increasingly experiencing emergent climate change effects. Regarding the potential contribution of peri-urban ecosystem services to climate change resilience-building, Article I emphasises a few possible entry points. These includes increasing socio-economic resilience for climate change effects and reducing the exposure of the peri-urban areas to floods and their associated effects. However, these examples are, to a large extent, drawn from elsewhere (i.e. Europe, Asia and America) owing to the limited research focus into this topic in Sub-Saharan Africa.

Article I argues that despite ecosystem services conceived to provide low-cost opportunities for building resilience for climate change effects in urban landscapes, little if anything has been done in tapping this opportunity in Sub-Saharan Africa. As shown in Table 7, there is limited research on

ecosystem services potential contribution towards resilience-building pathways for climate change effects in Sub-Saharan Africa. The lacuna spans from the inadequate conceptualisation of ecosystem services concept to the actual knowledge on how ecosystem services might be deployed in building resilience for climate change effects in peri-urban areas. Article I posits that this is an area worth considerable attention in terms of multi-disciplinary case studies envisioned by generating context-laden knowledge that can easily fuse into local policy and thereby transform the practice on the ground. Moreover, analysis of ecosystem services typologies aligned with climate change resilience-pathways are presented. In this regard, as discussed in Chapter 1, Article I posits that the cultural and provisioning ecosystem services are minimally explored in the context of building resilience for climate change effects in peri-urban areas broadly, with specificity in Sub-Saharan Africa. The little focus on the cultural and provisioning ecosystem services aligned with climate change resilience in peri-urban areas in Sub-Saharan Africa constitutes the knowledge gap that this Thesis engages (see Chapter 1).

Another imperative finding in Article I is that peri-urban is generally under-researched, particularly in Sub-Saharan Africa. This is happening in the era where urbanisation and urban sprawl are on the rise, with deadly implications for the quality and quantity of ecosystem services in these transitional urban spaces. Article I argues further that the attention to peri-urban areas, and their associated ecosystem services, will not only have considerable impact on climate change resilience-building processes but also on the wider urban planning quagmire in the region, which is increasingly threatened by increasing urbanisation and urban sprawl. The Article therefore forms the basis of the Thesis by problematising the research gap, and thereby justifying the study and earmarking the area's potential for knowledge contribution.

5.2 Article II: Socio-ecological resilience to climate change effects in peri-urban areas: Insights from the Pugu and Kazimzumbwi forest reserves of Dar es Salaam, Tanzania (published)

Article II takes the study to another level by partly responding to the challenging discourse expounded on in Article I, the scarcity of context-laden peri-urban studies exemplifying how ecosystem services might serve as entry points in building resilience to climate change effects. Yet, the Article narrows down to the peri-urban areas of Dar es Salaam city (i.e. Case II, see Section 4.2), exploring the socio-ecological systems adaptive capacities for building resilience to climate change effects. Article II is thus responding to the second research question (RQII) of the Thesis, *How might the identified Pugu and Kazimzumbwi socio-ecological system adaptive capacities contribute in building resilience for livelihood induced effects of climate change*? The Article builds upon previous climate change research at Pugu and Kazimzumbwi socio-ecological systems. Article II starts by painting an overview of the lived climate change reality at the study area as an imperative background. Moreover, climate change effects linked to a decline in ecosystem services are discussed. This in turn rationalises the need for exploring resilience-building potential at the local setting. The Article further deploys the socio-ecological system resilience lens to unpack a set of adaptive capacities towards building resilience for the livelihood induced effects of climate change. Two sets of adaptive capacities aligned with cultural and provisioning ecosystem services (i.e. economic diversity and ecological knowledge) are explored and discussed. Table 8, for instance, portrays occupation heterogeneity at the study area which is intrinsic to economic diversity. However, occupation distribution in the area lies contrary to the situation of the remaining part of the Kisarawe District of which about 90% of the population relies on rain fed Agriculture (see Chapter 2). This is likely attributable to the reality that the area is at the peri-urban of Dar es Salaam city and so highly influenced by the multiple income earning opportunities accorded by the city. Yet, as discussed in article II the presence of multiple income earning sources is an indication of resilience to livelihood effects of climate change. However, this is subject to whether such income earning sources offer options that are not affected in the same way by climate change (i.e. diverse response options).

Table 8. Occupation diversity at Pugu and Kazimzumbwi socio-ecological systems.

Occupation type	Study hamlet (n=50) Nzasa (%)	Study hamlet (n=48) Pugu-Kibaoni (%)	Study hamlet (n=47) Kisarawe (%)	N=147 Total %
Farming	13	3	12	29
Cattle keeping	3	2	2	7
Poultry husbandry	3	4	5	12
Casual labour	3	3	9	16
Public employee	0	0	5	5
Vegetable gardening	4	2	5	11
Tree nursery gardening	1	0	1	2
Brick making	1	4	0	5
Matching guys	2	8	2	13
Logging	1	1	3	5
Bee keeping	1	1	6	8
Charcoal making and selling	1	2	6	10

Source. Field work (October 2017-March 2018).

An example of cultural ecosystem services based adaptive capacity that offers diverse response options to the livelihood effects of climate change is arts and crafts tourism (Image 1). Other cultural and provisioning ecosystem services aligned with adaptive capacities articulated in Article II includes bee keeping (Image 2), food tourism, and wild mammal cave. The analysis of how the identified economic diversity adaptive capacity might be deployed for building socio-ecological system resilience are further provided for in Chapter 6. Yet, the identified potential for building resilience towards climate change effects is argued to be largely underexploited. The Article argues that the underexploited cultural and provisioning ecosystem services potential for building resilience to the livelihood induced effects of climate change ought to be revitalised so as to bring them into full employment for a win-win-win outcome. As discussed earlier, the first win regards to the opening up of the ecosystem services sector and thus widening climate friendly livelihood options for the peri-urban community. The second win regards ecosystem services welfare due to a reduced encroachment level as community members would have climate friendly livelihood options. The third win regards the extended implication of climate change mitigation and adaptation options. This will be realised through reduced degradation, thereby increased carbon sequestration function.

Image 1. Arts and crafts items (cultural ecosystem services) potential for cultural tourism at Pugu and Kazimzumbwi socio-ecological systems. Photo: Lazaro Eliyah Mngumi, February 2018.

Image 2. A bee keeper at Kisarawe towards attending her bee hives at the Pugu and Kazimzumbwi socio-ecological system (provisioning ecosystem services). Photo. Lazaro Mngumi, March, 2018.

Article II further analysed ecological/cultural knowledge aligned with adaptive capacities at the Pugu and Kazimzumbwi socio-ecological systems. These include ecological knowledge transfer, ethnic diversity and literacy levels. The analysis of this ecological knowledge-related set of adaptive capacities portrays a considerable bearing that suggests the potential of contributing to resilience-building. The analysis of how the identified ecological knowledge attributes might contribute to socio-ecological resilience building are discussed further in Chapter 6. Overall, Article II posits that the Pugu and Kazimzumbwi socio-ecological systems have considerable adaptive capacity potential for building resilience for the livelihood induced effects of climate change. Moreover, the article argues that the identified adaptive capacities should be enhanced for win-win-win resilience outcomes against the livelihood effects of climate change.

5.3 Article III: Exploring the contribution of social capital in building resilience for climate change effects in peri-urban areas, Dar es Salaam, Tanzania (published)

Article III advances further the discussion of the Thesis. It builds on both Article I and Article II. It elaborates on Article I by partly responding to the claim raised in Article I regarding the limited attention allotted to the social parameters pertaining to the climate change resilience-building discourse. It builds on Article II by partly exploring the question of social capital in building resilience for climate change effects, which is furthering upon the adaptive capacities discussed in Article II (See Chapter 6 and Article III). The Article analyses the two social capital attributes imperative for building resilience against climate change effects (i.e. bonding social capital and bridging social capital). The Article posits that the neglect of social attributes in climate change resilience-building discourse is increasing, especially in urban and peri-urban contexts in Sub-Saharan Africa. This is in part rationalised by the predominance of engineering solutions and approaches in the region. Despite the fact that it is largely socio and not physical/ engineering parameters that derive socio-ecological system resilience. It is on this basis that Article III makes both theoretical and empirical contributions on climate change resilience discourse in peri-urban areas in the context of the Global South. Theoretically, the Article draws on social

capital and resilience-related literature, whereas empirically the article draws from Case II – the Pugu and Kazimzumbwi socio-ecological systems. The article found that, both bonding and bridging social capital were strong in the studied area. Examples are discussed through a number of resilience-building interventions established through synergies between social capital actors and local communities. However, some doubt is cast over the sustainability of these initiatives. Overall, both theoretical and empirical evidence suggests the importance of including a focus on bonding social capital and bridging social capital, in exploring climate change resilience-building pathways in peri-urban areas, and especially in the context of the Global South.

6 Discussion

This chapter discusses the Thesis findings and reflections. It begins with a discussion of the research questions in the context of the Thesis findings, followed by theoretical and methodological reflections.

As noted earlier, the entry premise for this Thesis was the findings in Article I, that there is a knowledge gap on typified studies regarding how ecosystem services might be deployed in building resilience for climate change effects in peri-urban areas of Sub-Saharan Africa. Through iterative, reflective and progressive research approaches (see Section 4.1), the overarching aim of this Thesis was to contribute knowledge in this area, what typical ecosystem services are and how they might be engaged towards building resilience in peri-urban areas in Sub-Saharan Africa. It was deduced that the context for the study, urban and peri-urban areas in Sub-Saharan Africa and the Pugu and Kazimzumbwi socio-ecological systems, are largely characterised by infra-structure deficits. This has, in part, rationalised engineering resilience pathways in Sub-Saharan Africa at the expense of socio-ecological system approaches. Whilst engineering resilience contributes indirectly to resilience-building processes, I argue that resilience is largely a social phenomenon and should therefore be approached looking through a social lens. Yet, since the Thesis stresses exploring the contribution of cultural and provisioning ecosystem services, it deploys socio-ecological system resilience as its over-arching lens of analysis. The analysis in this Thesis focuses on socio-ecological system pathways to climate change resilience in Sub-Saharan Africa and the Pugu and Kazimzumbwi socio-ecological systems. The analysis largely centres on the socio-ecological system's adaptive capacity frame of analysis towards understanding

resilience-building potential pathways in climate change affected peri-urban socio-ecological systems in Sub-Saharan Africa.

6.1 Potential contribution of ecosystem services for climate change resilience in peri-urban areas

This Section discusses response to RQI, what is the potential contribution of peri-urban ecosystem services for climate change resilience in Sub-Saharan Africa according to research? Moreover, the provisioning and cultural ecosystem service's potential for building resilience for climate change effects, typified from the Pugu and Kazimzumbwi socio-ecological systems, are discussed. It starts with a preamble on ecosystem services at Pugu and Kazimzumbwi socio-ecological systems as depicted hereafter.

> Due to life hardships aggravated by climate change, I find myself being part of forest-ecosystem services encroachers in order to acquire the daily bread for my family. [….] I do this despite knowing the side effects of that action to the environment and further that the act itself is illegal. (Key informant interview at Kisarawe)

The above quote is from a member of the Village Environmental Committee (VEC) at Kisarawe hamlet (one of the study hamlet at the Pugu and Kazimzumbwi socio-ecological systems). Being part of the committee responsible for safeguarding forest ecosystem services, he is acknowledging that he takes part in raising awareness and actually guarding other community members from illegally accessing and exploiting forest ecosystem services. However, given the lived poverty reality (see Section 2.3), which is worsened by climate change effects, he himself participates in doing the same (i.e. illegally accessing forest ecosystem services). This confession indicates the gravity of climate change-related effects in these peri-urban forest reserves. It further indicates that ecosystem services serve as de facto sources (see Section 2.2) of livelihoods for peri-urban dwellers, especially in the face of climate change. De facto ecosystem service dependence is likely to result in maladaptation to climate change, thereby yielding counterproductive effects on earlier intervention initiatives.

As expounded upon in Section 1.1 and Article I, peri-urban ecosystem services are increasingly thought to have enormous potential for building

resilience to climate change effects in both urban and peri-urban areas. Yet, as substantiated in Chapter 1 and Article I, the discourse has largely received fringe attention from both academia and practitioners, especially in Sub-Saharan Africa. The published literature has shown that the discussion of the potential of ecosystem services in building resilience to climate change effects in peri-urban areas in Sub-Saharan Africa is negligible. This is further portrayed in Table 7, which shows that there is limited scholarly research on how ecosystem services might potentially contribute towards building resilience for the livelihood-induced effects of climate change in peri-urban areas in Sub-Saharan Africa. However, the services, such as provisioning services like timber products, game, berries, mushrooms and fresh water are argued to potentially contribute to building socio-economic resilience against climate change effects in peri-urban areas. On regulating services, the discussion is revolving around climate regulation, protection of coastal areas, rain water absorption and forming buffers against floods. Cultural services are rather discussed in terms of recreation for urban dwellers. Yet in this category, unlike provisioning and regulating services, no research was conducted in Sub-Saharan Africa. This implies fringe attention by researchers and academia on the subject of ecosystem service's potential contribution to climate change resilience building pathways. This observation has twofold implications intrinsic to this Thesis. First, it rationalises the topicality of the subject of this Thesis in Sub-Saharan Africa, as the topic has not received the attention it deserves. This is especially so in the current era, where the understanding that ecosystem services have the potential for building resilience for climate change effects in peri-urban areas is on the rise. Second, the observation serves as an eye–opener for researchers in the region to provide due attention to this subject matter, which is largely neglected. The call for researchers in the region to pay keen attention to this topic is premised upon the context-laden reality of ecosystem services.

Another intriguing finding regards the context-based provisioning and cultural ecosystem services potential for building resilience to climate change effects. Indeed, the Thesis has brought into focus the discussion on possible ecosystem services and how they might contribute to climate change resilience pathways in peri-urban areas. This was a step towards contributing to the previously discussed knowledge gap in this growing field of study in Sub-Saharan Africa. As discussed in Chapter 4, empirically grounded information is drawn from the Pugu and Kazimzumbwi socio-ecological

systems. Particular input in the field has been on the contribution of the cultural and provisioning ecosystem services for the climate change resilience-building discourse in peri-urban areas in the Sub-Saharan African region. On provisioning ecosystem services, the Thesis has looked at the potential of bee keeping as contributing to climate change resilience, apart from other co-benefits to livelihoods and environmental protection. On cultural ecosystem services, various forms of tourism (i.e. food, arts and crafts, wild mammal, etc.) have been identified and their potential contribution to climate change resilience-building processes analysed in Article II (see further discussion under Section 6.2). Developing pathways of deploying ecosystem services in building resilience to climate change effects might not only appreciate their value, but also contribute to creating a sense of stewardship for these natural resources in adjacent communities. This suggests that there is a need for deploying case studies in other peri-urban areas so as to map ecosystem services specific to a given region. This is an imperative cost-effective approach to addressing the growing climate change challenge in urban areas, more so in the era when informality, urban sprawl and urbanisation under poverty in Sub-Saharan Africa is on the rise.

6.2 Socio-ecological system adaptive capacities and climate change resilience building pathways

This Section responds partly to RQII, how might the identified adaptive capacities at Pugu and Kazimzumbwi socio-ecological systems contribute in building resilience for livelihood induced effects of climate change? Indeed, it is imperative to appropriately articulate the adaptive capacities existing in a given socio-ecological system, as they form the basis of resilience-building pathways. Overall, two sets of socio-ecological system adaptive capacities were explored and are hereby discussed (i.e. economic diversity and cultural /ecological knowledge). As articulated in Chapter 3, adaptive capacity as deployed in this Thesis refers to context dependent-resources with dynamic attributes for influencing resilience-building pathways in a given socio-ecological system. It is in this understanding that adaptive capacity is conceived as a socio-ecological system, with resources upon which resilience is built as the system responds to the effects of climate change.

Economic diversity is one of the primary socio-ecological system's adaptive capacities necessary for building resilience against the livelihood

effects of climate change. This is invaluable in poverty marked areas (see Section 2.3) where climate change stress affects livelihood systems. Yet, as discussed in Section 2.4, one of the immediate effects of climate change at the Pugu and Kazimzumbwi socio-ecological systems is declining crop production and consequently diminishing livelihood potential. Further, it was underscored that one of the consequences of declining livelihood options was increased forest encroachment and declining forest ecosystem services. However, as expounded upon in Chapter 1 and 3, this Thesis stresses cultural and provisioning ecosystem services. It is on this basis that climate-friendly cultural and provisioning ecosystem services economic diversity potential was explored. It was found that economic diversity at Pugu and Kazimzumbwi socio-ecological systems include bee keeping, art and craft tourism, wild mammal tourism, food tourism and nature tourism. It can be argued that bee keeping is a threefold resilience building imperative. This is in part reflected in an assertion from one informant at Kisarawe.

> Bee keeping is helping us to earn a living as crop production is no longer reliable due to unpredictability of rainfall patterns. Through bee keeping we can supplement our income and hence sustain our daily needs. Another advantage of bee keeping is that it serves as a "forest guard" meaning that when bee hives are installed along the border, or forest buffer zone, due to fear of being stung by bees' people who have no bee keeping equipment and training cannot get closer to the forest. This discourages encroaching on the forest reserve to access ecosystem services.

Bee keeping, by discouraging forest encroachment, is indirectly contributing to climate change mitigation efforts through increased forest cover and increasing carbon sequestration. Overall, bee keeping offers diverse economic responses and livelihood potential towards building resilience for climate change effects at Pugu and Kazimzumbwi socio-ecological systems. As mentioned earlier, tourism is one of the viable economic activities identified at the Pugu and Kazimzumbwi socio-ecological systems, providing response diversity to the livelihood induced effects of climate change. Cultural ecosystem services-based forms of tourism were identified (i.e. food tourism, arts and crafts tourism, wild mammal's tourism, antiquities and nature tourism). As articulated in Article II, these are socio-ecological system's inherent adaptive capacities that offer potential diverse responses for livelihoods potential through cultural tourism. In other words, tourism in

its multiple forms, provides survival options that respond differently, unlike rain fed agriculture (see Section 2.3). However, it was underscored that the identified socio-ecological adaptive capacities were underexploited and thus an implicit call for their revitalisation should be made to build resilience capacity against climate change effects.

However, cultural/ecological knowledge of adaptive capacity was identified. In this category, socio-ecological memory, literacy rates, ethnic diversity and occupation heterogeneity are explored. Socio-ecological memory, which is one of the cultural adaptive capacities is argued to form a smooth knowledge transfer mechanism from one age cohort to another. Yet, the knowledge in this context must be on how to go about in times of stress and shocks. As argued in Article II, the presence of different age cohorts, which correspond to the Tanzanian age structure, was indicative of having potential resilience knowledge transfer from the elderly to the younger. In resilience discourse, having a mixture of different age cohorts in a socio-ecological system is positively regarded, as it provides a venue for cross-age mentoring (Benard, 1997). Therefore, socio-ecological memory, through the elderly can easily be transferred to the younger generation. This is particularly true in different approaches by which the previous generations used to address similar stress using traditional knowledge. On another account, the level of education is one of the cultural capitals, which explains to some extent the level of employability and flexibility was assessed at Pugu and Kazimzumbwi socio-ecological system. It was found that, nearly 80% of community representatives had attained at least primary education (i.e. basic literacy knowledge of how to read and write). However, these findings suggest that there is weak flexibility in community members in terms of seeking alternative or better paying employment in times of crisis, since the majority only have up to primary education. Moreover, in resilience building perspectives, the education level stance at Pugu and Kazimzumbwi socio-ecological systems shows positive community adaptive capacity. This is owing to the fact that the majority of community representatives have cognitive knowledge, which might enable them to process information, perceive, interpret and make sensible decisions towards addressing climate change effects. Another imperative cultural capital explored was ethnic diversity. The findings reveal a hybrid ethnic composition in the study area. The area is composed of native ethnic groups (Zaramo, Kwere, Ndengereko, and Makonde) and non-native ethnic groups (Matumbi, Chagga, Haya, Pare,

Nyakyusa, Pogoro, Kurya, Sukuma, Hehe, Jita, Nyiramba, Masai, Makua and Nyamwezi). These non-native ethnic groups migrated to the area mostly from up country (Bara) for diverse reasons. The ethnic mix in the Pugu and Kazimzumbwi socio-ecological systems is often taken for granted yet is an asset in the resilience building perspective. In resilience thinking, ethnic mixing is often described as ethnic diversity and is believed to be one of the socio-ecological system capacities in building resilience to shocks and stresses, such as climate change, as is the case in the study area. The confluence of ethnic groups in a given socio-ecological system is an asset towards building resilience by pulling together diverse coping and adaptation strategies. This is due to the fact that in such socio-ecological systems there are community members with varied and extensive experience on how to address such changes from different stand points. This is rationalised by the fact that some ethnic groups migrated from different regions, which have been experiencing different calamities and might have knowledge of how to maintain in such situations.

On another account, occupation heterogeneity was explored in Pugu and Kazimzumbwi socio-ecological systems. Occupation position was explored as it is believed to be amongst the cultural capital attributes, which communicate community dependence on ecosystem services. It was found that there is an excessive diversity of income generating activities upon which individuals within the Pugu and Kazimzumbwi socio-ecological systems earn their living. Although they are with varying proportions led by farming, other occupations include casual labour, howkers, poultry husbandry, vegetable gardening, charcoal making and selling, bee keeping, cattle keeping, logging, brick making and serving as a public employee. In resilience discourse, presence of multiple sources of income activities in a socio-ecological system is positively regarded as a potential adaptive capacity. This feature is one of the socio-ecological system's adaptive capacities, providing a conducive working ground for agents to act upon in building socio-ecological system resilience against climate change effects. In a nutshell, the findings on cultural capacities at Pugu and Kazimzumbwi socio-ecological systems have shown that the system has rich cultural diversity (i.e. diverse age cohorts, ethnicity, promising literacy rates and occupation heterogeneity) with a potential towards building resilience to climate change effects. This reasoning agrees with arguments by (Sabatier, 1992), that cultural diversity promotes the ability to build and increase the adaptive capacity for learning

and acclimatising to environmental change. This suggests that the Pugu and Kazimzumbwi socio-ecological systems have positive cultural adaptive capacities imperative for building resilience for climate change effects. However, these capacities are largely unexploited.

6.3 Bonding and bridging social capital and socio-ecological system resilience building discourse

This Section contributes to responding to RQIII i.e. *How might bonding and bridging social capital contribute in building resilience for livelihood induced effects of climate change at Pugu and Kazimzumbwi socio-ecological systems*? The inquiry into social capital was prompted by the general lack of social analysis in climate change resilience pathways broadly and specifically in urban and peri-urban areas in Sub-Saharan Africa as articulated in Article III. However, as discussed in Chapter 1 and Article III, the lack of attention in social perspectives to resilience in urban and peri-urban areas in Sub-Saharan Africa is largely rationalised by the infrastructure deficit (see Chapter 1, 3 and Article III). In much of the developing world, the infrastructural deficit challenge is a lived reality, which dictates to a considerable extent urban planning and development. The focus on the infrastructure deficit challenge, and consequently engineering resilience, has largely jeopadised the deployment of a social lens in exploring and understanding social issues pertinent to resilience building discourses in urban and peri-urban areas of Sub-Saharan Africa. Yet, resilience is increasingly understood to be largely a social phenomenon. The social nature of resilience is based upon the idea that resilience is a process of navigating plausible potential options towards predicted positive futures and is not an end in itself. At the core of this notion lies the imperative of contextualising resilience, (i.e. setting resilience within its social milieu). While this Section is delimited, specifically on the role of social capital towards building socio-ecological system resilience in relation to climate change effects in peri-urban areas in the global south, it is worth noting that the social climate, which encompass resilience-building discourses, are much broader than social capital. Other intriguing social discourses pertinent to socio-ecological system resilience building processes include agency, sustainability, power and power relations. Subject to this explanation, bonding social capital and bridging social capital were explored both theoretically and empirically. As argued in Article III, the exploration focused

on how they might potentially contribute to, or inhibit, the socio-ecological system resilience building in the context of the climate change reality in peri-urban areas of Sub-Saharan Africa. Theoretically, insights are drawn from existing social capital and resilience-related literature whereas empirically, insights are derived from the peri-urban areas of Pugu and Kazimzumbwi socio-ecological systems (Case II).

On the one hand, bonding social capital thrives in well-embedded groups with strong affective ties linking group members to one another. It is crucial in providing social support and in cementing in-group solidarity. This type of social capital is important in building socio-ecological system resilience in climate change affected communities in peri-urban areas of the developing world. This is because social support and in-group solidarity are crucial in preparing the ground for other adaptive capacity attributes necessary for building socio-ecological system resilience to climate change effects. In the study area, it was found that, the peri-urban communities at Pugu and Kazimzumbwi socio-ecological systems have relatively strong social ties. The level of bonding social capital demonstrates the substantial degree of connectivity among the members of the peri-urban community in the Pugu and Kazimzumbwi socio-ecological systems. This indicates the existence of high levels of internal cohesion, that might be used in the course of building socio-ecological system resilience for climate change effects. The role of bonding social capital in building socio-ecological system resilience lies in its potential influence on economic development, which is a vital component in the resilience building discourse. In particular, bonding social capital is regarded as an essential element for collective action, which is a key ingredient for socio-ecological system resilience building processes. The importance of social capital in supporting economic development, which can promote socio-ecological system resilience building in the face of climate change effects in peri-urban areas in Sub-Saharan Africa is twofold. The first aspect relates to the widespread income poverty experienced in Sub-Saharan Africa. This regards the crucial role played by bonding social capital. Close social ties and help in times of need are of paramount importance in navigating pathways for building socio-ecological system resilience in general, but also with specific reference to peri-urban areas, which are subject to stress, including climate change stress. Building socio-ecological system resilience is a key way of addressing and alleviating this stress, and social capital lies at the core. As previously noted, this holds true for Sub-

Saharan Africa and for other countries with similar social and economic structures in the Global South, which face widespread poverty linked to community dependence on (unsustainable) extraction from provisioning ecosystem services (see Article II). This extractive dependency - or socio-ecological interdependence - highlights the reality of poverty in these communities. It also demonstrates the importance of deploying bonding social capital as vital tool in building socio-ecological system resilience against climate change effects. This is reflected in the study area, which is characterised by poverty and the negative impact of climate change on ecosystem services (for details see Chapter 2). Bonding social capital is thus increasingly regarded as an essential stimulus for fuelling economic development, thereby forming a key attribute in building socio-ecological system resilience against climate change effects.

However, the coexistence of urban and rural features in peri-urban areas of the developing world makes the deployment of bridging social capital even more imperative in building socio-ecological system resilience. Bridging social capital links people or groups of different orientations; in addition, it addresses how social capital facilitates resource acquisition (Putnam, 2000), which is central to resilience building pathways. Unlike bonding social capital, whose networks are comprised of similar individuals with supposedly equivalent resources, bridging social capital can address an array of differences typical of peri-urban areas. It also plays a crucial role in facilitating information flows within and between groups and improving access to a wide range of resources (Ibid.). Bridging social capital enables the best use of relevant knowledge and technical know-how in terms of what is feasible and what options have the most potential in a given context. The role of this category of social capital in building socio-ecological system resilience against climate change effects in peri-urban areas of the Global South is related to the realities of poverty linked to resource scarcity. The poverty situation is prevalent in most urban and peri-urban areas in Sub-Saharan Africa as well as in Pugu and Kazimzumbwi socio-ecological systems, as partly shown in Chapter 2. However, this reality renders sections of the population at odds with each other when subjected to shocks and stresses, such as climate change. As noted earlier, if left on their own without the external synergies made possible by bridging social capital, communities would devise their own autonomous adaptation modalities, which would most likely undermine long-standing efforts geared at addressing climate

change effects. This scenario has indeed manifested itself in the peri-urban areas of Pugu and Kazimzumbwi socio-ecological systems. After being subjected to climate change, which reduced their livelihood options, a substantial proportion of community members resorted to encroaching on adjacent ecosystem services to earn their living, with no regard for the impact of their actions on those ecosystem services and on the climate. These undermined earlier initiatives towards addressing climate change by, for example, degrading forest ecosystems, thereby reducing the carbon sequestration function of those forests. The 'resource gap' that is thus created can be at least partly addressed by bridging social capital. How the synergies of bridging social capital were manifested in the peri-urban areas of Pugu and Kazimzumbwi socio-ecological systems is articulated hereafter.

Like many other peri-urban areas in Sub-Saharan Africa, the Pugu and Kazimzumbwi socio-ecological system sites are experiencing declining ecosystem services, with negative implications for livelihood options and for climate change adaptation and mitigation potential. Indeed, ecosystem services decline in the Pugu and Kazimzumbwi socio-ecological systems are likely to have been partly triggered by climate change effects, forcing peri-urban dwellers to increasingly exploit ecosystem services as a way of adapting to the growing effects of climate change. Although such autonomous adaptation may not be bad in itself, when viewed through the lens of climate change, it can become critical. This raises the question of soliciting and engaging input, which is external to the socio-ecological systems in question in order to support local potential in building socio-ecological system resilience against climate change effects to arrive at a 'win-win-win' outcome. The sum of resources external to the socio-ecological system, which synergistically engages with existing potential within the socio-ecological system towards building socio-ecological system resilience, is expressed as bridging social capital. As already noted, analysis of the household survey suggests that the Pugu and Kazimzumbwi socio-ecological systems have considerable bridging social capital resources. However, findings show that bridging social capital is particularly strong, relative to bonding social capital. While, as previously discussed (see Chapter 3), very high levels of bonding social capital can be undesirable, this is not the case for bridging social capital. For the case of bridging social capital, the higher the score the better in terms of building synergies, integrating resources from inside and outside the socio-ecological systems.

Moreover, as articulated in Article III, bridging social capital networks were established at the Pugu and Kazimzumbwi socio-ecological systems by a range of actors, each playing a substantial role in building socio-ecological system resilience against climate change effects. These integrative networks embodied 'alien' thinking and were crafted within local structures, which deployed local resources towards the common goal of building socio-ecological system resilience.

Another key role for bridging social capital in the context of the Pugu and Kazimzumbwi socio-ecological systems was the promotion of climate friendly income-earning activities (i.e. livelihoods that do not exacerbate climate change but rather help to mitigate against it). This provides community members with survival strategies, which reduce the level of forest encroachment and its negative consequences from climate change (Scott and Becken, 2010). This was partly achieved through the concerted efforts between bridging social capital players and resources inherent within the Pugu and Kazimzumbwi socio-ecological systems. Bee keeping is one of climate friendly income generating activities introduced and championed by a number of the governmental organisations. These include Tanzania Forest Services (TFS), and the Kisarawe District Council (KDC). The non-governmental organisations (NGOs) involved include Wildlife Conservation Society of Tanzania (WCST), and Green Voices. On the other hand, the community-based groups involved include Popote Pamoja Sikuzote (PPS), Mwangaza, Vigama, Maguruwe, Nchage and Chanzige. Bee keeping was thus introduced through bridging external social capital to the Pugu and Kazimzumbwi socio-ecological systems (WCST and Green Voices, in 2010 and 2015 respectively). Established bee keeping groups were supplied with the initial capital necessary for start-up, which was particularly vital as most members of the groups could not raise enough funds for installing the project due to income poverty. This initial financial help was followed by capacity building, assisting the groups with establishing bee hives, hive management, bee products and their respective potential markets. This example supports the theoretical preposition explained in Chapter 3, that social capital is an important factor in building socio-ecological system resilience in peri-urban areas of the developing world and Sub-Saharan Africa in particular. While the argument in Chapter 3 relates to bonding social capital, via its collective action potential, the findings show that bridging social capital was also vital in the Pugu and Kazimzumbwi socio-ecological systems, suggesting that this

type of social capital can play a synergistic role in building socio-ecological systems resilience in peri-urban areas of Sub-Saharan Africa. In this context, bee keeping, as a climate friendly economic activity (provisioning ecosystem service), enabled peri-urban dwellers to increase their income, which in turn reduced the potentially damaging community dependence on other, at-risk ecosystem services. Given the potential benefits of bee keeping, the responsible authorities felt justified in allowing such activities to take place within the forest reserves.

Overall, the analysis has shown that both bonding and bridging social capital are essential ingredients in building socio-ecological systems resilience against climate change in peri-urban areas in Sub-Saharan Africa. This argument aligns with the growing thinking that sees resilience primarily as a social phenomenon. Indeed, the social nature of resilience is even more relevant in urban and peri-urban areas in Sub-Saharan Africa, where engineering approaches have been largely dominant. This analysis suggests that that social capital needs to be clearly conceptualised and then factored into climate change resilience building pathways in peri-urban areas of Sub-Saharan Africa.

6.4 Reflection on ascertaining the theoretical niche of the Thesis

The process of finding the theoretical footing that theorises the confluence between ecosystem services on the one hand and peri-urban communities on the other hand towards navigating through potential entry points for building resilience to climate change effects was largely a daunting and painstaking process. Undergoing Theoretical Task I (Article I*),* I found a niche in the Thesis's topic (see Section 1.3*),* yet, the theoretical environment explaining the phenomenon I was exploring was still a dilemma that went unresolved. The quest for an ideal theoretical expression of my work was sharpened after reading previous Thesis and especially theoretically based ones. The more I read the more I became fascinated. Yet more questions kept lingering. The lectures and literature on how to find a theory or relevant concept suitable for a particular scientific inquiry are largely clearer, simpler and more direct than undergoing the process itself. A lot remain largely untold in many theses. After the research process in Case I, I got some insights such as 'excessive ecosystem services degradation in peri-urban areas in Sub-

Saharan Africa*'* that led me to suggest the theory on the tragedy of the commons as an appropriate theoretical articulation of the phenomenon I was exploring. However, after conducting Empirical Task II, in Case II and its respective analysis (iterative, reflective and progressive analytical process), I understood that the earlier theoretical suggestion was largely telling of resource degradation in the context of governance handicaps. Though ecosystem services degradation was revealed to be a reality in both cases (i.e. Case I and Case II, see Article I and Section 2.4 respectively), resource degradation issue is not at the pinnacle of the issue this Thesis is destined to explore thereby understand (see Section 1. 3*).* In other words, after going through Phases I and II of the research process (see Figure 6*),* I deduced that the 'tragedy of the commons theory' could not provide an ideal conceptual milieu in understanding the potential of deploying ecosystem services in building resilience for climate change effects in peri-urban areas of the Global South. This understanding yielded into twofold set of conclusions. First, I had to '*kill my darlings*' (forsake the first theoretical focus suggestion). Second, I had to start thinking afresh to venture into another painstaking analysis of seeking the ideal theoretical premise of the Thesis. Whilst, this stage was somewhat discouraging, it marked substantial progress towards understanding the theoretical red-thread of the Thesis. I therefore had no option but to go back to the iterative, reflective analytical process. Yet, in the earlier analysis in Case II, I deduced that there was a striking relationship between ecosystem services and the neighbouring communities in the peri-urban context.

In the work that followed, I explored several theoretical milieu and later understood that the socio-ecological system resilience thinking was an imperative tell of the phenomenon I was investigating. Another imperative concept that I deduced to resonate well with socio-ecological system resilience potential pathways was the adaptive capacity concept. While I continued exploring these concepts (socio-ecological system resilience and adaptive capacity), I realised that they were not only uniting concepts, but they helped me to more clearly analyse the initial empirical information in Case II. While observing the empirical data (Empirical Task II*),* through the 'newish' theoretical concepts of socio-ecological system resilience and adaptive capacity, I started to see how the empirical information made sense in the context of the Thesis's foci (see Section 1.3). This newish understanding generated a sense of legitimacy, thereby authenticating the Thesis's

theoretical ambiance as clearly articulated in Chapter 3. The Thesis's theoretical niche discovery marked distinctive progress in my PhD journey. Yet, the newish theoretical basis became the defining feature of the latter research work (Theoretical Task III and consequently Empirical Task III see Figure 6) as articulated in Chapter 3 and Articles II and III.

6.5 A note on the generalisation of the Thesis outcome

The outcome of this Thesis can to some extent be argued to be qualitatively generalisable (Yin, 2017), subject to a twofold rationale. First, the nature of the engaged study cases, which were both selected by non-probability approaches (see Section 4.2). They could in no way lead to quantitative generalisations. Second, the study object itself, the ecosystem services contribution to building socio-ecological system resilience for livelihood effects of climate change in peri-urban areas which subscribes to the reality that ecosystem services are context-laden and therefore difficult to generalise. The Thesis therefore does not cover the whole range of options or potential for how ecosystem services might be used as entry points in building resilience to climate change effects in peri-urban areas in Sub-Saharan Africa. The Thesis rather sheds light on possible ecosystem services-based entry points for building socio-ecological system resilience against the livelihood induced effects of climate change in peri-urban areas. Despite the growing similarities in the demographic, social, economic, ecological and infrastructure characteristics of most urban and peri-urban areas in Sub-Saharan Africa (Article I*),* there are many ways in which the selected peri-urban area (i.e. Case II) might not be a representative case of other peri-urban areas. For instance, the Pugu and Kazimzumbwi socio-ecological systems are characterised by forest and the associated ecosystem services, which is not necessarily the case to other peri-urban areas in the region. At the same time the Pugu and Kazimzumbwi socio-ecological systems are characterised by an intricate relationship and dependency (see Section 2.3 and 3.2), between social and ecological systems. This has been evidenced by the extractive dependency on ecosystem services in these peri-urban forest reserves, which goes against the existing theoretical proposition that urban socio-ecological systems ought to portray more cultural dependency on ecosystem services (Article II). Yet, it is an undeniable reality that not all peri-urban areas in Sub-Saharan Africa possess the aforementioned

characteristic features. This suggests that different peri-urban areas can have different ecosystem services-based entry points for building resilience to climate change effects. This is the reason why case studies are imperative in ecosystem services studies, since they are suitable for unpacking context-laden knowledge. However, as discussed in Section 4.2, Case II can also be regarded as a revelatory case analysing how cultural and provisioning ecosystem services might be deployed in building win-win-win resilience options to the livelihood effects of climate change in peri-urban areas of the Global South. In other words, the findings of this study are imperative in that they portray a showcase of how ecosystem services may possibly serve as a laboratory for building socio-ecological system resilience for the livelihood effects of climate change in peri-urban areas of Sub-Saharan Africa.

7 Conclusion

The overarching aim of this Thesis was to investigate the potential contribution of the cultural and provisioning ecosystem services in building resilience for the livelihood effects of climate change in peri-urban areas in Sub-Saharan Africa from a socio-ecological perspective. The quest for this scientific inquiry was prompted by the reality that ecosystem services research in urban and peri-urban areas in Sub-Saharan Africa has largely been given periphery attention (see Section 1.1 and Article I). Secondly, Theoretical Task I, showed that the discussion on ecosystem services with specificity to cultural and provisioning services in building resilience for climate change effects was largely limited, particularly in peri-urban areas in Sub-Saharan Africa. However, as substantiated in Section 1.1 and Article I, the engineering resilience dominance in urban areas, owing to the infrastructure deficit challenge, constitutes the setting behind this research undertaking the generation of knowledge thereby contributing to both empirical and conceptual understandings. To realise this end, explorative and iterative research strategies were deployed, yielding novel empirical findings and theoretical discussions. The theoretical discussions in this cover story constitute the contribution of this Thesis in the fields of urban climate change resilience and urban ecosystem services. Indeed, the theoretical discussions engaged in this Thesis yield imperative novel insights and thereby contribute to scholarship of the subject of this Thesis. Broadly, the Thesis shies away from the dominating engineering resilience approaches in the climate change resilience context of the Global South, particularly in the Sub-Saharan African region. It instead argues towards more socio-ecological approaches to climate change resilience building potential. In doing so, this Thesis contributes to the understanding of ecosystem services contributions to

building socio-ecological system resilience for climate change effects in peri-urban areas. Another imperative argument of this Thesis is that resilience is largely a social process, as opposed to a physical or mere infrastructure based one. In this case, the Thesis contributes to the conceptual evolution of this thinking. Indeed, the aforementioned arguments of this Thesis are thematically categorised into either theoretical or empirical contribution.

As highlighted beforehand, through the novel approach adopted in this research, some newish insights were developed. It showed that, despite circumstantial settings warranting deployment of engineering resilience approaches in tackling climate change, tragedy in urban areas of the developing world and Sub-Saharan Africa (see Chapter 1, Section 2.1 and Article III), resilience is largely a social phenomenon as opposed to an engineering fixing of infrastructures. Engineering resilience fails to take on board the social milieu, which might contribute to factors triggering the occurrence of climate change, thereby the associated effects in a given peri-urban locale. It is in this line of thinking that this Thesis argues that the social milieu or social capital (see Article III), is an imperative attribute (adaptive capacity) towards forging the plausible desired future (i.e. building socio-ecological system resilience) especially so in the Global South context. The particular imperativeness to the Global South context owes to the poverty reality, which necessitates social capital as a vital pillar of building socio-ecological system resilience, which has been proven to work effectively in yielding collective action and economic growth. Yet, social capital is a central area of concern in building socio-ecological system resilience to climate change effects in the developing world, particularly in the context of sustainability. By analysing and identifying the potential interlinkages between social capital, adaptive capacity, ecosystem services and socio-ecological system resilience in climate change, and emphasising the imperative role of social capital, this Thesis makes a distinctive contribution to our understanding of the potential contribution of social capital towards building socio-ecological system resilience against climate change effects.

Another equally crucial area that this Thesis contributes to is the body of scholarship regarding novel definitions. Within the theoretical concepts engaged in this Thesis (see Chapter 3), some definitions are critically analysed yielding newish definitions, which is part of the contribution this Thesis makes. These are, as summarised in Table 9.

Table 9.Conceptual contribution definitions to the body of scholarship.

S/n	Concept	How this Thesis defines	Section	Scholarship domain
1	Urban ecosystem services	Urban ecosystem services are services or benefits accruing to humans that are either directly or indirectly produced by the ecological structures within the urban landscape.	3.2.1	Urban ecosystem services
2	Socio-ecological system	Socio-ecological system is defined as an ecosystem service-dependent peri-urban community whereby the flow and use of the service is mediated by both social and ecological attributes.	3.2.2	Urban ecosystem services
3	Peri-urban	Peri-urban is conceived as a city transitional zone, amalgamating both urban and rural landscapes' functions and features.	3.2.3	Landscape planning
4	socio-ecological system resilience	Socio-ecological system resilience is conceived as a process whereby the socio-ecological system navigates its adaptive capacities towards a positive future trajectory after being subjected to climate change stress.	3.2.4	Urban climate change resilience

Source. Author's own construct.

In another imperative account, as earlier articulated (see Section 1.1 and Article I), the limited research, thereby literature on the potential contribution of cultural and provisioning ecosystem services towards building resilience to climate change effects in peri-urban areas in Sub-Saharan Africa, this Thesis contributes to knowledge in this area. The Thesis explored and analysed some cultural and provisioning ecosystem services potential for building socio-ecological system resilience for climate change effects. Explicitly, through the distinctive approach deployed in this research, using both literature and a revelatory case (see Section 4.2), this Thesis contributes to the Sub-Saharan Africa literature on the potential contribution of cultural and provisioning ecosystem services towards building resilience for climate change effects in peri-urban areas. The particular contribution comes from provisioning ecosystem services through the bee keeping industry, of which the study area (Case II and Article II), has shown enormous potential. In

addition, this Thesis provides elaborative descriptions of how the bee keeping industry might be tapped and capitalised upon, building socio-ecological system resilience for climate change effects in peri-urban areas. At the same time, this Thesis argues that cultural ecosystem services (i.e. tourism industry in its multiple forms (food tourism, arts and crafts tourism, antiquities tourism and nature tourism) has the potential for providing viable livelihood potential dissimilar to the common livelihood means to the majority of peri-urban dwellers. Yet, these ecosystem services are not affected by climate change in the same way as rain fed agricultural products (see Chapter 2). Instead they have the potential to contribute to both mitigating and adaptation initiatives and they thus have the potential to yield win-win-win resilience outcome.

Drawing on the theoretical and empirical materials presented in this work, this Thesis contributes to the generic understanding of socio-ecological system resilience. This is realised through analysing the synergistic interlinkages of varied socio-ecological system adaptive capacities towards navigating the plausible positive futures in the face of climate change (for details see Section 3.3). This distinctive account of socio-ecological system resilience is particularly imperative to peri-urban areas of the developing world characterized by poverty and a high dependence on provisioning ecosystem services. The dependence on ecosystem services is one of the necessitating factors for approaching resilience by considering the socio-ecological systems, thereby emphasising socio-ecological system resilience. On the other hand, the social environment of the socio-ecological system is argued to be of two imperatives. First, it is an appropriate angle to navigate community resilience pathways in a poverty context, owing to its potential to economic breakthroughs, which are pivotal to resilience building discourses. On the other hand, the social milieu (bonding social capital) is virtually imperative in socio-ecological system resilience discourse, as it provides the grounds for other resilience building factors, herein referred as adaptive capacities. This analysis, informed by the reflective, iterative yet progressive research process yields the analytical framework for exploring socio-ecological system resilience for livelihood effects of climate change in peri-urban areas of the Global South (Figure 5). This framework presents the novel contribution that this Thesis adds to the peri-urban socio-ecological system resilience scholarship.

Finally, it is crucial noting that although the aim of this Thesis is to make a contribution largely at empirical and theoretical levels, it is believed here that the research approach that was adopted, the theoretical concepts engaged as well as the empirical materials produced and argued for in this Thesis has deeper implications informative to policy and practice. It reveals different cultural and provisioning ecosystem services and analyses different ways by which they can be deployed for building socio-ecological system resilience for livelihood effects of climate change in peri-urban areas of the Global South. By analysing the potential of cultural and provisioning ecosystem services which had received peripheral attention in climate change resilience discourse in Sub-Saharan African region, it is believed here that the empirical and the theoretical contribution of this Thesis becomes highly relevant to policy and practice across scales. Broadly this Thesis has typified the understanding that ecosystem services can provide opportunities for building resilience for climate change effects in urban landscapes and in particular peri-urban areas (see Section 1.1), which has been often taken for granted. In the local policy context, enormous policy instincts are dedusable from the empirical and theoretical materials presented in this Thesis. Policy thematic areas intrinsic to this Thesis includes, Urban Climate Change Resilience, Natural Resource Management, Urban and Regional Planning, Landscape Architecture, Urban Design etc. Moreover, explicitly for instance on Urban Climate Change Resilience, this Thesis has presented and analysed different cultural (arts and crafts, wild mammals, local foods) and provisioning (bee keeping) ecosystem services and how they can be used as entry points in building resilience for climate change effects in peri-urban areas. The Thesis has analysed how climate change resilience can be realised through both adaptation and mitigation pathways via cultural and provisioning ecosystem services. This presents an imperative area in the local policy discourse that this Thesis contributes to. Policy makers in this area can draw insights on how to capitalise on the available cultural and provisioning ecosystem services in the course of building resilience to climate change effects in peri-urban areas.

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Popular science summary

This Thesis has explored climate change resilience from socio-ecological system perspective. The inquiry depart from the conventional resilience approach refferred to as "engineering (infrastructure upgrading, strategic planning, regularization and formalization)" at the expense of social and ecological lenses. The Thesis argues that while a number of attempts have been put in place in addressing resilience from impacts emanating from climate change, limited approaches have embrased socio-ecological system as an entry point in exploring climate change resilience building options particularly for peri-urban natural resources dependent communities in Sub-Saharan Africa. The Thesis also questions the generalised knowledge that ecosystem services can help communities fight against climate change effects.

The overarching aim of this Thesis is to investigate the potential contribution of cultural and provisioning ecosystem services in building resilience for the livelihood effects of climate change in peri-urban areas in Sub-Saharan Africa from a socio-ecological perspective. The Thesis explores two progressive case studies, which have been complementing each other at different levels of both empirical and theoretical analysis. Empirical data was collected via a systematic literature review, key informant interviews, focus group discussions and household surveys. The results were analysed following socio-ecological system resilience thinking, using adaptive capacity as the analytical frame.

The results show that literature is largely silent on the contribution of the cultural and provisioning ecosystem services in building resilience for climate change effects in peri-urban areas, especially in Sub-Saharan Africa. In the investigated case for socio-ecological system adaptive capacities it was revealed that the case has considerable resilience-building potential aligned to cultural and provisioning ecosystem services. These include: ecological

knowledge (ethnic diversity, promising literacy rates, and diverse age cohorts), economic diversity (bee keeping industry, tourism industry in its multiple forms i.e. food tourism, arts and crafts tourism and nature tourism). It also showed that social milieu constitutes an important adaptive capacity towards building socio-ecological system resilience for the livelihood effects of climate change in peri-urban areas in Sub-Saharan Africa. This is substantiated by the analysed synergies between bonding and bridging social capital on the one hand and the identified cultural and provisioning ecosystem services based adaptive capacities towards building win-win-win resilience for the livelihood effects of climate change. The Thesis suggests an analytical framework for exploring socio-ecological system resilience for livelihood effects of climate change in peri-urban areas in the Global South. The Thesis further argues that theoretical debates on approaches towards resilience building ought to be enriched by context specific studies that expouses differentiated realities between the North and the South.

Populärvetenskaplig sammanfattning

Denna avhandling studerar resiliens mot klimatförändringar ur ett socio-ekologiskt systemperspektiv. Forskningen skiljer sig från det konventionella synsättet där resiliens främst kopplas till ”teknik” (infrastrukturuppgradering, strategisk planering, regularisering och formalisering) på bekostnad av sociala och ekologiska synsätt. Avhandlingen argumenterar att trots att ett flertal försök gjorts avseende att adressera resiliens mot effekter som härrör från klimatförändringar, har ett begränsat antal tillvägagångssätt utgått från socio-ekologiska system i sitt val att beskriva hur klimatresiliens byggs. Detta gäller särskilt peri-urbana naturresurs-beroende samhällen i Afrika söder om Sahara. Avhandlingen ifrågasätter också den allmänna kunskapen om att ekosystemtjänster kan hjälpa samhällen att bekämpa effekter av klimatförändringar.

Det övergripande syftet med denna avhandling är att ur ett socio-ekologiskt perspektiv undersöka kulturella och försörjande ekosystemtjänsters potential till att skapa resiliens mot effekter av klimatförändringar i peri-urbana områden söder om Sahara. Avhandlingen undersöker två progressiva fallstudier som kompletterar varandra både empiriskt och teoretiskt. Empirisk data samlades in via en systematisk litteraturöversikt, intervjuer, fokusgrupp-diskussioner och enkätundersökning riktad till hushåll. Resultaten analyseras utifrån ett socio-ekologiskt system-resiliens tänkande, där begreppet adaptiv kapacitet används som analytiskt ramverk.

Resultatet visar att det finns kunskapsluckor om hur kulturella och försörjande ekosystemtjänster kan bidra till resiliens mot klimatförändringar i peri-urbana områden, särskilt gällande Afrika söder om Sahara. Fallstudien visar att det socio-ekologiska systemets anpassningsförmåga har en betydande potential för att skapa resiliens anpassat till kulturella och försörjande ekosystemtjänster. Dessa inkluderar: ekologisk kunskap (etnisk mångfald,

läskunnighet och olika åldersgrupper), ekonomisk mångfald (biodling, turism i dess många olika former, dvs. matturism, konst- och hantverksturism och naturturism). Studien visar också att den sociala miljön utgör en viktig del av den adaptiva kapaciteten för att bygga ett socio-ekologiskt resilient system mot effekterna av klimatförändringar. Detta underbyggs av de analyserade synergierna mellan bindande och överbryggande socialt kapital å ena sidan och de identifierade kulturella och försörjande ekosystemtjänsterna – baserade på anpassningsförmåga för att bygga vinn-vinn-vinn-resiliens – å andra sidan. Avhandlingen föreslår ett analytiskt ramverk för att utforska socio-ekologiska resilienta system mot klimatförändringar som påverkar försörjningen i peri-urbana områden i Syd. Avhandlingen hävdar vidare att teoretiska debatter om synsätt för att skapa resiliens bör berikas med kontextspecifika studier som visar en differentierad verklighet mellan Nord och Syd.

Appendix I: 1st Round Data Collection Protocol

Data Collection Protocol on capturing the baseline information on ecosystem services and their adaptive capacities at Pugu and Kazimzumbwi forest reserves towards building resilience to Climate Change Effects. (*This Protocol is meant to provide the guidelines on how the data will be collected in each method to be deployed*).

Note: Ecosystem services will be explored and thereby discussed in local relevant terms as has been used by the community in their day to day interaction with nature.

Section 1. Focus Group Discussion (FGDs)

1.1 Three FGDs will be carried out from each of the three study villages.

1.2 FGDs will comprise of an estimate of seven members of the community to be identified with the help of community leaders.

1.3 FGDs will be conducted in the three selected study villages for the sake of obtaining general information about socio economic condition of the community and the way they perceive ecosystem services, the institutional capacity and organization structure as specified in the focus group discussion guide (FGDG).

1.4 The FGDs will be useful in identifying individuals and institutions to be involved in key informant interview.

1.5 Information regarding community appreciations of the ecosystem services will be gathered through this technique.

1.6 FGD will also be of use in fine turning the questionnaire as it will be the first technique to be employed to lay the ground for other techniques.

1.7 After identification of members for the FGD with the help of village/street leaders the date, time and venue for the discussion will be communicated to them.

1.8 The discussion will be guided by the FGDG; deep probing shall follow if response given is hanging.

1.9 After the discussion, I will transcribe the key messages coming of the discussion and take on board issues that requires follow ups such as those that need to be followed up through key informant interviews and those that need to be used to re-fine the household questionnaire

Section 2: Household Interviews (HHI)

2.1 Household questionnaire will be administered to the households for the sake of complementing information collected through other techniques.

2.2 10% of households estimated to 50 households per hamlet/village will be interviewed through household questionnaire.

2.3 Household information was obtained through prior visit to the village/hamlet offices.

2.4 Three enumerators will be recruited to assist in data collection in households through questionnaires. The enumerators to be recruited will be graduates, who are fluent in English and Kiswahili both in reading, writing and speaking. The enumerators will be trained on the questionnaire for two days for the sake of being familiar with all the questions and the anticipated response.

2.5 After enumerator's training there shall be one day of testing the questionnaire in the field. This will be done so that they get experience of what is expected of them and what is expected from the respondents.

2.6 After test of the questionnaire together on the field on the very day we shall have a brief discussion on the modality of executing the questionnaire on the field and on the possible emerging issues or surprises. We shall discuss the emerging issues and draw the way forward for actual field work.

2.7 During field work, after the end of each working day, there shall be a review meeting aimed at assessing the collected information whether it has been appropriately filled in the questionnaire.

2.8 After assessing the work of the day and discussing on the shortcomings in the process a clear path for the upcoming interview day will be laid.

2.9 At every evening of data collection, I will gather the questionnaires, and then filing them in a case study database waiting processing and analysis.

Section 3. Key informant Interviews (KII)

3.1 Respondents for KII shall include members from the community, community leaders (street/village leaders), district and regional environmental officers, forest managers and managers of other institutions to be identified during FGDs.

3.2 After identification of a complete list of key informants for the study which will be completed after FGDs, they will be approached through phone or face to face conversation for the sake of seeking appointment with them prior to the day of interview. The schedule for the interview for each key informant will be established and will be keenly adhered to so as not to disappoint the respondents'/key informants.

3.3 The actual interview will be face to face unless otherwise under special situation phone interview will be done. I will personally do the interview with the informant with the aid of a recorder which will later on be used to deep extract of information from the interview.

3.4 The discussion/interview will be guided by the KIIG though depending on the response and the level of understanding of the informant deep propping will be done so as to get rich information.

3.5 After the discussion I will summarize the main messages from the interview through the recorder and put them in writing ready for analysis.

Appendix II: 1st Round Household Questionnaire

Section 1. Demographic and Socio Economic Information

1. Date of interview ----------
2. Name of the Village /Street.....
3. Name of the Ward .....
4. Name of the District .....
5. Name of respondent (Preferably HH head) .....
6. Phone number of respondent.....
7. Marital status of respondent ..... a) Single b) Married c) Divorced d) Widowed
8. Household size ..... a) 1-2 b) 3-4 c) 5-7 d) 8+
9. Respondent's level of education.....a) None b) Primary education (1-7) c) Secondary education (1-4) d) Secondary education (5-6) e) Certificate f) Diploma g) Bachelor degree h) Master's degree i) Doctoral degree
10. What are your income generating activities?.....(Tick all relevant for you)
    a) Farming
    b) Cattle keeping
    c) Casual labour
    d) Poultry husbandry
    e) Vegetable Gardening
    f) Tree nursery caring
    g) Brick making
    h) Public servant
    i) Matching guys
    j) Logging
    k) Charcoal making & selling
    l) Bee keeping
    n) Unemployed
11. The income I earn is sufficient for my household needs....
    a) Strongly agree
    b) Strongly disagree
12. Income per month
    a) 1-50,000 TSH
    b) 51,000 – 100,000 TSH

c) 101,000 – 500,000 TSH

d) > 500,000 TSH

13. Respondent's Age

a) 18-35 Years

b) 36- 60 Years

c) 60+ Years

14. What forest products do you normally use?

a) Charcoal
b) Timber
c) Honey
d) Mushroom
e) Firewood
f) Others (Specify…….)

15. What is the main source of energy in your household?

a) Fire wood

b) Charcoal

c) Kerosene cooker

d) Gas cooker

e) Electricity cooker

f) Other (Specify....)

16. If a) or b) in question 15 above; what is the source of firewood of charcoal?

a) Forest reserve

b) My own farm/private forest

c) Bought

d) Other (Specify...)

e) NA

17. What is your tribe?

a) Zaramo

b) Kwere

c) Ndengereko

d) Others

18. Where were you born?

a) Within the village/street

b) Within the ward but outside the village

c) Within the district but outside the ward

d) Outside the district

19. If born outside the ward in 14 above what reasons led you to migrate to this very ward/district?

a) Family reasons i.e following parents, relatives etc

b) Economic reasons i.e such for income earning activities (farming, charcoal making etc)

c) Socio-environmental reasons i.e running away from space pressures in the City

d) Environmental reasons i.e to enjoy environmental amenities in the peri-urban

e) Other (specify).....

20. If born outside the ward in question 14 above, when did you migrate to this location?

a) Less than one year

b) 1-6 years

c) 7-14 years

d) 14 + years

Section 2: Perceptions Issues

1: I feel strongly attached to this community

a) Strongly agree
b) Strongly disagree

2. There are many people in my community whom I think of as good friends

a) Strongly agree

b) Strongly disagree

3. Ecosystem services in this area have benefits to society

a) Strongly agree

b) Strongly disagree

4. How do you value the following ecosystem services?

Forest products	**Perceived ecosystem services use rate/value**					
	Very High	**High**	**Medium**	**Low**	**Very low**	**None**
Timber						
Charcoal						
Honey						
Mushroom						
Fire wood						
Building materials						
Medicine						
Tourism and recreation						
Rituals/Religious						
Aesthetic value						
Air purification						
Buffer to flood incidents						

5. Climate change have substantial impacts in the landscape.

a) Strongly agree

b) Strongly disagree

6. Severity of impacts of climate change in the landscape

Climate change impacts	Severity of perceived impact of climate change					
	Very high	High	Medium	Low	Very low	None
Rainfall						
Temperature						
Crop yield						
Forest products						
Flood intensity						

7. Awareness on the importance of ecosystem services on climate change resilience

a) Strongly aware

b) Strongly unaware

Section 3. Institutional/Organizational Issues

1. I have access to forest ecosystem services.....
   a) Strongly agree
   b) Strongly disagree
2. How often do you access the ecosystem services from the forest reserve?
   a) 1-2 times per week
   b) 3-4 times per week
   c) Daily
   d) None
3. For how long have you been accessing the ecosystem services from the forest reserves?
   a) 1-6 years ago
   b) 7-10 years ago
   c) 11-15 years ago
   d) 16-20 years ago
   e) 20+ years
4. There are rules in place to be followed for one to access ecosystem services from the forest reserve
   a) Strongly agree
   b) Strongly disagree
5. If agree in question 4 above have you been following the rules in the course of accessing ecosystem services from the forest reserves?
   a) Yes
   b) No
6. If no in question 5 above how do you rank reasons for non-compliance to the rules in place? (tick the reason (s) from the table below)

Reasons for non-compliance to rules	Rank	Rank	Rank	Rank
Inadequate awareness/information				
Lack of incentives for compliance				
Weak enforcement mechanisms				
Poor management				

Please note: Rule 1; Fill only one box in a single row with ranks 1, 2, 3 or 4 : Rule 2; Do not repeat a rank (number) you have filled in the previous row : Rule 3; Only one score (rank) has to appear in a single column

7. There are user fees for the use of forest ecosystem services in this reserve.....
a) Strongly agree
b) Strongly disagree
8. Iam willing to pay for some amount of money for the use of ecosystem services...
   a) Strongly agree
   b) Strongly disagree
9. I trust the authorities responsible for management of ecosystem services in this locality.
   a) Strongly agree
   b) Strongly disagree
10. Give reasons for agree or disagree in question 9 above

a)----------

---

b)----------

---

11. Iam a member of a social-community organization
    a) Strongly agree
    b) Strongly disagree

12. If agree in question 11 above, what kind of benefits do you get by being a member of the social-community organization?

a) Financial support e.g. through loans etc

b) Social support during unfortunate events

c) Material support during unfortunate events

d) Technical support through education, awareness campaign etc

e) Other (Specify) .....

f) NA

13. How long have you been a member of a social-community organization?

a) Less than a year

b) 1-3 years

c) 4-5 years

d) 5+ years

e) NA

14. What is the primary purpose of the organization you are holding membership with?

a) Financial

b) Self-help

c) Faith -based

d) NA

15. Iam satisfied with the services offered by the management of the organization I hold membership with.....

a) Strongly agree

b) Strongly disagree

c) NA

16. I suggest that the organization I hold membership with to be integrated into ecosystem services management

a) Strongly agree

b) Strongly disagree

Appendix III: Focus Group Discussion Guide

1. What tribes constitute the majority of the inhabitants of this community?
2. What is the migration status of this community?
3. What constitute the ecosystem services in this community?
4. What are the direct and indirect benefits derived by the community from ecosystem services?
5. What are the possible challenges encountered in accessing ecosystem services in this community?
6. What are the possible opportunities are embedded with ecosystem services?
7. What do you consider to be the relationship between climate change and ecosystem services?
8. What are the formal and informal procedures that one needs to follow so as to benefit from ecosystem services?
9. What organizations in this locality are responsible for the management of ecosystem service? (Whether private or public ones).
10. What can you say regarding the effectiveness of these organizations in terms of managing ecosystem and their associated services? In which areas do the respective organizations do better and in which areas do they do worse and what are the suggestions for improvement?

Appendix IV: 2nd Round Data Collection Protocol

Data Collection Protocol on Assessing the Peri-urban Socio-ecological System towards Building Resilience to Climate Change Effects

1. We are interested in learning about the social network coherence and the agency at the Pugu and Kazimzumbwi socio-ecological system, in the course of building resilience to climate change effects
2. This data collection protocol is aimed at providing key hints for the second round field work at the peri-urban socio-ecological system at Pugu and Kazimzumbwi. This field work shall involve two data collection techniques namely household interview/survey and the key informant interview.
3. The household survey/interview shall comprise around 150 respondents/household heads to be selected at random from among the three study villages. The sample size i.e 150 is due to the online sample size calculator of 10% of the households in the entire study village. On each study village an approximate of 50 respondents will be interviewed.
4. This survey is complementary to the previous one in the same study area but respondents should not necessarily be the same i.e those participated in the previous survey. The additional component which this survey seeks to establish is gauging the socio-ecological network coherence towards building resilience to climate change effects.
5. Three enumerators will be engaged for administering household survey i.e one enumerator per study hamlet. On average an enumerator can administer 10 questionnaires in a day therefore a total of 5 working days shall be spent. Enumerators shall be recruited among recent university graduates with experience in data collection and questionnaire administration. This will simplify questionnaire administration as enumerators will be responsible for translating the questions to respondents who are not conversant with English language and filling in the questionnaires after capturing response from interviewee.
6. Prior actual field work there will be a two-day enumerator training session to familiarize them with the general aim of the survey, the specific questions, response options and how and where to fill in responses. Additionally, enumerators will be exposed to basic ethical considerations necessary during research undertaking including seeking informed consent from respondents' prior the interview.
7. During survey execution, the researcher will be overseeing the execution. Every evening after data collection, the researcher will convene a brief feedback meeting with enumerators. The meeting will ensure among other things proper filling of the questionnaires, discuss and address on-site emerging challenges and collect filled questionnaires ready for further processing.
8. The field work will involve key informant interviews that is targeted to individuals or institutions who have/are playing agency role in the area of enhancing peri-urban socio-

ecological (the use of ecosystem services) in building resilience to climate change effects

9. The actual number of key informant is yet to be established but will include District departmental heads (bee keeping, tourism, forestry),
10. Notes during the key informant interview will be taken and thereafter (in the evening of the interview day and thereby be transcribed) to provide a summary of key massages captured in the interview.
11. Ecosystem services of interest in this case are provisioning and cultural services.

Appendix V: 2nd Round Household Questionnaire

Socio-Network and Agency Survey on the Pugu and Kazimzumbwi Socio-Ecological System towards Building Resilience to Climate Change Effects

Part I: Basic demographic information

1. Date of interview ----/-----/201---
2. Sub ward name----------
3. Ward name----------
4. District name___ a) Kisarawe b) Ilala
5. Age of respondent/Household head___
6. Phone number of respondent_____
7. Residence status____ a) Native b) Migrant from Dar es Salaam c) Rural/Upcountry migrant
8. Sex of respondent___ a) Male b) Female
9. Education status___ a) Primary or less b) Secondary c) High school d) Certificate and above

Part II: Social Contact and people skills

1. Among all the people you know, with how many do you interact well? ___ a) All b) Most c) Some d) Few e) None
2. How often do you have to deal with people in your work? ___ a) Always need to deal with people b) Most often need to deal with people c) Sometimes need to deal with people d) Rarely need to deal with people e) No need to deal with people
3. Among all people who live in your community and the neighborhood, how many of them can support each other and get along with each other well?__ a) All b) Most c) Some d) Few e) None
4. Among all the governmental, political, economic, economic, social, cultural, recreational groups and organizations, how many can collaborate with each other? __ a) All b) Most c) Some d) Few e) None
5. How do you rate the frequency of doing the following activities?

Categories	**Likert scale options**				
	Every day	**Often**	**Sometimes**	**Rarely**	**Never**
Chatting with others	5	4	3	2	1
Gift giving	5	4	3	2	1
Working together	5	4	3	2	1
Playing together	5	4	3	2	1
Visiting each other	5	4	3	2	1
Communicating by phone or internet	5	4	3	2	1
Offering assistance to others	5	4	3	2	1
Participating in parties and gatherings	5	4	3	2	1

Part III: Social network

QUESTION ONE (Cap 1): How do you rate the number of people in each of the following six categories

Categories	Likert scale options				
	A lot	More than average	Average	Less than Average	A few
Your family members	5	4	3	2	1
Your relatives	5	4	3	2	1
People in your neighborhood	5	4	3	2	1
Your friends	5	4	3	2	1
Your coworkers/fellows	5	4	3	2	1
Your country fellows/old classmates	5	4	3	2	1

Whereby A lot = > 10, More than average =(9-10), Average= (6-8), Less than average = (3-5), A few = (1-2).

QUESTION TWO (Cap 2): With how many people in each of the following categories do you keep a routine contact?

Categories	Likert scale options				
	All	Most	Some	Few	None
Your family members	5	4	3	2	1
Your relatives	5	4	3	2	1
People in your neighborhood	5	4	3	2	1
Your friends	5	4	3	2	1
Your coworkers/fellows	5	4	3	2	1
Your country fellows/old classmates	5	4	3	2	1

QUESTION THREE (Cap 3): Among the people in each of the following six categories, how many can you trust?

Categories	Likert scale options				
	All	Most	Some	Few	None
Your family members	5	4	3	2	1
Your relatives	5	4	3	2	1
People in your neighborhood	5	4	3	2	1
Your friends	5	4	3	2	1
Your coworkers/fellows	5	4	3	2	1
Your country fellows/old classmates	5	4	3	2	1

QUESTION FOUR (Cap 4): Among people in each of the following six categories, how many will definitely help you upon your request?

Categories	Likert scale options				
	All	Most	Some	Few	None
Your family members	5	4	3	2	1
Your relatives	5	4	3	2	1
People in your neighborhood	5	4	3	2	1
Your friends	5	4	3	2	1
Your coworkers/fellows	5	4	3	2	1
Your country fellows/old classmates	5	4	3	2	1

QUESTION FIVE (Cap 5): When people in all the six categories are considered, how many possess the following assets/resources?

Categories	Likert scale options				
	All	Most	Some	Few	None
Certain political power	5	4	3	2	1
Wealth or owners of an enterprise or a company	5	4	3	2	1
Broad connections with others	5	4	3	2	1
High reputation/influential	5	4	3	2	1
With high school or more education	5	4	3	2	1
With a professional job	5	4	3	2	1

Part III: Bridging and Linkage Issues

QUESTION SIX (Cap 6): How do you rate the number of the following two types of groups/organizations in your community?

Categories	Likert scale options				
	A lot	More than average	Average	Less than average	A few
Governmental, political, economic and social groups/organizations (political parties, women's groups, village communities, trade union, cooperate associations, volunteer groups, etc)	5	4	3	2	1
Cultural, recreational and leisure groups/organizations (religious, country fellows, alumni, sport, music, dances, crafts, games, etc)	5	4	3	2	1

QUESTION SEVEN (Cap 7): Do you participate in activities for how many of each of these two types of groups and organizations?

Categories	Likert scale options				
	All	Most	Some	A few	None
Governmental, political, economic and social groups/organizations (political parties, women's groups, village communities, trade union, cooperate associations, volunteer groups, etc)	5	4	3	2	1
Cultural, recreational and leisure groups/organizations (religious, country fellows, alumni, sport, music, dances, crafts, games, etc)	5	4	3	2	1

QUESTION EIGHT (Cap 8): Among each of the two types of groups and organizations, how many represent your rights and interests?

Categories	Likert scale options				
	All	Most	Some	A few	None
Governmental, political, economic and social groups/organizations (political parties, women's groups, village communities, trade union, cooperate associations, volunteer groups, etc)	5	4	3	2	1
Cultural, recreational and leisure groups/organizations (religious, country fellows, alumni, sport, music, dances, crafts, games, etc)	5	4	3	2	1

QUESTION NINE (Cap 9): Among each of the two types of groups and organizations, how many will help you upon your request?

Categories	Likert scale options				
	All	Most	Some	A few	None
Governmental, political, economic and social groups/organizations (political parties, women's groups, village communities, trade union, cooperate associations, volunteer groups, etc)	5	4	3	2	1
Cultural, recreational and leisure groups/organizations (religious, country fellows, alumni, sport, music, dances, crafts, games, etc)	5	4	3	2	1

QUESTION TEN (Cap 10): When all groups and organizations in the two categories are considered, how many possess the following assets/resources?

Categories	Likert scale options				
	All	Most	Some	A few	None
Significant power for decision making	5	4	3	2	1
Solid financial basis	5	4	3	2	1
Broad connections with others	5	4	3	2	1
Broad social connections	5	4	3	2	1
Great social influence	5	4	3	2	1

QUESTION ELEVEN: How would you describe the capacity of the Agent in team building in each of the specific leadership areas below?

Categories	Likert scale options				
	Very strong	Strong	Moderate	Little	None
Agent's leadership ability of working together in building resilience to climate change effects	5	4	3	2	1
Agent's ability to engage and include core actors in building resilience to climate change effects	5	4	3	2	1
Agent's ability to share decision making and reach consensus with other actors	5	4	3	2	1
Agent's ability to innovate, lead, inspire and keep resilience building actors unified (including grass root)	5	4	3	2	1
Agent's ability to develop working relationship with non-traditional allies	5	4	3	2	1
Agent's ability to gain visibility and credibility with grassroots	5	4	3	2	1
Agent's ability to gain visibility and credibility with higher level policy organs	5	4	3	2	1

Thank you for your time!

Appendix VI: Key Informant Interview Guide

Key informant Guide on Actors towards Building Resilience to Climate Change Effects at the Pugu and Kazimzumbwi Socio-Ecological System (This guide is meant to pin-point key discussion areas with key informants in the study area).

1. The general history and profile of the actor, this should include;
   i) Time in operation,
   ii) Scale of operation,
   iii) Specific target intervention areas,
   iv) Who are the target audience/recipient etc
2. Who is behind the actor, this should include;
   i) Who funds the agency,
   ii) Who are the key (existing and potential) partners (their spatial location, type of partners' influence to the agent etc),
   iii) What about achievements/contribution made to date? (if there are some statistics or some show case examples of say actual impact and weather if possible to visit and ground truth the same),
   iv) who runs the agent (to get details of the management board etc)
3. Constraints and opportunities, the discussion shall dwell on issues including;
   i) What are the operational constraints (policy related/systemic or locally created) what has/is being dome to address them?
   ii) What are the emerging opportunities and weather there are plans to tape them
   iii) Issues on local community support (how receptive is the local community on the service/influence made by the actor?)

NB*: It is imperative to request for policy, programme documents if any which will aid in capturing the additional details not explored in the interviews.*

Articles

Acta Universitatis Agriculturae Sueciae

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This thesis investigates the contribution of ecosystem services in building resilience for the livelihood effects of climate change in peri-urban areas in Sub-Saharan Africa (SSA) from a socio-ecological perspective. The thesis thus contributes to knowledge on the potential contribution of cultural and provisioning ecosystem services in building resilience for livelihood effects of climate change in peri-urban areas. A socio-ecological system analytical framework for building resilience to livelihood effects of climate change in the global south is also suggested.

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