EiABC

Ethiopian Institute of Architecture, Building Construction and City Development

Addis Ababa University

Building Ethiopia Since 1954

Integrating attributes of spatial resilience into city-wide structure plan of secondary cities in Ethiopia: Perspectives from Kombolcha city, Amhara Regional State.

Author: Mulugeta Maru

This dissertation is submitted in Fulfillment of the Requirements for the Degree of Doctor of Philosophy in Urban and Regional Planning at Addis Ababa University

Supervisors:

Prof. Hailu Worku /EiABC, Addis Ababa University

Prof. Dr.-Ing.habil Joern Birkmann /IREUS, University of Stuttgart, Germany

Addis Ababa, Ethiopia

June 2022

EiABC, Addis Ababa University

This is to certify that the thesis prepared by Mulugeta Maru Mekuria entitled: **Integrating attributes of spatial resilience into city-wide structure plan of secondary cities in Ethiopia: Perspectives from Kombolcha city, Amhara Regional State** and submitted in fulfillment of the requirements for the degree of Doctor of Philosophy in Urban Regional Planning complies with the regulations of the University and meets the accepted standards concerning originality and quality.

Signed by Examining Committee

Hailu Worku (Professor)	________________	________________
Supervisor	Signature	Date
Amare Bantider (PhD)	________________	________________
External Examiner	Signature	Date
Wubshet Berhanu (Dr.-Ing.)	________________	________________
Internal Examiner	Signature	Date
Hayal Desta (PhD)	________________	________________
Chair Person	Signature	Date
Dagnachew Adugan (PhD)	________________	________________
Post-Graduate Office Director	Signature	Date

Declaration

I, the undersigned, declare that this thesis is my own and original work and has not been presented for a degree in any other university and that all sources of material used for the thesis have been duly acknowledged, following the scientific guidelines of the University.

PhD candidate's Name: Mulugeta Maru

Signature: ______________

Confirmation

The thesis can be submitted for examination with my approval as an Institute's supervisor.

Supervisor's Name: Hailu Worku (Professor)

Signature: ______________

Abstract

According to existing literature, studying secondary cities in the global south can help us better understand spatial resilience in the face of multivariate, intersecting, and uncertain challenges. As a result, this study attempted to investigate the urban uncertainties affecting the spatial resilience of Kombolcha city in Amhara Regional State and develop strategies to integrate the attributes of resilience into the city's structure plan. Exploratory, descriptive, and explanatory research designs were used in this paper. Ex-ante evaluation of the policy documents and post-ante examination of the city's spatial plans were conducted by employing redundancy, diversity, robustness, and integration principles of spatial resilience as evaluation criteria. The thesis deployed document search as a data collection strategy to examine the policy and planning documents governing structure plan preparation in the country: Urban Development Policy(UDP), Urban Planning Proclamation(UPP), Urban Plan Preparation and Implementation Strategy(UPPIS), Structure Plan Manual(SPM), and the first and second Growth and Transformation (GTP I and II) and the two spatial plans: 2001 Development Plan(DP), the 2011 Structure Plan(SP), including 2020 Existing Land Use(ELU) of Kombolcha city. Questionnaires, site observations, base maps, and key informant interviews were also used to collect empirical data. The sample size for the study was 400 households, and thirty-five key informants were purposefully chosen from various institutions. The SPSS, Analytic Hierarchy Process (AHP), ArcGIS 10.8, and NVivo 12 plus software were applied to conduct qualitative and quantitative analyses. The study's findings revealed seventeen environmental and physical urban problems affecting the spatial resilience of the country's secondary cities. As a result, household respondents perceived deforestation as the top urban problem, while water scarcity and wind were considered the least recurring urban challenges in the city. Aside from these, the city's spatial resilience was harmed by unsustainable material and resource consumption, poor infrastructure, inadequate transportation, and insufficient response measures. The integration principle was well assimilated into the policy documents, followed by redundancy, diversity, and robustness. GTP I and II received the highest values regarding the policy-specific review, whereas UPPIS got the lowest. The non-spatial resilience of the city is further compounded by poor collaboration among land authority, water, green, and utility management institutions during the urban planning process. The absence of shared planning, task alignment, and public disclosure of achievements has also magnified the reappearance of hazards in the city. However, the study revealed that DRR-related information is being shared by community leaders (21%), family members (40%), community-based organizations(11.60%), and local administrations(Kebeles) (12.50%). The survey results further discovered a relationship and commonalities among the urban problems exacerbated by land-use zoning changes and the thriving informal settlements. In addition, the study depicted that the resilience principles had been inconsistently mainstreamed into the policy documents. Despite the spatial plans' optimistic visions of addressing hazards and anthropogenic pressures, their practical implementation remains challenging. Though the critical system operators were not collaborating, so does the engagement of local administrations in DRR is not uniform and convincing. However, the participation of communities in DRR is encouraging. Therefore, improving secondary cities' coping, adaptation, and governance systems is timely and critical. Furthermore, local governments in secondary cities commit to localizing global initiatives, setting and enforcing strict local resource utilization strategies, and improving living conditions within their cities.

Keywords: Household perceptions; Spatial resilience; Urban Problems; Hazard recurrence; Secondary cities; Collaboration; Disaster Risk Reduction

Dedication

I dedicate this dissertation work to my wife, whose words of encouragement and push for persistence ring in my ears and deserve special praise. The thesis is devoted to my loving parents, whose prayers have been with me throughout my life and in the PhD long journey,

I also dedicate this thesis to all families and friends who provided decent spiritual support and made me part of their daily prayer. The thesis is ultimately dedicated to Mrs. Taterech Mekonnen, a very helpful and courageous mother, may her soul rest in peace, Amen.

Acknowledgments

I am very much indebted to the guidance and follow-up rendered by the two PhD supervisors. I want to extend my heartfelt gratitude to Professor Hailu Worku for his dedication and commitment to showing the ins and outs in the entire PhD journey. All this paper's accomplishments were materialized with his utmost support, encouragement, and continuous motivation. He always supported and encouraged innovative ideas that produced very satisfying research output.

I would also like to acknowledge Prof.Dr.-Ing Joern Birkmann for hosting me for three intermittent, each with six months, periodic stays in Germany at the University of Stuttgart. He has evaluated the progress of my PhD work during my stay in Germany. Working with him has made an immense contribution that facilitated access to read and refer to subscription-based scholarly books and journal articles, which may not be possible at home university. The supervisor has also permitted me to participate in PhD colloquiums and present the PhD proposal in 2018. The contributions of Iris Peterson, a secretary at the university, were immense and praiseworthy.

My wife's courage, belief, and enthusiasm were unforgettable, and she is my gifted soul from the divine GOD who created her to help and encourage me, not only in this PhD work but also in our entire life. I also extend my sincere gratitude to Mr. Tilahun Bahiru, Mr. Sintayehu Belay, Mrs. Kebedech Tilaye, Miss Aynadis Tafesse, and Mr. Dereje Abate, Mr. Gedion Woldesenbet, and Mr. Minyahel Sintayehu for their immense financial, logistic and moral support.

The researcher would also like to extend my best gratitude to Tesfa's families in Stuttgart, Germany, who made my periodic stays in Germany very meaningful and valuable; their support was very much appreciated and unforgettable. They are my German family, together with Mrs. Chritina Hoeckel, who provided a decent flat to stay in.

Mr. Teferra Sileshi, National Project Officer at UN-Habitat, Ethiopia, showed his honest belief that the PhD could be done with utmost courage and enthusiasm. He proved this by providing hard and soft copies of spatial data essential to enhance the quality of this paper. Besides, he was very keen and elaborative during the interview we had. The researcher is very much indebted to his contribution. His fellow partner, Mr. Abaychew Ayele, is one of the interviewees who shared valuable information from this international organization.

I also like to thank W/ro Eleni Zemenfekidus, UNDP-Ethiopia, for the time and data shared that complimented the output of this paper.

The acknowledgment further goes to the employees' contributions, various departments, and the four hundred households of the Kombolcha city administration. These data sources provided invaluable information that made this paper possible. Special mention is given to the city manager's office and Mrs. Seada Adem Mohammed from the urban plan implementation, follow-up and feedback case team. The willful engagement and contribution of Mr. Shiferaw, a former Red-Cross society Kombolcha branch manager, is very much emphasized in this paper. The guards hired to guard the Yeguf protected forest have significant contributions in delivering the required data concerning the management of the forest and its products.

The researcher would like to extend immense gratitude to Bureau Heads and spatial planning experts at the Ministry of Urban and Infrastructure Development. Special gratitude is given to Mrs. Genet G/Egziabher, Mr. Melaku Eticha, Mr. Nibras Mohammed, Mr. Wondu Beneye, and Mrs.

Etsegent Garedew. The role of local and international urban and regional planning consultants is well appreciated in this paper.

The contribution of the twelve data collectors coordinated by Mr. Atinkut is pivotal, and the researcher would like to extend his acknowledgment for their time and patience in the process. Mr. Zeleke, a driver in Kombolcha city, deserves credit for his assistance in field visits undertaken at various locations in the city. The contribution of Miss Etsegent Melaku, who printed the manuscript, is immense.

Last but by no means the least, I praised God and St. Virgin Mary for giving me the strength, courage, and health to finalize this study.

List of abbreviations

AACA	Addis Ababa City Administration
ADPC	Asian Disaster Preparedness Center.
AHP	Analytic Hierachy Process
AMP	Asset Management Plan
ARS	AmharaRegional State
BDCA	Bahir Dar City Administration
BDIDP	Bahir-Dar’s Integrated Development Plan
BRIC	Baseline Resilience Index for Communities
CART	Communities Advancing Resilience Toolkit
CCRAM	Conjoint Community Resiliency Assessment Measure
CDKN	Climate Development Knowledge Network
CS	Collector Street
CSA	Central Statistical Agency
DEFF	Design Effect
DEM	Digital Elevation Map
DNR	Department of Natural Resources
DoLA	Department of Local Affairs
DP	Development Plan
ECPI	Ethiopian Cities Prosperity Initiative
ECSU	Ethiopian Civil Service University
EIA	Environmental Impact Assessment
ELU	Existing Land Use
EPA	Environmental Protection Authorities

ETM+	Enhanced Thematic Mapper
FDRE	Federal Democratic Republic of Ethiopia
FUPI	Federal Urban Planning Institute
FUPL	Federal Urban Planning Law
FUPMG	Federal Urban Planning Manual and Guideline
GIS	Geographic Information Systems
GTP	Growth and Transformation Plan
ICT	Information Communication and Technology
IDP	Integrated Development Plan
IIDA	Integrated Infrasructure development Agency
IPCC	International Panel on Climate Change
KCA	Kombolcha City Administration.
KCAMP	Kombolcha City Asset Management Plan
LDPs	Local Development Plans/
LLC's	Limited Liability Company's
LS	Local Streets
MDGs	Millennium Development Goals
MoFA	Ministry of Federal Affairs
MoFED	Ministry of Finance and Economic Development
MoUDH	Ministry of Urban Development and Housing
NUDS	National Urban Development Scheme
NPSDPM	National Policy and Strategy for Disaster Prevention and Management
NUDSP	National Urban Development Spatial Plan
OLI	Operational Land Imager

PAS	Arterial Street
PCP	Pollution Control Proclamation
PES	Physical, Environmental, and Social dimensions
RUDSP	Regional Urban Development Spatial Plan
RUPI	Reginalurban Planning institute
SAS	Sub Arterial Street
SD	Sustainable Development
SDFCDD	Spatial Development Framework for the City of Dire-Dawa
SDGs	Sustainable Development Goals
SES	Social Ecological Systems
SP	Structural Plan
SWMI	Solid Waste Management Infrastructures
SWZAO	South Wollo Zone Agriculture Office
SWZCO	South Wollo Zone Communication Office
TCS	Total Correct Sample Points
TPLF	Tigray People's Liberation Front
TS	Total Sample Points Taken
USGS	United States Geological Survey
TVET	Technical and Vocational Education Training
UCRS	Urban Climate Resilient Strategy
UP	Urban Plan
UDHCB	Urban Development, Housing and Construction Bureau
UPMG	Urban planning Manual and Guideline
WBG	World Bank Group

TABLE OF CONTENTS

List of abbreviations viii

List of Figures xviii

List of Tables xxi

List of annexes xxiii

CHAPTER ONE : INTRODUCTION 1

1.1. Introduction 1

1.2. Background to the Study 1

1.3. Research gap 4

1.4. Problem Statement 9

1.5. Research Questions 11

1.6. Objectives of the study 12

1.6.1. General objectives 12

1.6.2. Specific objectives 12

1.7. Scope of the Study 13

1.7.1. Spatial and thematic Scopes 13

1.7.2. Temporal scopes of the study 14

1.8. Significance of the Study 14

1.9. Limitations of the study 15

1.10. Ethical considerations 15

1.11. Research Outline 16

CHAPTER TWO : LITERATURE REVIEW 18

2.1. Introduction 18

2.2. Definition of key terms 18

2.3. Theoretical review 19

2.3.1. School of thoughts in urban resilience 19

2.3.2. Theoretical frameworks for urban local spatial resilience 22

2.3.2.1. Spatial factors affecting urban resilience 22

2.3.2.2. Characteristics of resilient urban spaces 26

2.4. Conceptual review 27

2.4.1. Spatial resilience and secondary cities 27

2.4.1.1. The concepts of spatial resilience 27

2.4.1.2. Why resilience of secondary cities? 28

2.4.2. Relevance of Spatial Planning in creating spatially resilient secondary cities 29

2.4.3. Discourses, Dimensions, and Applications of Urban Resilience 31

2.4.3.1. Discourses of urban resilience 31

2.4.3.2. Dimensions and application of urban resilience 31

2.4.4. Institutional collaboration and DRR communication systems 33

2.4.5. Conceptual framework of the study 36

2.5. Contextual reviews 37

2.5.1. Urbanization and Urban centers in Ethiopia 37

2.5.2. Resilience-based policies in Ethiopia 39

2.5.3. Spatial planning and resilience in Ethiopia 41
2.5.3.1. Urban Planning Systems (Spatial Planning frameworks) in Ethiopia 41
2.5.3.2. Challenges of urban spatial planning, development, and resilience in Ethiopian.. 44
2.6. Effects of Internal war on the spatial resilience of Kmbolcha city..................................45
2.7. State of the art of urban local spatial resilience 47
2.8. Methodological review 49
2.8.1. Urban Resilience Assessment frameworks: A comparison.................................. 49
2.8.2. Assessments of urban spatial resilience 52
2.8.3. Approaches to resilience-oriented urban policy review.. 54
2.8.4. Indicators of spatial resilience 57
2.8.5. The factors that affect spatial resilience to urban uncertainties 60
2.9. Summary 63
CHAPTER THREE : RESEARCH METHODS AND MATERIALS 65
3.1. Introduction...65
3.2. Secondary cities in Ethiopia...65
3.3. Description of the study area: Kombolcha city 67
3.3.1. History and naming 67
3.3.2. Location of Kombolcha city 68
3.3.3. Population and urbanization 69
3.3.4. Physical characteristics of the city 70
3.3.4.1. Topography 70
3.3.4.2. Geology 71

3.3.4.3. Hydrology 73

3.3.5. Urban Economy 75

3.3.6. Natural and manmade hazards 75

3.3.7. Locational advantage and constraints of the city 76

3.4. Investigating issues of urban spatial resilience 76

3.4.1. Research Design 76

3.4.2. Data Types and Collection Methods 78

3.4.3. Sampling Methods/techniques 86

3.4.4. Data analysis, interpretation, and presentation 92

3.4.4.1. Units of analysis 92

3.4.4.2. Data Analysis Tools 93

3.4.4.3. Data Interpretation and Presentation 98

3.5. Adequacy and Statistical Validity of the data 98

3.5.1. Adequacy of the data 98

3.5.2. The statistical reliability of the data 99

3.6. Source Maps 101

3.7. The methodological framework of the study 101

3.3. Summary 104

CHAPTER FOUR : RESULTS AND DISCUSSIONS 106

4.1. Introduction 106

4.2. Profile of the sampled households in Kombolcha city 106

4.2.1. Demographic characteristics 106

4.2.2. Education ... 108

4.2.3. Employment ... 109

4.2.4. Access to basic infrastructures by the sample households ... 111

4.3. Results ... 112

4.3.1. Environmental and physical factors affecting the spatial resilience of Kombolcha city ... 112

4.3.1.1. Level of the urban uncertainties in Kombolcha city ... 115

4.3.1.2. Rating the severity of the environmental and physical factors in Kombolcha city 121

4.3.1.3. Urban environmental setting as a factor affecting spatial resilience of Kombolcha city ... 123

4.3.1.3.1. Material and resource consumption: forest and energy resources ... 123

4.3.1.3.2. Flood occurrence ... 128

4.3.1.4. Physical /Built environment and infrastructure/ as a factor affecting spatial resilience of Kombolcha city ... 130

4.3.1.4.1. Type, condition, and availability of drainage lines ... 130

4.3.1.4.2. Solid waste management infrastructures ... 133

4.3.1.4.3. Traffic accidents and congestion ... 136

4.3.1.5. Responses to the urban problems: Adaptation measures ... 139

4.3.1.5.1. Planning measures ... 139

4.3.1.5.2. Biophysical measures ... 140

4.3.1.6. Urban resilience issues in secondary cities of Ethiopia ... 142

4.3.2. The integration of the spatial resilience principles into urban local spatial planning documents 144
4.3.2.1. Integration into urban local spatial planning legal frameworks of Ethiopia 144
4.3.2.1.1. Results from the key informant interview 144
4.3.2.1.2. Review results of the Ethiopian local urban spatial planning legal documents 146
4.3.2.2. Practices of integrating the principles into spatial plans of cities........ 148
4.3.2.2.1. The views from experts........ 148
4.3.2.2.2. Urban spatial resilience principles, DP and SP proposals, and the 2020 ELU of Kombolcha city 149
4.3.2.3. Challenges hampering the practical implementation of the proposals of the spatial plans........ 166
4.3.3. Collaboration among institutions during local urban spatial planning processes 167
4.3.4. The disaster communication system deployed in Kombolcha city 173
4.4. Discussions 178
4.5. Spatial planning implications of the study 189
4.6. Summary 190
CHAPTER FIVE : RESILIENCE-BASED SPATIAL PLANNING STRATEGIES........194
5.1. Introduction........194
5.2. Spatial Resilience Framework for the city........194
5.3. Strategies to enhance spatial resilience of cities 196

5.4. Strategies to adapt or mitigate the resilience issues (physical and environmental factors) 198

5.5. Strategies to enhance the governance systems of spatial planning 199

CHAPTER SIX : CONCLUSIONS AND RECOMMENDATIONS 200

6.1. Conclusions 200

6.2. Recommendations 203

References 205

Annexes 239

List of Figures

Figure 1:1: Major natural hazards and secondary cities in Ethiopia 7

Figure 2:1 The study's theoretical framework 25

Figure 2:2 Matrix showing urban resilience attributes against parameters of resilience 32

Figure 2:3 Conceptual framework of the study 36

Figure 2:4 Urban Population as a proportion of the total population 37

Figure 2:5 Urban Population proportion in Ethiopia (2005 – 2020) 38

Figure 2:6 Urban spatial planning frameworks in Ethiopia 43

Figure 2:7 TPLF's destruction resulted in litter in the city of Kombolcha 46

Figure 2:8 The elements of a resilience framework 53

Figure 3:1 2017 Woreda level Population and secondary cities in Ethiopia 67

Figure 3:2 Location map of Kombolcha city 69

Figure 3:3 Digital Elevation Map(DEM) of Kombolcha city 71

Figure 3:4 Lithological formation of Kombolcha city 73

Figure 3:5 Hydrology map of Kombolcha city 74

Figure 3:6 Sample points considered for site observation 80

Figure 3:7 Spatial sampling units of the study 91

Figure 3:8 Methodological framework of the study 103

Figure 3:9 Overall framework of the PhD work 105

Figure 4:1 Educational achievements of sampled household heads 109

Figure 4:2 Employment status of sampled household heads 110

Figure 4:3 Source of income for household heads 111

Figure 4:4: Access to utilities by households in Kombolcha city 112

Figure 4:5 the 2010 (a) and 2020 (b) LULC map of Kombolcha city 124

Figure 4:6 Proportion of energy resources used for cooking and heating purposes by the sampled households 126

Figure 4:7 Proportion of construction materials used for constructing low-rise residential houses by the sampled households 127

Figure 4:8 Proportion of options available to obtain the forest products in Kombolcha city 128

Figure 4:9 Households (a,b,d) and fences (c) affected by flooding and clearing the mud sediments (a,b) 129

Figure 4:10 Access to physical infrastructures by the sampled households 130

Figure 4:11: Drainage systems of Kombolcha city 131

Figure 4:12: Materials used for the construction of the existing drainage lines in Kombolcha 132

Figure 4:13 conditions of the existing drainage lines: good (a), moderate (b), and bad (c) 133

Figure 4:14 Proportion of drainage lines conditions in Kombolcha city 133

Figure 4:15 Open ditches filled with solid wastes 134

Figure 4:16 Solid waste management infrastructures in Kombolcha city: landfill site (a), open dumping (b), transfer station(c), and solid waste layers along river banks (d) 135

Figure 4:17 The 2011 Structure Plan land-use proposals (a) and 2020 existing land- uses (b).. 137

Figure 4:18: major land uses generating traffic congestion 139

Figure 4:19 Retaining wall constructed to protect soil subsidence from mountainous areas (a) and river banks (b) 142

Figure 4:20 Views of the key informants on the integration of urban resilience principles 145

Figure 4:21 Views of the key informants on the integration of spatial resilience principles into city-wide structure plans of cities 149

Figure 4:22 The 2001 DP (a) and the 2011 SP (b) proposals for Kombolcha city 151

Figure 4:23 The main and sub-centers of Kombolcha city proposed in the 2011 SP.................. 155

Figure 4:24 The 2011 SP reserved areas and protected forest proposals and their situation in the 2020 existing land use of Kombolcha 156

Figure 4:25 Google earth pro image showing informal residential buildings built in reserve areas (a) and protected land (b) 158

Figure 4:26 Typical informal residential buildings built on protected forests (a) and reserved sites(b).. 158

Figure 4:27 ELU of Kombolcha city in 2020 (a), main city center (b), and sub-center (c) 159

Figure 4:28 The 2011 SP proposal (a) and the 2020 existing (b) road hierarchies and networks map of Kombolcha city. 161

Figure 4:29 Connectivity issues in Kombolcha city 164

Figure 4:30 Inconsistent urban block arrangements in Kombolcha city in 2020 (d) a grid pattern (a), mixed pattern (b), and inorganic pattern (c) 165

Figure 4:31 Major factors affecting the implementation of local urban spatial plans toward resilience 166

Figure 4:32 Consolidated scores for each criterion.. 170

Figure 4:33 Application of communicative planning principles... 171

Figure 4:34 The effects of poor collaboration on the spatially non-resilience of the city. 172

Figure 4:35: Pre and post-disaster communication systems deployed in the city 173

Figure 4:36 Level of participation of local communities towards disaster risk reduction in Kombolcha city 177

Figure 4:37 Disaster Risk information providers 178

Figure 5:1 Urban resilience strategy: an emphasis on spatial resilience 195

List of Tables

Table 2:1 Characteristics of spatial resilience. 26

Table 2:2 Phases of disaster communication systems 34

Table 2:3 An assessable framework of resilience-oriented planning decision-making 50

Table 2:4 Description of spatial resilience principles and their pre-conditions used in this study. 60

Table 2:5 Factors affecting spatial resilience considered in this study 62

Table 3:1 Level of Urbanization of Kombolcha city 70

Table 3:2 Satelite images acquired and their characteristics 82

Table 3:3 Descripion of LULC classes 83

Table 3:4 Spatial household sampling frameworks of the study 89

Table 3:5 Grading values of purely spatial urban uncertainties 96

Table 3:6 Illustration of Equation 3:3 and factor grading to fit the AHP model 97

Table 3:7:Data adequacy to measure the factors affecting the spatial resilience of Kombolcha city 98

Table 3:8:Reliability statistics for plot-level hazards in Kombolcha city 100

Table 3:9 Principal component Eigenvalues (λ1) 101

Table 4:1: Average family size of sampled households 107

Table 4:2 Marital status of household heads 108

Table 4:3 Grading of the environmental and physical urban challenges in Kombolcha city 113

Table 4:4 2010 and 2020 land use/cover analysis of Kombolcha city 125

Table 4:5 Percentage of the household perception of the biophysical measures deployed 140

Table 4:6 Urban resilience issues in secondary cities in Ethiopia. 143

Table 4:7 Scores of urban resilience principles against the local urban spatial planning policy documents 147
Table 4:8 Land allocation in the DP and SP 152
Table 4:9 Proportion of reserved areas and protected forests proposed in the 2011 SP and occupied by other urban functions in 2020 157
Table 4:10 Land allocated to various road Hierarchies proposal of Kombolcha city 162
Table 4:11 Existing road hierarchies of Kombolcha city 163
Table 4:12 Pairwise comparison of the collaboration among operators of critical urban systems 168
Table 4:13 Factor normalized matrix 169
Table 4:14 Components of CBA communication systems 175
Table 4:15 Level of participation by Local administrations/Kebeles/in disaster risk reduction in Kombolcha city 176

List of annexes

Annex 1: LULC change detection 239

Annex 2: Accuracy assessment and Kappa coefficients 241

Annex 3: Published articles 243

CHAPTER ONE : INTRODUCTION

1.1. Introduction

New methodological and conceptual approaches to urban resilience lensed with spatial contexts of urban development would go a long way towards alleviating the physical-environmental problem in a city. Therefore, this study was concerned with the spatial resilience of secondary cities in Ethiopia with empirical evidence from Kombolcha city. As a result, the first topic of this chapter is the study's background, where an attempt was made to reveal the concepts of resilience and its application in the urban context. The section described the methodological underpinnings: assessment, measurement pre-requisites, and the importance of international policy initiatives governing urban resilience.

The research gap showing the rationale for conducting the study is the second topic narrated in this chapter. The problem statement, research questions, research objectives, scope, significance, limitations of the study, and research outlines were the topics covered in this chapter.

1.2. Background to the Study

The concept of resilience originated from ecology in the 1960s and at the beginning of the 1970s (Tabibian and Rezapour 2016). The notion has been applied in urban planning endeavors since the 1980s (Darkwah 2016), guides and frames the urban design theories, discourses, policies, and processes (Yamagata and Sharifi, 2018). According to Hudson (2010), the concept became the normative goal of environmental management and a foundational part of sustainable development.

Following Holling's seminal 1973 work, resilience thinking appeared in local and national agendas of development policy (Evans, 2011; Martin-Breen and Anderies, 2011; Yamagata and Sharifi, 2018).

Consequently, Local Agenda 21, 100 Resilient Cities, 2015-2030 Sendai Framework for Disaster Risk Reduction, Sustainable Development Goals, and UN-Habitat III New Urban Agenda are the national and transnational initiatives that introduced the concepts to enter the policy action arena (Rogov and Rozenblat, 2018; Romero-Lankao et al., 2016; Yamagata and Sharifi, 2018).

In addition, the Organization for Economic Co-operation and Development (OECD), the European Commission/EC/, and the Rockefeller Foundation, in collaboration with ARUP, have introduced strategic frameworks for creating resilient cities (Angelidou et al., 2018). According to Laframboise and Loko (2012), such frameworks have significantly changed urban policy design and implementation.

Morgado and Dias (2013); Pinho et al. (2013) discussed that creating a resilient city requires the designation, formulation, and enactment of urban policies encompassing the basic resilience characteristics. Accordingly, Godschalk (2003) named the characteristics as principles: redundancy, diversity, efficiency, autonomy, strength, interdependence, adaptability, and collaboration.

In support of this, Figueiredo et al. (2018) posited that a city that seeks to transition, transform and change to a better, robust state should focus on redundancy, flexibility, resourcefulness, inclusion, and integrated resilience-building. Fleischhaur (2008), on the other hand, coined that redundancy, diversity, strength/robustness, and collaboration/integration are essential in making cities more resilient through spatial planning and related policy instruments.

The concept gradually builds up the ability of systems, communities, or societies potentially vulnerable to hazards to resist and/or change to reach and retain a level of functioning and structure that can be tolerated (UNISDR, 2013). Furthermore, resilience and its underlying conceptual body of knowledge help explain changes in spatially interconnected complex adaptive urban systems (Müller, 2011) from individual settlements to networks of settlements in urban areas (McGranahan et al., 2005).

In the urban context, resilience aims to develop answers to theoretical problems, ongoing environmental and ecological concerns, the dynamic urban built environment, evolving socio-economic regimes, and the interplay of political ideas, among various other things (Eraydin, 2013). An urban system's resilience depends upon the interactions between structure and dynamics at multiple spatial scales, directly affecting the planning processes and disaster risk reduction efforts (Benson and Garmestani, 2011).

Cities' growing financial, social, and spatial vulnerabilities, resource exploitation, increased hazard events, and environmental deterioration has prompted resilience discussions in planning paradigms. Such urban planning thinking provides a foundation for thoroughly examining urban areas and their vulnerabilities (Taşan-Kok et al., 2013).

Accordingly, resilience-based urban planning was introduced to intervene in the spatial changes resulting from disasters (dos Santos and Partidário, 2011; Galantini and Tezer, 2018). As per Berkes (2008); Berkes and Ross (2013); Twigg (2009), such a process reshapes legal frameworks and urban responsibilities, capacities, and structures.

In this context, Keen et al. (2005) emphasized that institutional planning concerns play a critical role and suggested the need for enhanced collaboration, decision making, and stakeholder involvement. Furthermore, such planning recognizes human-environment interactions, placing people at the center of planning efforts and activities (Yamagata and Sharifi, 2018).

In addition, connecting the process, which defines the stakeholders, interdependencies, scale, attributes, and planning instruments (Grazia and Stefano, 2019), with institutional frameworks, is indispensable in any resilience-oriented planning activities (Müller, 2011). Bahadur et al. (2016); Plata and México (2019) quoted that the involvement of various actors enhances the resilience of an urban system.

UNISDR (2013) provided nine key views of how planning can add to developing resilient cities and decreasing disruptions, particularly in developing countries of Africa. These include: incorporating risk assessment, engaging stakeholders, ensuring land is reserved for anticipated development, upgrading informal settlements, installing risk-reducing infrastructure, assessing the effects of urban development on the most vulnerable in a city, collecting accurate information about the risks, and communicating risk information widely and protecting ecosystems to allow proper stormwater drainage to avoid extensive erosion and protect against storms and tidal waves.

In light of all these, UN-Habitat III (2016) has set out the need to enhance the resilience of cities and human settlements, promoting the development of infrastructures that are resilient, resource-efficient, and will reduce the risks and the impact of disasters, including the rehabilitation and upgrading of slums and informal settlements.

1.3. Research gap

This part of the study presents the rationale for conducting the research. Accordingly, it has established the methodological and conceptual gap it strives to address.

- **Methodological gap**

African cities' efforts to achieve sustainable development goals are hampered by multiple hazards and a lack of concerted efforts to incorporate and apply the concept of urban resilience in spatial planning (Darkwah et al., 2018). Nevertheless, Colucci (2014) stressed that innovative principles and appropriate urban resilience strategies are not strongly focused on urban and planning issues within the planning contexts.

On the other hand, Adger et al. (2005); Allen et al. (2011) indicated the need for a paradigm shift that calls for new research on comprehending spatial resilience in the face of multivariate, intersecting, and uncertain risks/urban challenges.

Recent literature alluded to the increasing interest in studying urban uncertainties impacting spatial resilience through household perception (Allen et al., 2016). RIMA (2016), in this context, indicated the possibility and need for applying factor analysis in resilience studies, which still needed further research.

- **Conceptual gap:**

i. **The rationale to focus on urban local spatial resilience**

The resilience of urban spaces has become a topic of concern in urban planning and design, landscape architecture, and others. The role of these spaces is vital in the urban formation and may affect urban systems' ability to develop and survive in the long run (Allan et al., 2013; Berke et al., 2009; Godschalk, 2003). Despite an increasing body of literature on resilience, the importance of understanding urban spatial resilience and how elements of urban space affect it has not been well researched. Therefore, spatial studies and planning can give us a new perspective on disasters and changes in our environment (Lu et al., 2021).

ii. The rationale for emphasizing secondary city

Globally, more emphasis has been placed on urban centers other than major cities (Roberts, 2014), recognizing that a growing proportion of national and urban populations live in secondary and small cities (Satterthwaite, 2017).

Secondary cities' vulnerability to hazards is underappreciated (Garschagen and Romero-Lankao, 2015). Current research on urban resilience pays little attention to the effects of city demographic changes in second-tier cities (Sherbinin et al., 2011). In this vein, Olazabal and Pascual (2012) claimed that most of the focus on urban resilience had been done at the highest levels of governance. As a result, lower-level urban networks, social behaviors, and local institutional structures, including secondary cities, have received less attention.

Cote and King (2017) argued that these cities are not prepared to accommodate rapid urban expansion while people occupy fragile ecosystems, subject to man-made and natural hazards. These cities further lack the data on spatially unique urban problems, the analysis required for spatial planners and policymakers, and the resilience of these cities remains unstudied(Shores et al., 2019).

The unique characteristics of urbanization in Ethiopia are due to the lack of large or super-large urban centers and the growing number and size of medium-sized and secondary cities (Tegenu, 2010). According to Horst A. (2006), these urban areas are growing faster than Addis Ababa, the primate city. Ethiopia's secondary city growth rates exhibited significant changes, increasing by 267% between 1994 and 2008 (Tegenu, 2010; Tesfaunegn, 2017). According to Roberts and Hohmann (2014), they are growing rapidly but with fewer capacities to plan and manage urban development and promote employment and economic growth. Furthermore, they are vulnerable to multiple hazards and lack resilient planning approaches (World Bank, 2018).

The hazards include but are not limited to flooding, erosion, landslide (Figure 1:1), pollution, poor infrastructure, and informal settlements. According to Assefa (2018), these disruptions subtly undermine the urban development opportunities of cities in Ethiopia.

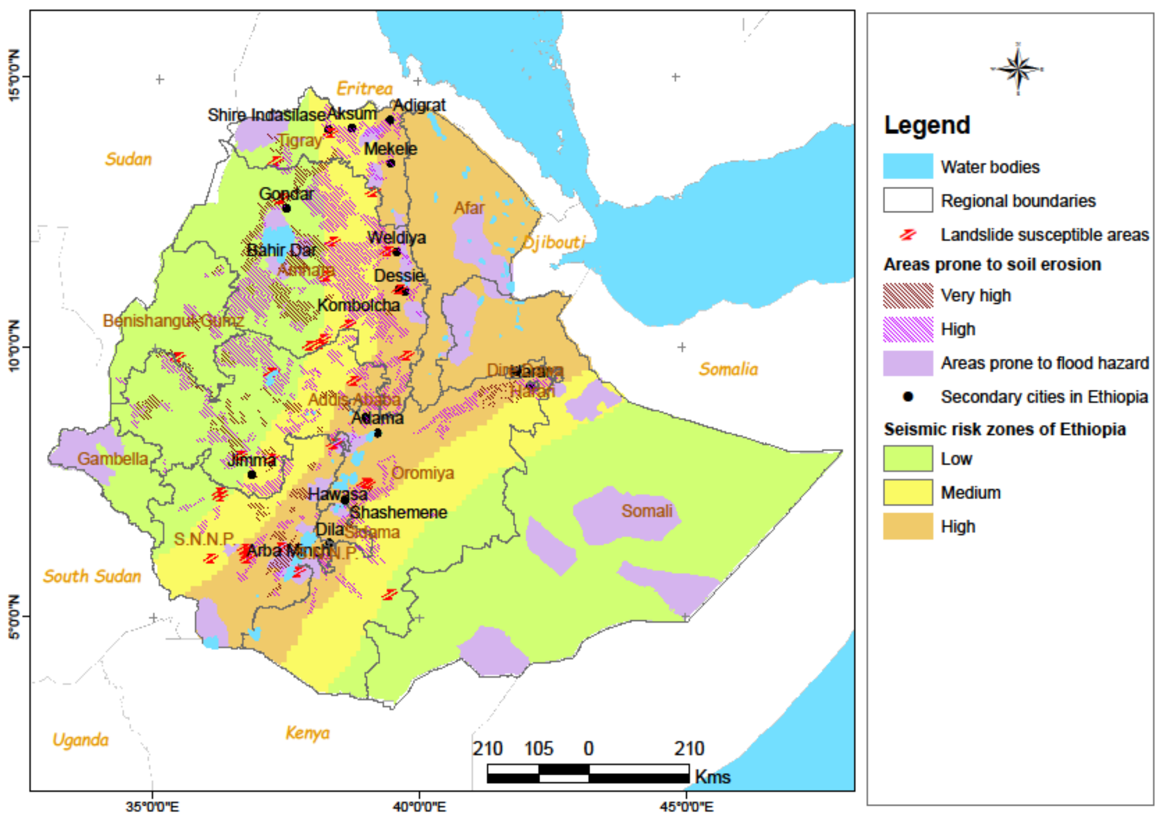

Figure 1:1: Major natural hazards and secondary cities in Ethiopia
Source: MoUDH (2015b)

iii. The rationale for choosing Kombolcha city, one of the secondary cities in Ethiopia

The city's locational advantage (section 3.3.7) and the recurrence of major shocks and stresses (section 3.3.6) are the prime motivational elements for choosing Kombolcha for this study. Despite these, the urban climate resilience strategy did not recognize or take account of the urban problems stirring in the city or make it part of the strategy document. However, except for Addis Ababa, all regional cities mentioned in the document are secondary cities whose vulnerability to many urban problems was shown (MoUDH, 2014).

The researcher believes that the lack of consideration for spatial attributes of resilience and urban problems observed in secondary Ethiopian cities is more pronounced, has damaged properties, and has affected human well-being in Kombolcha city than in other cities.

However, the foundation of this paper is based on three scholarly contributions, which showed that the theme under consideration is worthy of study. The first one is attached to the scientific discourse that Viverita et al. (2014) emphasized the need for original research on the physical and environmental factors influencing urban spatial resilience. The second lies in Yamagata and Sharifi (2018), who proposed country-specific research on various themes of spatial resilience. These authors further extended their suggestion to consider the relevance and application of resilience principles on spatial planning legal frameworks and their practical implementation in urban spatial plans and on the ground. The third research gap anticipated to be filled attached to Poku-Boansi and Cobbinah's (2018) works, which supplemented the focus on urban planning processes and communicating DRR to achieve resilience in African cities.

1.4. Problem Statement

Almost all of the world's future population growth is expected to occur in cities and urban areas, housing nearly 70% of the world's population by 2050 (UN DESA, 2014). According to Salehi et al. (2011), most of this growth will occur in developing African and Asian countries, primarily small and medium-sized cities. According to the World Bank (2018), such urbanization is one of the most important factors influencing the resilience of urban areas.

As a result of rapid urbanization, cities across the globe are facing numerous challenges, including resource exploitation, increased hazards, environmental degradation, poverty, pollution, and disease, in addition to being engines of economic growth with burgeoning financial, social, and spatial vulnerabilities (Alliance, 2007).

Cities' ecological footprints and impacts on ecosystem services extend to 500-1000-fold farther away from their boundary (Colding and Barthel, 2013). Accordingly, they are responsible for approximately 78% of all carbon emissions, 60% of all water consumption, and 76% of all wood used due to these ecological footprints(Shaw et al., 2009).

Godfrey and Savage (2012); Cain et al. (2002) disclosed that urban residents in developing countries are impoverished and lack basic services and access. Besides, many of them reside in informal settlements near environmentally sensitive areas.

Such land occupation has resulted in unplanned or poorly regulated city expansion on vulnerable land, exposing people and infrastructure investments to risks and jeopardizing the city's overall functions (Asian Disaster Preparedness Center, 2015; MoUDH, 2015a). Small and medium-sized cities' non-resilience is exacerbated by a lack of concerted efforts to identify the factors influencing spatial resilience and a limited ability to incorporate resilience into urban planning and design (Sherbinin et al., 2011).

Ethiopia was ranked 10th for extreme weather vulnerability, 34th for flood risk, and 5th for landslide risk out of 162 countries (Climate Development Knowledge Network (CDKN), 2017). Ethiopia's 2015 Growth and Transformation Plan (GTP II) document stated that a lack of workable policies, strategies, and institutional frameworks are major barriers to building urban resilience (MoUDH, 2015a).

Furthermore, according to Ethiopia's draft urban climate resilience strategy, none of the regional capital cities are resilient. As a result, more than half of these cities are vulnerable to earthquakes. Landslides are a problem in one-third of them (MoUDH, 2017). As per the strategy document, all regional capitals face housing shortages, higher unemployment rates, traffic accidents, energy shortages, and flourishing informal settlements. Ethiopia's urban challenges, the document stated, extend to all levels of the urban hierarchy, including primary, secondary, and tertiary cities.

The frequency, magnitude, and scope of natural/man-made disasters in Ethiopia's urban areas are unknown. However, according to Billi et al. (2015), the 2006 flash floods in Dire-Dawa city, one of Ethiopia's chartered and secondary cities, resulted in the killing of 256 people, 244 disappeared, and displaced 10,000. Houses, infrastructure, and human livelihoods have suffered significant damage due to the flood.

Another secondary city, Kombolcha, has experienced urban problems due to its seismic zone location, forest degradation, landslides, poor green infrastructure coverage, housing issues, unemployment, urban pollution, and low efforts to generate green jobs (KCA, 2011). These challenges are described as environmental risks in the city's structure plan, operational since 2011 and expiring after 2020.

Due to various issues, the structure plan proposals depicting the principles of spatial resilience are not well implemented. As a result, the city's spatial resilience has been influenced by physical and environmental factors coupled with social, political, and economic dimensions. Therefore, researching these resilience themes is both timely and critical.

As a result, the consolidated problem statement of this paper is to investigate the environmental and physical factors influencing the spatial resilience of Kombolcha city and examine the resilience principles mainstreamed into Ethiopia's urban local spatial planning documents. It also focused on determining institutional collaboration in the planning process and exploring DRR communication systems in the city.

1.5. Research Questions

It would be valuable to pose the subsequent questions to achieve the thesis's specific objectives, which are this study's research questions.

- What environmental and physical factors affect the spatial resilience of Kombolcha city to urban uncertainties?
    - How do the households in Kombolcha city perceive the extent and impact of the factors?
    - Do the built environment conditions affect the spatial resilience of the cities?
    - What are the hazard adaptation measures affecting the spatial resilience of the city?
    - What are the urban resilience issues of secondary cities in Ethiopia?
- Are the spatial resilience principles mainstreamed into local urban spatial planning legal documents of Ethiopia: Urban Development Policy /UDP/, Urban Plan Proclamation/UPP/,

Structure Plan Manual/SPM/, Urban Plan Preparation and Implementation Strategy, Growth and Transformation Plan /one and two, and then 2001 development plan (DP), 2011 structure plan (SP), and 2020 existing land (ELU) plans of the city?

- How do urban land administration and operators of urban green, infrastructure, utilities, and water institutions collaborate in the local urban spatial plan-making process?
- What are the communication systems deployed toward DRR in the city?
- What resilient-oriented spatial planning strategies allow for integrating the resilience attributes into the city-wide structure plan of Kombolcha city?

1.6. Objectives of the study

1.6.1. General objectives

The research's main objective is to investigate the urban uncertainties affecting the spatial resilience of Kombolcha city in Amhara Regional State and develop strategies to integrate the attributes of resilience into the city’s structure plan. Thus, the following are the specific objectives of this study:

1.6.2. Specific objectives

- To identify and determine the environmental and physical factors affecting the spatial resilience of Kombolcha city to urban uncertainties.
- To unpack the principles of urban spatial resilience mainstreamed into Ethiopia's local urban spatial planning documents and investigate the practices through the 2001 development plan, 2011 structure plan, and 2020 existing land use of Kombolcha city.

- To examine the collaboration among urban land administration authority and operators of critical urban systems: water, infrastructure, green, and utilities in the urban plan-making process and
- To identify the DRR communication system deployed in Kombolcha. City.
- To develop resilience-oriented spatial planning strategies that integrate resilience principles into the city-wide structure plan of Kombolcha city.

1.7. Scope of the Study

Urban local spatial resilience requires innovative approaches to understanding the changing dimensions and engaging science with society (Shove, 2010). Accordingly, it is imperative to understand the urban systems: social, economic, technological, environmental, and governance networks across temporal and spatial scales. The scales, along with the thematic scope, defined the scope of this study.

1.7.1. Spatial and thematic Scopes

The thesis's spatial scope included the entire city of Kombolcha. It is situated in the eastern part of Amhara Regional State. On the other hand, the thematic scope included identifying the country's urban resilience issues for secondary cities. The scope is further attached to examining planning legal frameworks relevant to preparing local urban spatial plans: the 2005 UDP, the 2008 UPP, the 2006 SPM later revised in 2012, the 2014 UPPIS, and the 2010 and 2015 GTP documents.

The thematic scope also includes exploring the collaboration among operators of critical urban systems. The study gathered information from urban land administration, water and sewerage enterprises, infrastructure development, environmental protection, and utility-providing institutions in this context.

Thematically, the thesis was also delimited by DRR communication systems deployed in the city, attributed to pre and post-disaster hazard mapping and Community-Based Approaches: participation, training, and information sharing.

1.7.2. Temporal scopes of the study

The practices of showing the implementation of policy provision concerning the attributes of spatial resilience were done by examining two spatial plans, which were prepared in different years and validated through the 2020 ELU of Kombolcha city. Accordingly, the temporal scope included 2001 marked the preparation of the DP, 2011 showed the year the SP was prepared, and 2020 indicated the ELU of the city. In addition, the temporal scope included the review of the country's local urban spatial planning legal frameworks endorsed after 1991.

The 2010 Landsat 7 ETM+ and the 2020 Landsat 8 OL satellite images of the study area have also been used to carry out land use/land cover analysis for Kombolcha city.

1.8. Significance of the Study

The thesis will greatly contribute to dealing with urban resilience discourses in the Ethiopian context in a more linked and integrated manner so that the development and management of secondary urban centers will be sustainable and resilient. Thus, it has policy, strategic, and planning importance and methods to integrate the principles of spatial resilience into urban plans and designs. The experience shall be shared among small towns of Ethiopia and the global south. Specifically, the thesis will have the following significance.

- The thesis will have strategic level significances where decision-makers and planners at all tiers of government, those working in municipalities, can apply the principles and methodological approaches or strategies to be developed to fit with the contexts of their cities.
- The thesis is expected to enrich the literature on urban sustainability and resiliency, emphasizing mid-sized or secondary cities.
- Establish methodologies for improving the planning, management, and monitoring of the discourses of urban resilience, with particular emphasis on spatial contexts, in creating sustainable and appealing cities.
- The concern of a PhD dissertation is to build on and add new ideas to the existing knowledge. Thus, the academicians can use this paper to deal with urban resilience and sustainability, work on the concepts and strategies attached, and develop their research topic from suggestions on future research areas.
- Future researchers may cite this paper as pioneering, and the issues raised can be used as a reference and educational document.

1.9. Limitations of the study

Despite the limitation of Covid 19, this PhD work was completed successfully.

1.10. Ethical considerations

The importance of ethics in human-centered research cannot be overstated. The researcher went out of his way to be personable during the fieldwork. The researcher realized that gaining participants' trust was the most important aspect of conducting successful fieldwork. The familiarization visits and observations aided in establishing the researcher's presence and gaining and maintaining people's trust throughout their fieldwork. According to Cohen et al. (2011), informed consent is the foundation of the ethical procedure.

As a result, participants' permission was sought. The research assured participants that their information would be used solely for academic research purposes throughout the fieldwork. They would not reveal anything about what they said to anyone they knew who might be interested in knowing what they said. The research participants offer their knowledge and share their experiences in a way that might bring positive changes. Confidentiality was maintained in reporting the information. Accordingly, informed consent was obtained from all participants included in the study.

1.11. Research Outline

This part of the research discusses the various parts or chapters that divide the thesis's various sections. Accordingly:

Chapter one is dedicated to the introduction, where the background, research gap, problem statement, research questions, objectives, the scope, significance, and limitations of the study, along with ethical considerations, were dully discussed.

Chapter two is allocated to a review of relevant literature showing the scientific underpinnings of the study. Thus, it presented the operational definition of key concepts and critically analyzed the scholarly works related to the topic. Thus, this chapter constituted theoretical, conceptual, contextual, and methodological reviews and the state of the arts.

Chapter three: this chapter is devoted to research methods and materials. It discussed the location and other features of Kombolcha city. The third chapter discussed the research designs adopted, the data types and their collection methods, sampling methods and sizes, data analysis, interpretations, and presentations. The chapter also discussed the two SPs of the city and google earth images as source maps or materials utilized for this study.

Chapter four: this part of the research paper is devoted to the results and discussion parts of the study. The chapter discussed the profile of the sampled households. All the results discussed in chapter four are given meaning and interpretation to show their implications for policymaking and spatial planning. The results and their interpretations were presented in line with the research objectives of the thesis.

Chapter five is allocated to developing resilient-oriented spatial planning strategies to integrate the attributes of spatial resilience into the city-wide SPs to make secondary cities in Ethiopia, Kombolcha in particular, more resilient. The strategies are targeted toward the results discussed and the four principles of spatial resilience: redundancy, robustness, diversity, and integration.

Chapter six, the final chapter, dwelled on making conclusions and recommendations for the study's major findings. The chapter further provided insights on the potential areas of future research that should be filled to make secondary cities more resilient.

In summary, chapter one introduced the study. It is meant to introduce or orient the reader to the whole essence of the research with its special focus on spatial resilience. The following chapter focuses on the literature review pertinent to the study.

CHAPTER TWO : LITERATURE REVIEW

2.1. Introduction

This literature review has searched and included those kinds of previous scholarly publications that are highly related to the subject matter of this paper. Hence, the reviews give due attention to the following issues related to urban spatial resilience and its factors and attributes. Consequently, the literature search focuses on theoretical, conceptual, methodological, and contextual reviews. State-of-the-art spatial resilience supplemented these reviews and forms part of this chapter.

2.2. Definition of key terms

This section of the chapter discusses the study's key terms. The terms were used throughout the study, and it was necessary to contextualize them in order for them to be relevant to the thesis.

Hazard: is the inherent danger associated with a potential problem (Randolph, 2004).

Resilience is the ability of a system to alter repeatedly and cope but maintain within the critical thresholds (Folke et al., 2003).

Urban resilience:

The Ethiopian draft urban climate resilience strategy defined urban resilience based on the definitions forwarded by International Panel on Climate Change (IPCC) (2012) as:

> *'The ability of a system and its parts to anticipate, absorb, accommodate, or recover from the effects of a hazardous event in a timely and efficient manner, including ensuring the*

preservation, restoration, or improvement of its essential basic structures and functions.' (MoUDH, 2017).

However, the contextual definition of the term is provided based on a structured questionnaire prepared for academicians, professionals, and urban planning and development consultants working in Ethiopia. Thus, urban resilience is defined as the ability of an urban area to survive and grow considering acute stresses and shocks.

Urban Local spatial resilience is defined as the ability of a local system to bounce back to desired functions after disruptions to enhance its ability to evolve all the elements toward a new territorial organization (Brunetta and Caldarice, 2020).

Disaster Risk Reduction/DRR/: refers to the concept and practice of reducing disaster risks through systematic attempts to identify and minimize disaster-causing factors (International Strategy for Disaster Reduction, 2009).

Institutional Collaboration: is an initiative or arrangement of some sort between two or more organizations that are intended to help achieve specific goals in urban development with an institutional commitment (Salmons and Wilson, 2009)

2.3. Theoretical review

2.3.1. School of thoughts in urban resilience

The concept of resilience is significant concerning hazards, disasters, and the coping mechanism, including shaping the response measures such as planning policies and practices (Coaffee, 2013). However, comprehending the concept entails knowing how resilience theory has evolved (Al-Bqour, 2020). According to this author, the scholarly contribution of Holling (1973) on ecosystem resilience with significance to urban context is the foundation for the contemporary resilience theories.

In the urban setting, UN Habitat (2017) concluded that resilience thinking has evolved tremendously and taken three schools of thought into account: The engineering, ecological, and social-ecological perspectives.

Plodinec (2009) argued that the 1970s were the year that marked the initial discussions on resilience thinking in engineering theories, which (McGill, 2020) asserted as a conventional approach to urban resilience. According to Nyström et al. (2000); Plodinec (2009); UN Habitat (2017), the engineering approach to resilience is directly dependent on the capability of all the urban system's physical components: buildings and infrastructures to absorb the damages due to disturbances and quickly restore their state before the shock.

However, in the 1980s, a new discourse, ecological perspectives, emerged that combined the engineering and ecological perspectives. During these periods, the concept of resilience was attached to the capability to absorb and recover from disasters (Plodinec, 2009).

In contrast to the static view of systems, *ecological resilience* was defined as "A measure of the persistence of systems and their ability to absorb change and disturbance and maintain the same relationships between populations or state variables.'' (Holling, 1973; Lasheen, 2014; Meerow et al., 2016). At the same time, (Pimm, 1984) added “the speed of return” to the system's earlier state.

According to Carpenter et al. (2001), the definition asserted that the resilience of a system could be measured by the tendency of the system to stay functioning after disturbances or maintain its structure or function without being significantly affected and changing into a new equilibrium or steady-state.

As demonstrated, the two schools of thought have varied emphasis on resilience. The engineering viewpoint stresses the ability to persist in stable states within a single equilibrium. At the same time, ecological resilience distinguishes that a system can have multiple stable states, which may develop and change, providing the system remains functional - the latter, therefore, values persistence and adaptability (UN Habitat, 2017).

A new scientific contribution, an SES perspective, came out in the 1990s with an advanced look into the concept of incorporating cities and their human settlements into resilience discourses (Brunetta and Caldarice, 2020). SES is also termed transformational or adaptive, or evolutionary resilience, focusing on dynamic non-equilibrium, signaling systems undergoing constant changes and having no stable state (Rega and Bonifazi, 2020). Pinho, P., Oliveira, V., and Martins (2013) argued that resilience as a conceptual framework has only been recently incorporated into planning research, while SES is considered the entry point for that integration.

Thus, as per Folke (2006); Meerow and Newell (2018), this notion of resilience "incorporates the idea of adaptation, learning, and self-organization along with the general ability to persist disturbance" and accordingly captures the importance of human potential to transform its surroundings. This idea is discussed by UN Habitat (2017) as urban resilience, where issues related to settlements, infrastructures, and their network can be seen.

Similarly, Sommerkorn et al. (2016) concluded that urban resilience is influenced by social and ecological interactions at all spatial scales. Consequently, Taşan-Kok et al. (2013) depicted that in the early 2000s, the concept was primarily applied to create urban spaces with resilience at a local level. However, research, discussions, definitions, planning, financing, implementing, and measuring urban resilience began in the 2010s (ICLEI, 2019).

International and regional initiatives have affected the resilience theory since the 2000s (Yamagata and Sharifi, 2018). These are the entry points of resilience thinking in urban spatial resilience ((Taşan-Kok et al., 2013).

2.3.2. Theoretical frameworks for urban local spatial resilience

Two paradigms have influenced the theoretical basis of spatial resilience. The first is the spatial factors related to urban spaces' structures, functions, networks, citations, and compositions. The other one is associated with the characteristics of these urban elements to withstanding potential urban challenges and bounce back by resisting the effects of the problems. The following discussions describe the theoretical underpinnings of the study.

2.3.2.1. Spatial factors affecting urban resilience

It is essential to identify and describe the most prominent spatial factors that could potentially affect the resilience of cities. According to Lu et al. (2021), the factors include spatial scale, urban structure, density, land use, public open spaces, and networks, and the characteristics of all these factors, which form the major theoretical frameworks of the study.

Urban spatial scale

Dong et al. (2020); Quinlan et al. (2016) argued that factors influencing the resilience capacity of communities vary across space. Accordingly, disasters seldom cause major damage in small cities and could devastate large cities. According to Brown et al. (2012), disasters represent the differences in resilience in urban areas under different spatial scales. Fleischhaur (2008) scholastic work asserted that spatial scale could also mean the national, regional, and local territories.

Urban structures and density

As per Moser (2004); Webber (2016), the urban structure includes the natural environment, topography, soil types (bearing capacity), water courses (rivers, streams, and lakes), vegetation types, micro climate, environment characteristics, and landscape features.

Furthermore, Feng et al. (2020) alluded that any city comprises a multi-level nested structure system, which Feliciotti et al. (2017) depicted as poly and mono-centric spatial structures in the current urban development practices. The former can promote urban resilience by modularizing infrastructure, urban functions, and institutions of various sizes, dispersing risk across sub-centers (Dieleman, 2013). However, the monocentric is characterized by the concentration of population and resources in a single central district of cities (Sadowy, 2016).

Both urban structures determine the distribution of urban population and services, i.e., density (Smith, 1997), an urban morphology index affecting cities' spatial resilience (Olds et al., 2012). Silva et al. (2017) disclosed that urban density, like population and building density, measures the intensity of urban development. Accordingly, Lu et al. (2021) disaggregated urban density as high and low, with positive or negative consequences (Wamsler et al., 2013) on the spatial resilience of cities. Wamsler et al. (2013) asserted that the high density intensifies the urban environment's damage and increases the population's risk exposure.

In emergency response activities, it has been demonstrated that high density can impede absorption and response capacities, resulting in secondary disasters or greater losses in urban areas. For example, major destructions in densely populated areas will obstruct streets and emergency access routes (Wamsler et al., 2013).

On the other hand, low density may result in large and inaccessible street interfaces that reduce the built environment's diversity, connectivity, accessibility, walkability, and vitality, leading to lower resilience (Lu et al., 2021). On the contrary, Chang and Shinozuka (2004) argued that cities with high density or compact development promote non-hazardous land uses, infrastructure systems, and socio-economic activities.

Land uses or Urban functions

However, with significance to urban resilience, the factor with due importance included land-use reserve (flexibility), land use mix (diversity), land-use change (transformability), and open spaces (diversity and redundancy) (Lu et al., 2021). In this context, Zhang (2010) argued that land use planning and management are tools available to control and optimize the development of disaster-prone areas.

Spatial networks

As elements of urban land use function, open spaces could serve as emergency evacuation sites in times of disaster (Allan et al., 2013). Their diversity also promotes the resilience of urban spaces (Fratini et al., 2012), characterized by the connectivity principle, i.e., spatial networks (Lu et al., 2021).

The urban spatial networks are further attributed to roads, transport, and open spaces or green frames, and their robustness is critical in promoting resilience thinking in urban spaces (Sakakibara et al., 2004).

The study concluded that the evolution of and the factors affecting spatial resilience constitute the theoretical framework of the study (Figure 2:1).

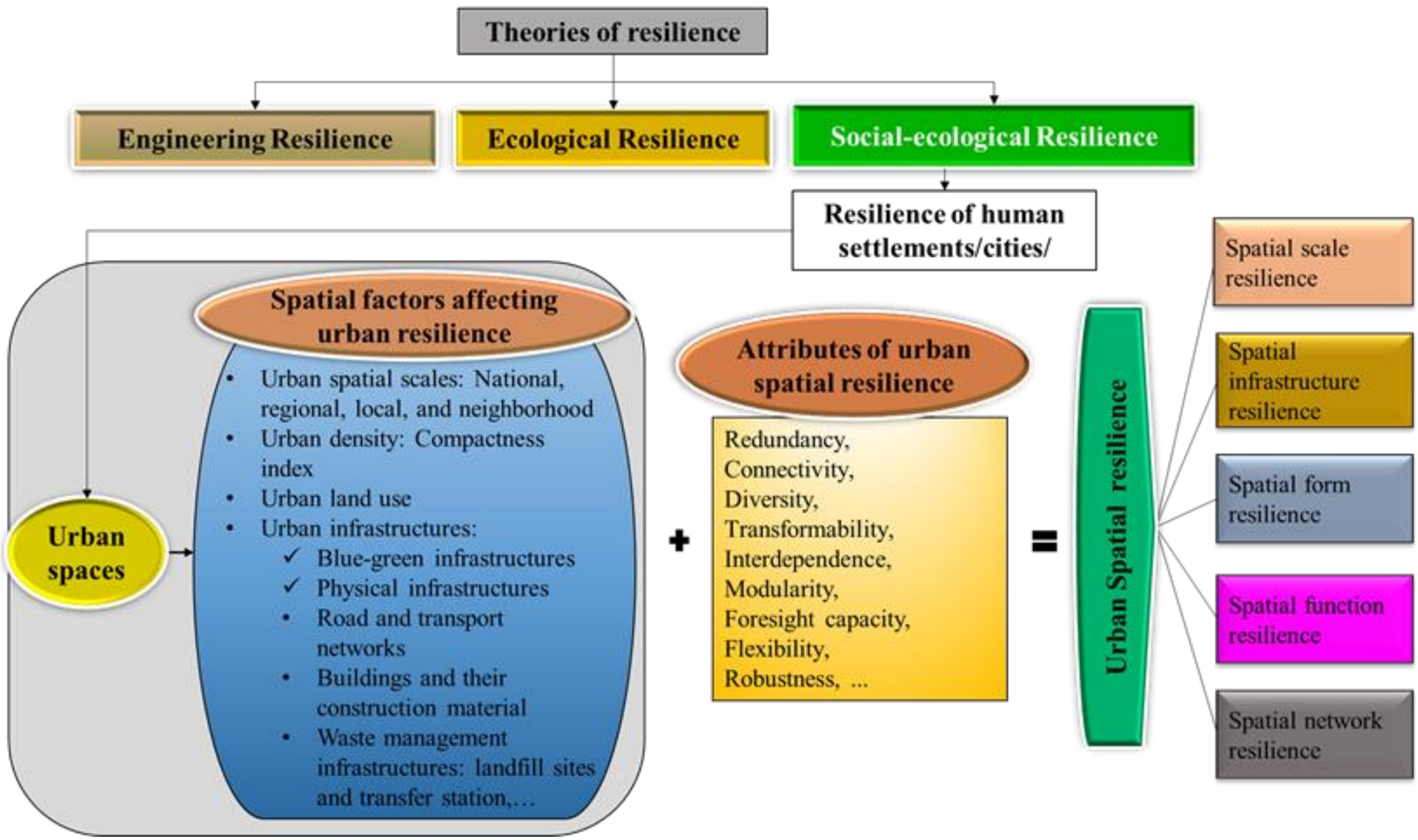

Figure 2:1 The study's theoretical framework

Source: adapted from Lu et al. (2021)

2.3.2.2. Characteristics of resilient urban spaces

An essential step in undertaking a study on urban spatial resilience is to conduct a literature review to explain and identify the characteristics that make urban spaces resilient. In this context, various scholars have developed resilience principles that define the inherent characteristics of urban spaces (Lasheen, 2014; Lu et al., 2021). However, Gharai et al. (2018) maintained these as the major gauges of urban local spatial resilience (Table 2:1).

Table 2:1 Characteristics of spatial resilience.

No	References	Resilience characteristics
1	(Allan and Bryant, 2011)*	Diversity, adaptability, modularity, innovation, rapid feedback, reserves of social capital, and the ability of ecosystems to serve and the attributes of the decision-making process
2	(Ahern, 2011) *	Versatility, redundancy, modularity, biological and social diversity, multi-scale network connectivity, and adaptive planning and design
3	(Sharifi and Yamagata, 2014) *	Redundancy, diversity, independence, interdependence, resources, adaptability, creativity, cooperation, self-organization, and efficiency
4	(Islam and Quek, 2014) *	Forward-looking, competence, autonomy, intensity, interdependence, collaboration, modularity, innovation, high-speed responsiveness, uncertainty, among others.
5	(Romice et al., 2017) *	Diversity, redundancy, modularity, connectivity, and efficiency

6	(Arup, 2014; Godschalk, 2003; Sharifi and Yamagata, 2016; Walker and Salt, 2006) **	Diversity, connectivity indicator (Different parts of the environmental system), climate and soil health, adaptive design (urban environmental quality index through the role of design and organization of space), urban infrastructure, ecosystem services, (modular) modularity, and measurement ability Robustness (the resistance of elements and physical components of the city, such as roads and buildings), adaptability capacity, redundancy, sustainability, and natural capital are all important considerations.
7	(Ernstson et al., 2010; Suárez et al., 2016)**	Institutional abilities and structures, decision-making and decision-making policies, integrated management, diversity of organizational levels and inter-organizational communication, connection index (different parts of the organization's and institutions' systems), adaptability or adaptation capacity, and timely response speed.

*Source: *Gharai et al. (2018); **Lu et al. (2021)*

2.4. Conceptual review

2.4.1. Spatial resilience and secondary cities

2.4.1.1. The concepts of spatial resilience

As resilience theory has developed, the concept of resilience has evolved in connotation and scope. Concurrently, Nyström and Folke introduced spatial resilience in the early 2000s (Kärrholm et al., 2014). Despite its dynamic nature, spatial resilience is an important concept for understanding social-ecological change and the current state of existing systems. Resources are both spatially and temporally unevenly distributed in most landscapes. A local disturbance regime can be affected by local variations in variables (such as slope or elevation) influencing the frequency and magnitude of disturbances (Franklin and Forman, 1987; Nepstad et al., 2001).

As well as determining the trajectory of change within a landscape, spatial properties can also determine the kind and magnitude of socio-ecological change (Iverson, 1988; Mertens and Lambin, 2000), the system's ability to cope with and adapt to disruptive forces (Hynes et al., 2020), and the regeneration of post-disturbance landscapes (Bengtsson et al., 2003).

Relevant patterns in human-dominated urban systems include the locations of centers: main and sub-centers, the spatial arrangement of land uses, and the number, hierarchy, magnitude, and arrangement of infrastructure connections. Location plays a profound role because disturbances rarely act homogeneously across various spatial scales. Additionally, the spatial arrangement of a social-ecological system would contribute to its ability to adapt to change. The spatial variation in the magnitudes and fluxes of available resources is also important for system-wide transformation. Developing and applying spatial resilience principles will allow practitioners to understand how and when spatial aspects of resilience at different scales influence system resilience (Cumming, 2011).

2.4.1.2. Why resilience of secondary cities?

Due to poor urban planning, many second-tier cities in sub-Saharan Africa lack adequate spatial frameworks to enable sustainable urbanization. Therefore, the spatial development of these cities has been slow since rural-urban migration has fueled poorly planned expansions and the proliferation of slums. Moreover, it is stated that the failure of services or infrastructure in secondary cities significantly impacts the communities around them: rural and urban centers (Githira, Wakibi, Njuguna, Rae, Wandera, Ndirangu, J.,., 2020; Perry et al., 2020). These cities lack the data and information relevant to developing national policies and planning urban spaces (Perry et al., 2020).

Thus, Cote and King (2017) argued there is a need to build resilience in secondary cities, particularly spatial resilience, to achieve national and local development objectives since these cities serve as a bridge between rural areas and large cities as traditional and industrialized economies.

In their work, Brunetta and Caldarice (2019) elaborated on spatial resilience approaches and how they engage in coordinated measures to adapt to and mitigate potential disasters in secondary cities. The framework also negotiates social and economic goals, considers conflicting interests, and considers sustainability targets and objectives.

2.4.2. Relevance of Spatial Planning in creating spatially resilient secondary cities

According to Shaw et al. (1995), the earlier definition of spatial planning is attributed to the territorial expressions made to socio-economic, cultural, and ecological legal frameworks governing communities. It further refers to the approaches widely applied by governments and institutions to affect the future distribution of land use functions in a physical space.

It is an important tool that brings economic, social, and environmental welfare by establishing more constant and foreseeable circumstances for investment and development, safeguarding the developmental benefits of communities, and promoting the wise use of land and natural resources for development. It is, thus, a vital instrument for promoting sustainable development and enhancing the quality of life (Stead and Nadin, 2008; Taşan-Kok et al., 2013).

Furthermore, Sutanta et al. (2010) connoted that it is considered one of the most effective tools for integrating urban risks, stresses, shocks, and uncertainties. It affects the long-term use of space by properly allocating land uses through identifying past, present, and future hazard scenarios that can be mitigated or adapted. Fleischhauer (2008) discussed that spatial planning follows a multi-hazards approach because it may threaten a locality or a single urban space. Thus, Fleischhaur (2008); Sutanta et al. (2010) noted the need to formulate coordinated policy documents dealing with urban hazards.

It has been claimed that the legal documents should spell out organizational and technical procedures for integrating urban uncertainties through spatial planning strategies at various scales: national, regional, and local (Fleischhaur, 2008; MoUDH, 2016b; Sutanta et al., 2010).

Concerning their application, Sutanta et al. (2010) claimed that national and regional spatial planning provides strategic directions on urban land use at wider territorial coverage with few operational plans. On the other hand, the local levels of spatial planning are more attached to operational and implementation levels at an urban or city level. These authors claimed that spatial planning influences the development of resilient cities by avoiding development in specific areas, providing differentiated land-use decisions, making the spatial plan a legally binding document, and providing options for adjusting to potential hazards.

Therefore, embracing these frameworks in policies and graphical representations and easing the practical implementation of spatial plans can create resilient and sustainable cities (Fleischhaur, 2008).

2.4.3. Discourses, Dimensions, and Applications of Urban Resilience

2.4.3.1. Discourses of urban resilience

The conceptualization of resilience has already been applied to multiple contexts. Due to its multidisciplinary nature, it does not constitute one discourse; rather, depending on the object and level of analyses, the resilience concept is decomposed into many different but still linked discussions with their dominating paradigms (Rogov and Rozenblat, 2018).

In this vein, Meriläinen (2019) extended the functional decomposition of the rhetoric into rural and urban settings. The author indicated that the inhabitants of cities and towns significantly depend on collectively systematized infrastructures.

With due attention to case-specific matters, in the light of local impacts in urban centers, Rogov and Rozenblat (2018) further break down the issues like natural disasters, internal effects of climate change, the resilience of communication networks inside a city, urban systems, resilience planning, among others. Nelson et al. (2007); Redman (2014) decomposed the concept to encompass vulnerability, transformation, and adaptability.

2.4.3.2. Dimensions and application of urban resilience

Habitat (2015) disclosed that individual or multiple urban systems are susceptible to internal and external shocks and disturbances. The document enlisted economic recession, social turmoil, diseases, or poor governance to formulate and succeed flaws in the urban systems as the disruptions that affected the resilience of urban areas.

The same document provided that urban systems can be understood across: functional (e.g., municipal revenue generation), organizational (e.g., governance and leadership), physical (e.g., infrastructure), and spatial (e.g., urban plans and designs) scales. Regarding the dimensions of urban resilience mentioned above, Tabibian and Rezapour (2016) argued that the resilience of urban areas depends on the resilience parameters (Figure 2:2).

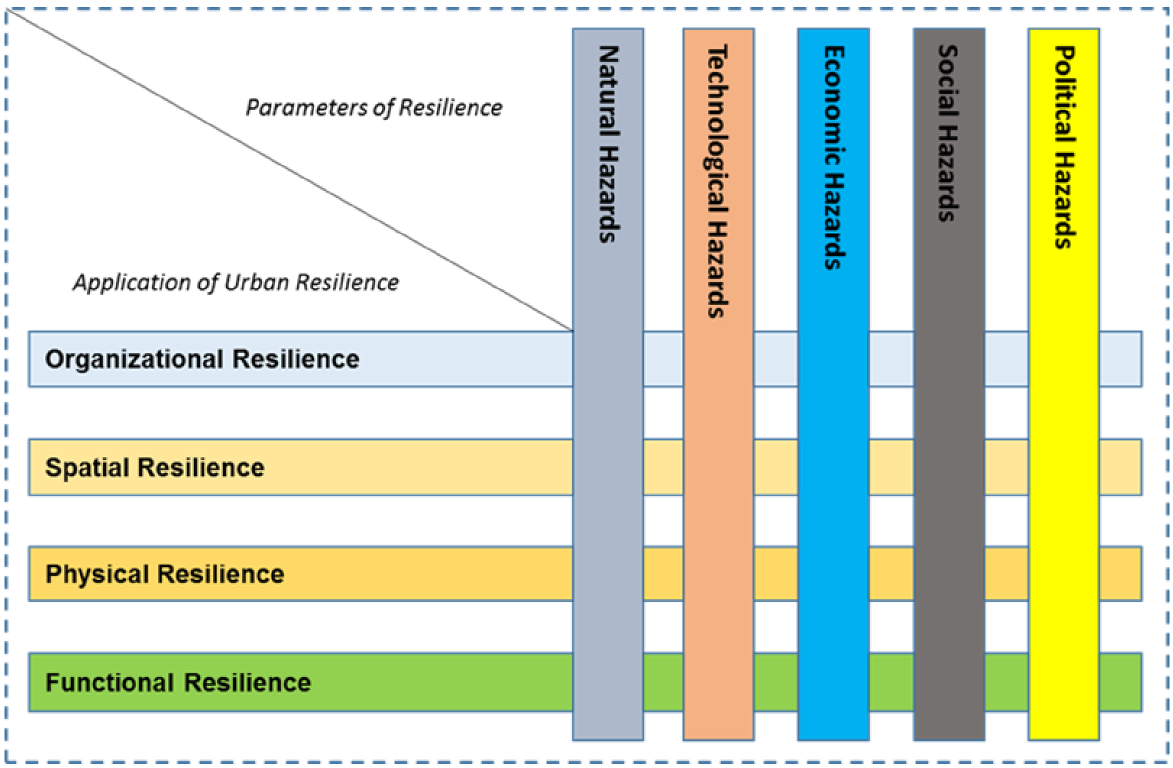

Figure 2:2 Matrix showing urban resilience attributes against parameters of resilience
Source: Habitat (2015)

Based on Figure 2:2, the efforts toward making cities resilient rely on the integrated approach of considering each part holistically rather than dwelling on one in isolation.

Lorenzo and Marta (2012) discussed that the application of the concept of urban resilience should be viewed in the setting of risk and vulnerability assessments, institutional and social governance structures, and resilience in (or of) different sectors (e.g., ecosystems, economy, and transformations of urban areas.

Island Press and The Kresge Foundation (2013) attributed the positive, negative, and neutral; short and long-term possible city disruptions will substantially affect prevailing urban systems to resilience to 'what' in cities.

2.4.4. Institutional collaboration and DRR communication systems

Institutional capacity for urban development is one of the entry points for enhancing the resilience of cities in the global south, underpinning the need for close collaboration among stakeholders with diverse perspectives (Bahadur et al., 2016). It is one of the major elements of resilience-oriented urban planning guided by adaptive strategies (Yamagata and Sharifi, 2018). In this context, Iturriza et al. (2020) contributed that collaboration will enhance understanding and engagement, as participation with other stakeholders will increase knowledge and activities to address urban disasters.

Baas et al. (2008) summarized collaboration as vertical and horizontal. Vertical coordination is made across governmental or organizational levels, i.e.national, regional, and local, while horizontal coordination is collaboration within the same government tiers or socio-economic layers (Chabay, 2011). Besides these, collaboration with local authorities such as government, non-government organizations/NGOs/, and community-based organizations engaged in urban development is needed to enhance urban communities' resilience (Islam et al., 2013; Izumi and Shaw, 2012).

Islam et al. (2013) noted that information sharing is critical in collaborative planning for DRR. Therefore, appropriate communication strategies facilitate collaboration between actors with different interests and backgrounds (Yamagata and Sharifi, 2018). Shome (2019) indicated three phases of communication systems to collaboration, including pre, during, and post-disaster reduction (Table 2:2).

Table 2:2 Phases of disaster communication systems

No	Phases of disaster	Communication system
1	Pre-disaster Risk	Early Warning System (Signals) Mapping of Vulnerable Area and Showing Probable Impacts Community-based Approaches
2	During-disaster Risk	Effective Role of Emergency Operation Center (EOC) Community Approaches
3	Post-Disaster Risk Communication System	Event Mapping and Hazard mapping Diffusing the results of the Post-Disaster Review

Source: Shome (2019)

Nevertheless, the study considered hazard mapping and community-based approaches, falling across the three phases of disaster communication systems.

- **Hazard mapping**

The Copernicus Emergency Management Service (2013) indicated the definitions and scopes of pre and post-hazard mapping. The pre-disaster map provides thematic information to help plan for contingencies in vulnerable areas. On the other hand, Post-disaster information contributes to reconstruction planning and progress monitoring post-disaster activities.

- **Community-based approaches/CBA/**

Top-down management has failed to address the needs of vulnerable people in disaster management, leading to applying a different approach, involving the people themselves in mitigation planning and implementation (Yodmani, 2001). In this context, Rahman (2018) argued that the 2015 Sendai Framework for Disaster Risk Reduction acknowledged the active role of local communities in disaster management. Sobian (2016) concluded that the framework showed the setting for local communities, including participation, information management and exchange, education and training, and public awareness.

The conceptual framework also connects the conceptual foundation of the paper, linking the disaster categories and policy initiatives (forming the basis for resilience principles and their application) to the study's theoretical frameworks against the thesis's core objectives. The framework has defined the study's variables, mapped out how they related to each other, and illustrated the study's expected output. Figure 2:3 shows the thesis's conceptual framework, denoting the links among the spatial factors of resilience, urban challenges, and policy dimensions.

2.4.5. Conceptual framework of the study

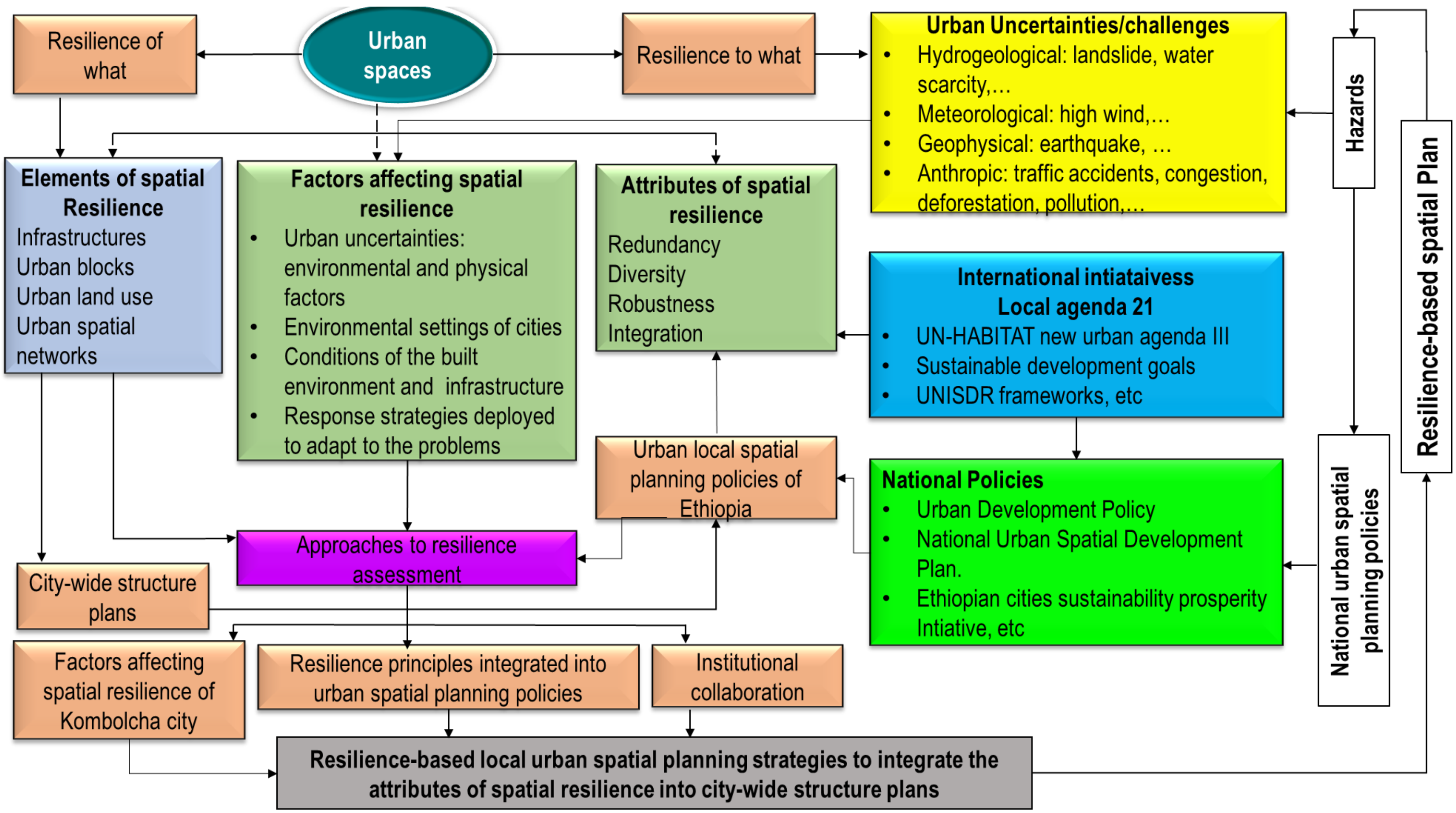

Figure 2:3 Conceptual framework of the study
Source: computed by the author (2022)

2.5. Contextual reviews

2.5.1. Urbanization and Urban centers in Ethiopia

Urbanization is highly recognized as one of the significant concerns of the 21st century. In 2016 the UN estimated that more than half of the world's population lived in towns and cities, which is expected to grow to 75% by 2050 (UN 2014). It is also noted that most urban growth is expected to concentrate in Africa and Asia (Awumbila, 2017; G/Egziabher, 2010). Figure 2:4 shows the urban population of various regions in the world.

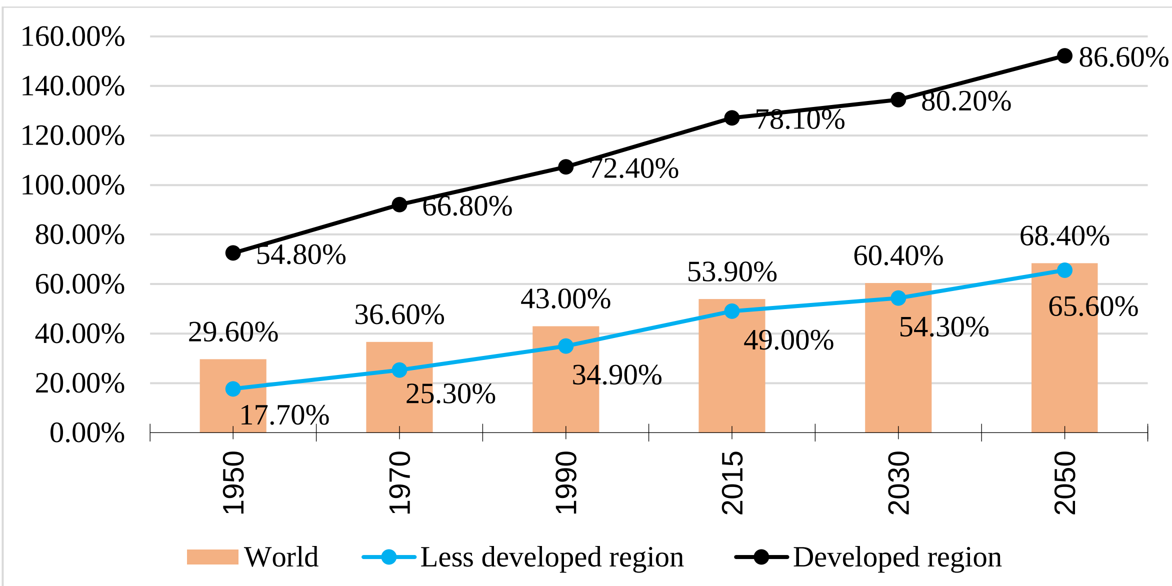

Figure 2:4 Urban Population as a proportion of the total population
Source: G/Egziabher (2010).

Regarding the situation in Africa, Njoh (2003) stated that the population growth is shifting from rural to urban despite the region remaining the least urbanized in the world. North Africa has a greater percentage of urban population (47.8%) than Sub-Saharan Africa (SSA) (32.8%) (G/Egziabher, 2010).

Boadi et al. (2005) reveal that SSA countries have an unprecedented level of urbanization with an average rate of 37%. The region has the highest rate of urbanization, i.e., 4.1% per annum, compared with a global rate of 2.0 % (Saghir and Santoro, 2018). Accordingly, the level of urbanization in SSA is anticipated to reach 60% by 2050 (G/Egziabher, 2010).

The same author further indicated that Ethiopia has a very small urban population. The 2014 UN (2014) report showed that the country is one of the sixteen countries globally with low levels of urbanization below 20%, owing to an estimated 16.0% of its inhabitants living in cities and towns (Figure 2:5). However, the figure was estimated to show a significant increment in 2021, reaching 21.70% (UN, 2018).

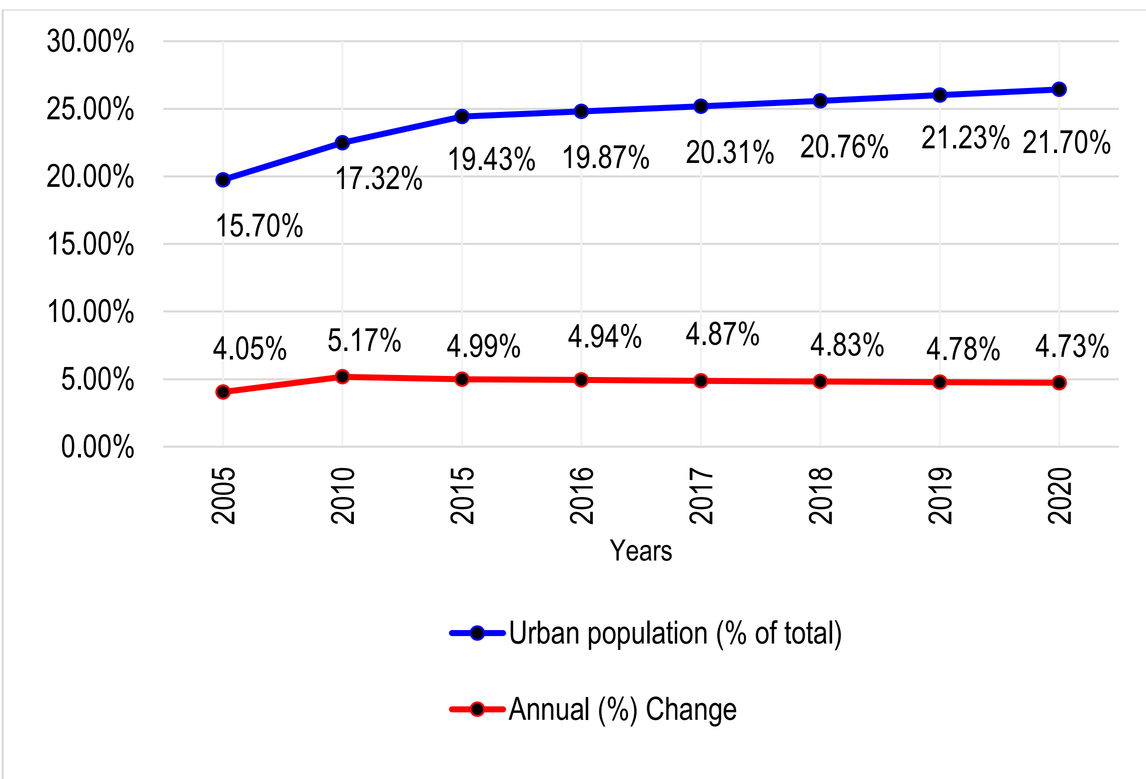

Figure 2:5 Urban Population proportion in Ethiopia (2005 – 2020)
Source: UN (2018)

According to the UN (2018), the Ethiopian urban population for 2020 was 24,941,349, a 4.85% increase from 2019. This trend shows that Ethiopia has the fastest urbanization rate, and its average urban growth rate for 2005 – 2020 is 4.83% which is higher than the average for SSA (3.95%) (Golini, 2001).

Consequently, MoUDH's (2015c) projections revealed that the proportion of the urban population in the country will reach 27 to 30% of the total population by 2025, and it is expected to be 40% by 2037.

The primate city of Addis Ababa characterizes urban centers in the country. However, few cities have populations ranging from 100,000 to 500,000, and many small towns with less than 5,000 inhabitants. The growth rate of secondary cities and small urban centers has recently increased in Ethiopia, as depicted in Tesfaunegn (2017).

2.5.2. Resilience-based policies in Ethiopia

Policy discourses commending resilience in urban Ethiopia are decisively not deep-rooted. The policy documents do not initiate the needs and priorities to build resilience in rural or urban contexts (MoUDH, 2017). However, the Ethiopian government has formulated and implemented policies and strategies to deal with resilience thinking in general. The most notable documents in this regard include National Policy and Strategy for Disaster Prevention and Management (NPSDPM), Climate Resilient Green Economy (CRGE) strategy, draft urban climate resilience strategy (UCRS), and Growth and Transformation Plans (GTP).

The NPSDPM, conceived in 1995, is the Ethiopian government's first step in showing its political will to integrate risk reduction concepts into development programs (Ponserre, 2004; Powrie, 2012). Based on this provision, various sectoral policy documents on resilience have been endorsed since then. The most prominent ones include but are not limited to Agricultural Policy, Health Policy, Environmental Policy, and Water Resources Policy (FDRE, 2013).

One of the good practices that linked environmental management or developments with risk reduction in Ethiopia is the environmental policy formulated in 1997 (Ponserre, 2004). The policy is designed to reduce disaster risk, and development measures are planned to protect and rehabilitate the environment.

CRGE strategy, formulated in 2011, is the next policy document with high significance to resilience. It aims to build a green economy based on four development pillars: agriculture, forestry, power, and transport (FDRE, 2011). This document's prime focus was climate change and its disasters.

Urban areas were the centers of the strategy document where carbon emissions and their abatement mechanism from industries, infrastructures, transport, buildings, and the management of wastes have been remarkably elaborated.

With the aspiration to realize the green economy strategy and take the responsibility vested on it to implement provisions of NPSDPM (FDRE, 2013) in urban contexts and realize the purveys of CRGE, the MoUHC formulated a draft UCRS in 2017.

The aim of the strategy is three-fold: To identify the economic and social impacts of current climate variability and future climate change on urban development and housing in Ethiopia; To identify priority ways for the urban development and housing sectors to build climate resilience and reduce the impact of climate variability and climate change; and To map the necessary steps to finance and implement measures in the urban development and housing sectors to build climate resilience in Ethiopia and deliver an integrated CRGE in urban areas (MoUDH, 2017).

The government of Ethiopia has shifted its policy formulation into a five-year comprehensive development plan called GTP and developed GTP one and two from 2010-2015 and 2015-2020, respectively. This action aims to internalize and act on Millennium Development Goals /MDG/ and the Hyogo action framework for Disaster Risk Reduction. The GTP is expected to take account of new paradigms and contemporary development pressures (MoUDH, 2015b).

The second GTP document was endorsed and implemented by considering the various proposals, actions, and initiatives introduced by Habitat III urban agenda, SDG, and Sendai frameworks for disaster reduction, which remain in action from 2015 to 2030 (Tesfaunegn, 2017).

Recently, the government of Ethiopia endorsed a ten-year development perspective plan in 2021, valid from 2021 to 2030. It has deliberated on how to achieve resilience and has provisions on the urban development and issues that affect the resilience of cities in Ethiopia (FDRE, 2021).

2.5.3. Spatial planning and resilience in Ethiopia

2.5.3.1. Urban Planning Systems (Spatial Planning frameworks) in Ethiopia

Ethiopia has a long history of urban planning, including making local spatial plans. However, the recent urban planning framework was founded on enforcing the Urban Development Policy/NUDP/ in 2005 (MoUDH, 2015b).

The plan's main features are strengthening rural-urban linkages, inter-urban linkages, and the integration of development and land use plans. These aspects of the planning system were the major direction set in the urban planning law enacted in 2008 (MoFA, 2008). However, its mere implementation should be supported by preparing detailed plans. The 2008 UPP has defined 'urban' in the context of Ethiopia as:

"*any locality with an established municipality or having a population size of 2000 or above inhabitants of which 50% of its labor force is primarily engaged in non-agricultural activities*." (FDRE, 2008).

According to MoUDH (2015b), this definition has widened Ethiopia's urban planning scope. Thus, it is reiterated that Proclamation No. 574/2008 was enforced to establish a legal framework to promote planned and well-developed urban centers in the country. The proclamation was endorsed per the provisions of the UDP (FDRE, 2008).

Hence, the most prominent aspect of the proclamation is setting the hierarchy of plans in Ethiopia: National urban development scheme, Regional urban development plan, and Urban plans (FDRE, 2008; MoUDH, 2015b). However, this proclamation has been revised. The draft was prepared in 2016 with changes to the hierarchy of urban plans: National Urban Development Spatial Plan/NUDSP/; Regional Urban Development Spatial Plan/RUDSP/ and Urban Plan/UP/. In both cases, the 2008 and 2016 proclamations, urban plans are taken as necessary aspects of urban development in all towns and cities of the country.

According to the draft proclamation, the country's national spatial development framework is set by NUDSP. This first level in urban planning systems portrays the country's urban systems and major development corridors. The plan serves to study regional urban development spatial plans and local urban plans.

The second hierarchy of plans, the regional development framework, considers regional resource potentials and development programs to integrate urban centers with the national and regional contexts

(MoUDH, 2016b). The third hierarchy discussed is urban plans with various forms and applications. It is followed by detailed plans (FDRE, 2008; MoUDH, 2016b).

The 2016 draft UPP identified four types and forms of urban plans: city-wide structure plans, strategic plans, basic plans, and sketch plans (Figure 2:6). The difference among these plans lies in their application, which depends on cities' spatial extent and population size. It is further depicted that all these urban plans should be prepared to guide the spatial development of urban centers in Ethiopia.

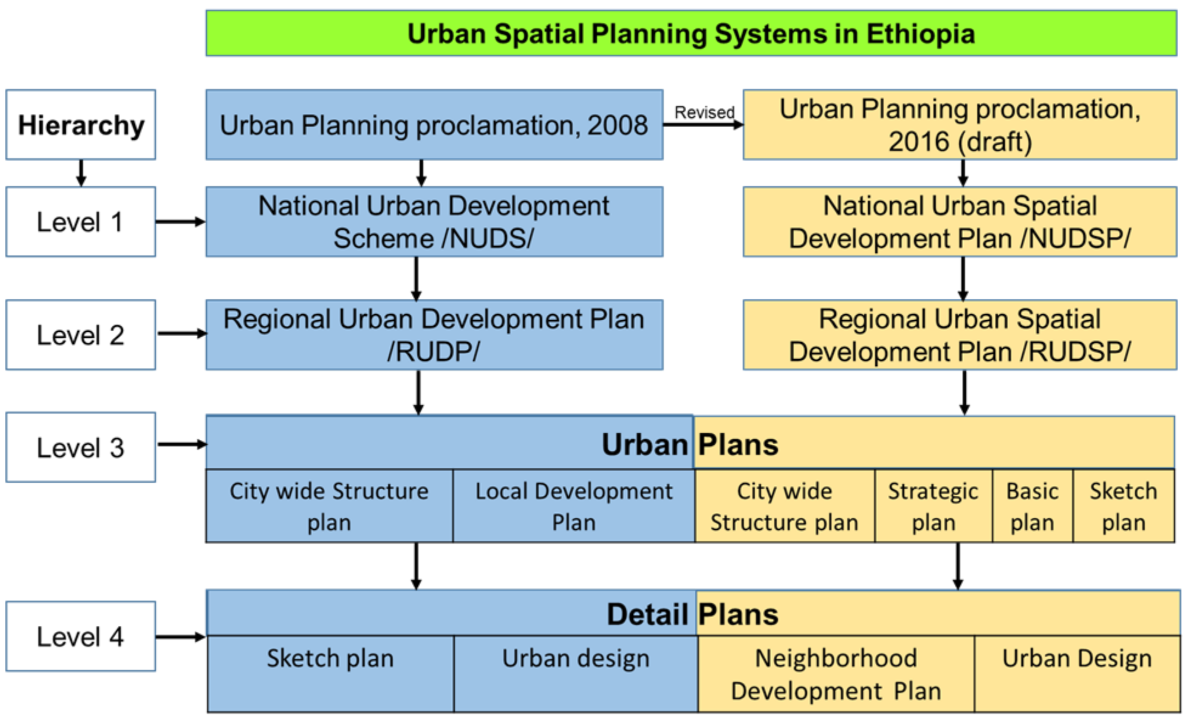

Figure 2:6 Urban spatial planning frameworks in Ethiopia
Source: FDRE (2008); MoUDH (2016b); (2015d); (2012)

The structure plan is a long-term plan, for up to 10 years, used at the city level for metropolis, regiopolis, and category one cities (FDRE, 2008; MoFA, 2005; MoUDH, 2016b, 2016a). It is depicted in both proclamations that the preparation of any urban plans should be conducted according to standards set on SPM (FDRE, 2008; MoUDH, 2016b). To this end, the MoUDH has developed manuals to guide the preparation and implementation of structure plans, local development plans, and urban design (MoUDH, 2015b).

2.5.3.2. Challenges of urban spatial planning, development, and resilience in Ethiopian

Cities employ urban planning as a basic tool to ensure orderly and proactive development of various land uses and infrastructure, including roads and public spaces. Although most Ethiopian cities have city-wide SPs, significant development still occurs outside the scope of planning. Such developments have resulted in the costly demolition of informally constructed structures and the reactive infrastructure provision, highlighting the need to integrate urban planning and land management processes (MoUDH and Ethiopian Civil Service University (ECSU), 2015).

Concerning the situation in Ethiopia, the UPPIS stipulates that 30% of built-up areas of cities should be allocated for public spaces (MoUDH, 2014). Nevertheless, cities are deficient in public spaces resulting from under-enforcement of plans due to a lack of a strong sense of ownership by the community and the local leadership to spearhead their development and upkeep.

The re-planning of cities requires utmost attention, given their crucial importance in national economic transformation. The timely revision and updating of city-wide plans are generally constrained by the limited capacity of urban planning institutes under the purview of regional governments and the absence of up-to-date base maps (MoUDH, 2012).

Further to these urban planning and development constraints, the following are pertinent challenges that contributed a lot:

- Lack of tools that support the urbanization process in the country
- Inconsistent establishment of plan-making bodies
  - No federal-level planning body to lead urban change
  - Absence of adequate urban infrastructure and services
  - Federal structure vs. regional organogram
  - Varied city grading systems applied
  - Limited coordination and integration among sectoral bodies

However, the UCRS of the country and state of Ethiopian cities report reported uncontrolled urban expansion, settlements in ecologically sensitive areas, population Density, Informal settlements, resource depletion, and poor and non-inclusive urban governance as the major challenges with significant contribution to the non-resilience of urban centers in Ethiopia (MoUDH, 2017; MoUDH and Ethiopian Civil Service University /ECSU/, 2015).

2.6. Effects of Internal war on the spatial resilience of Kmbolcha city

This part of the contextual review dealt with the effect of the recent war on the spatial resilience of Kombolcha city, which started between the FDRE and the Tigray Peoples Liberation Front (TPLF on November 04, 2020. The war has caused severe human suffering and fatalities in various parts, including urban centers, such as the Kombolcha city of the Amhara and Afar regions.

Consequently, numerous urban properties and infrastructures were damaged in the city. The TPLF stayed in Kombolcha for thirty-five days from October 31 until December 6, 2021 (Fana Broadcasting Corporation, 2021).

The local news agencies: Walta, Fana, Ethiopian Broadcasting Corporation/EBC/, South Wollo Zone Communication Office/SWZCO/ unveiled that mass graves were found on the premises of Kombolcha Technic College (Fana Broadcasting Corporation, 2021; SWZCO, 2021; Walta Information Center, 2021).

Figure 2:7 TPLF's destruction resulted in litter in the city of Kombolcha
Source: SWZCO (2021)

Besides this, buildings were fully or partially destroyed (Figure 2:7) due to the war and the brutal act of the rebels. The report released by Fana Broadcasting Corporation on December 14, 2021, exposed that the TPLF group plundered many products and inputs and destroyed machinery in factories in the industrial town.

Concerning the effect of the TPILF's occupation on the spatial resilience of the city, the chemicals stored for use to produce clothes, apparel, and textiles by the Xuaxu textile factory were deliberately discharged, causing massive soil and air pollution with devastating effects on the health of communities living near the factory (Fana Broadcasting Corporation, 2021).

Furthermore, the city manager claimed that the devastation of electric lines was among the infrastructures destroyed by TPLF. The manager reiterated that the group vandalized and looted urban properties, and the city was filled with litter, magnifying the urban problems' spatial effect. However, the destruction of urban roads, bridges, buildings, and forests is not magnified, and the spatial resilience of the city is not noticeably affected compared to the status quo.

2.7. State of the art of urban local spatial resilience

Rapid population growth and unplanned urban growth can exacerbate urban sprawl, resulting in negative economic, social, and environmental effects. Consequently, cities have increased vulnerability to disasters due to urbanization. The impacts, in this context, include a greater disruption of natural resources and the ever-increasing demand for infrastructure (Chakraborty et al., 2019).

Based on Coaffee and Lee (2016; Meerow et al. (2016), the increasing era of environmental hazards, urbanization, and rising population have pushed planners and policymakers to aspire to build resilient urban centers.

A descriptive concept, resilience, was first introduced in 1973 by Holling (Brand and Jax, 2007). Resilience influenced scientific publications on the environment, sociology, and engineering. Consequently, more than 2,300 scholarly contributions or articles were published until October 2018 associated only with the three disciplines (Brunetta and Caldarice, 2020).

Urban resilience, on the other hand, has physical/environmental, economic, social, and institutional dimensions (enabling environments and organizational settings) (Ostadtaghizadeh et al., 2015; Ribeiro and Gonçalves, 2019; Sharifi et al., 2017; Sharifi and Yamagata, 2016). Forster et al. (2015); Jamshed et al. (2020) added that linkages of various types, including urban-urban and urban-rural, are explained through economic, environmental, social, spatial patterns, and transport, which are the other dimensions that can affect cities' spatial resilience.

In line with this, studying the hazards and their spatial contexts explained through scales and system boundaries was also the focus of previous studies. Urban spatial scales are compartmentalized at national, regional, local, and neighborhood levels (Sharifi et al., 2017).

Concerning systems, Brunetta and Caldarice (2020) depicted that resilient systems, in general, are territorial systems that are flexible and adaptable to uncertainties while maintaining a co-evolutionary perspective. Real properties, landscape, and ecology are among the major concerns of spatial resilience (Assumma et al., 2021).

However, Kärrholm et al. (2014) contended that spatial resilience entered into the scientific discourses two and half decades ago in 2001 with contributions by Nyström and Folke (2001) in an article entitled "Spatial resilience and coral reefs." According to these authors, spatial resilience focuses on dynamic interaction and interdependence among systems.

As Brunetta and Caldarice (2020) explained concerning urban centers, spatial resilience emphasizes the importance of systemic characteristics such as flexibility, redundancy, responsiveness, reliability, capacity to learn, and interaction between multiple sectors. Yamagata and Sharifi (2018) uttered that these features enable the urban system to be flexible in response to changes and retain its advantage. According to Ribeiro and Gonçalves (2019), these characteristics are important to understanding the factors and indicators characterizing and evaluating spatial resilience.

Gharai et al. (2018) developed key indicators and measures based on a literature review on adaptability, livelihoods and viability, diversity and connectivity, and institutional structure attributes of spatial resilience. With the specific application of the principles, Schouten et al. (2012) discovered applying the qualities to review policies and serve as a criterion in evaluating resilience in planning (structure plans, master plans, development plans) (Pinho et al., 2013).

The more recent state of the research concerning spatial resilience is attached to the scholarly contributions by Lu et al. (2021). These authors developed the theoretical underpinning relevant to the theme and showed the scientific basis and linkage of spatial factors (road networks, urban form, and structures) against the resilience principles. Apart from the criteria, urban challenges, institutional set-up, and recovery plans (adaptation and mitigation) were among the requirements for research on spatial resilience and formed the main emphasis of such study (Brunetta and Caldarice, 2020).

2.8. Methodological review

2.8.1. Urban Resilience Assessment frameworks: A comparison

Sharifi and Yamagata (2014) claimed that evaluating the magnitude, frequency, and extent of urban resilience should develop assessment tools and methodologies that effectively integrate resiliency-related concerns into the urban planning processes.

Scholars have crafted various methods to frame or assess resilience (Alsaqqaf and Zhang, 2011). Their emphasis varies considerably from a comprehensive analysis of urban systems to taking notes on man-made infrastructure, the natural environment, governance, and social attributes of urban areas.

According to Foster (2006), as cited in (Lu and Stead, 2013), two terms govern the assessment of urban resilience: preparation and performance resilience. The capability to assess and be ready for potential disturbances is the concern of the preparation stage; performance resilience, on the other hand, denotes coping mechanisms once a disruption of a system is observed. The preparation stage is the most important resilience assessment framework in spatial planning. These scholars have indicated the basic urban resilience characteristics that need to be addressed by planning systems, as depicted in Table 2:3.

Table 2:3 An assessable framework of resilience-oriented planning decision-making

No	Resilience characteristics addressed by a planning system	Measures/indicators
1	Attention to the current situation	Monitor current conditions: the ability to understand and maintain the existing conditions of the environment. It addresses the physical facilities and monitoring and evaluation of policy. *The connectedness and resource potentials of cities and their hinterland
2	Attention to trends and future threats	• Predict regional trends and patterns • Identify and assess the probability of risks and disturbances.
3	Ability to learn from previous experience	Learn from past lessons and use the required knowledge to cope with related circumstances in the upcoming event.
4	Ability to set goals	Set up 'priorities' based on risk assessments and probabilities. The most important aspect in this regard is to reply to the issues of alterations and visioning maneuvers, including multi-sectoral collaboration to craft the goals.

5	Ability to initiate actions	• Invest in and develop scientific scenarios for risk assessments • Collaborate decision-making between different levels of governance
6	Ability to involve public responses	Communicate findings (concepts, skills, actions) in planning policy. This part of the characteristics involves the level of participation in policy-making in terms of providing information and obtaining answers to resilience matters by the public.

*Source: Lu and Stead (2013) and * Zhongming et al. (2012)*

According to Sharifi (2016), an effective assessment tool should broadly address: multiple dimensions of spatial resilience, consider the associations between diverse spatial scales, be capable of measuring changes across temporal scales, cultivate suitable measures for capturing uncertainties, be established and realized in collaboration with stakeholders, and lead to the development of action plans for improving resilience. It is further noted by Mägdefrau (2016) that the assessment should be based on a comprehensive participation process that incorporates the stakeholders' various perceptions and understandings of risk or hazard.

Hence, Sharifi (2016) revealed that urban resilience measurement and assessment tools should offer an amalgamated framework for integrating various resilience dimensions and aspects into the assessment process.

2.8.2. Assessments of urban spatial resilience

The urban hazard assessment determines the planning and implementation of risk prevention and mitigation measures through suitable response and recovery measures following a disaster (UNDP, 2010). The approach is the first step in operationalizing and measuring resilience (Mitchell and Harris, 2012). Berkes (2007); Obrist et al. (2010) found that the risk and resilience approach comprehensively assesses systems and the interactions, from neighborhood plots to regional and national levels.

A growing body of research suggests that resilience can be measured through qualitative and quantitative methods, participatory assessments, statistical analyses, models, and metrics (Allen et al., 2016). Measurements are, however, subject to conceptual and methodological limitations, that is, knowing what to measure and obtaining the correct data (Brunetta et al., 2021). According to Adger (2006); Allen et al. (2016); Cutter et al. (2008), resilience assessment considers the context and disruptions occurring in a city.

Nevertheless, identifying the 'of what' and 'to what' of resilience is the precondition for measuring resilience (Carpenter et al., 2001). The 'of what' concerns of resilience are tied to place-specific or answer the 'where' question with two primary conditions: a system's spatial extents and the ranking, scoring, or prioritization of some areas' resilience (Figure 2:8).

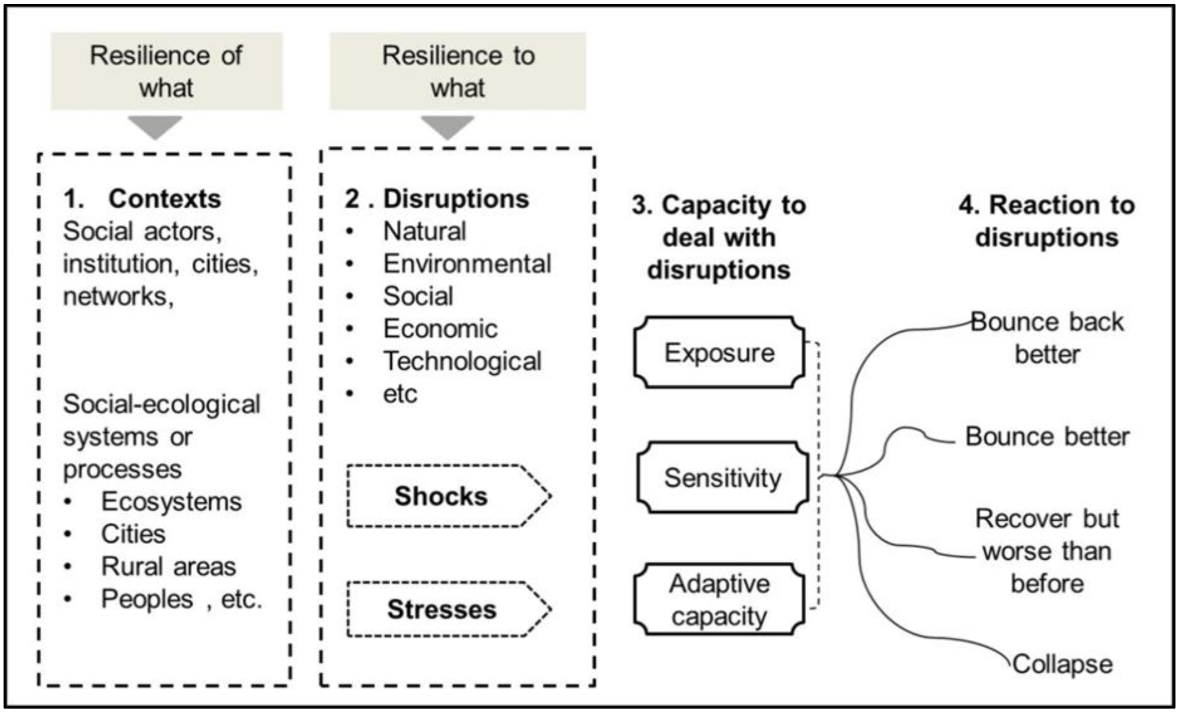

Figure 2:8 The elements of a resilience framework
Source: Crown (2011)

In support of this, the Asian Development Bank (2013) elaborated that risk assessment measures the vulnerability of human beings, properties, and infrastructure to various disturbances to which urban areas are exposed. On the other hand, the 'to what' concern is attributed to the disturbances expected in an urban system to be resilient (Crown, 2011; Meerow and Newell, 2018).

Two resilience assessment methods dominate the scholarly literature: the objective approach, imposed by experts, and the subjective approach, based on individuals' experiences with hazards. The approaches can be used separately or jointly (Jones, 2018; Jones, 2019; Jones and Tanner, 2017).

The two measurements are interrelated in describing and measuring resilience (Jones, 2019). Nevertheless, subjective approaches differ from objective approaches in epistemological understanding (Jones, 2018). It is a bottom-up approach to resilience and is best applied in contexts where individuals understand localized risks (Jones, 2019).

Moreover, recent literature alluded to the increasing interest in studying the impacts of urban risks concerning spatial resilience through subjective assessments (Allen et al., 2016).

Hazard analysis takes many forms in an urban setting. Accordingly, Asadzadeh et al. (2015) used factor analysis and AHP to develop disaster resilience indicators. RIMA (2016) also demonstrated the application of factor analysis. The study also noted the importance of correlation among the variables to rank.

Secondary data, field observations, and other datasets collected through community or qualitative data helped validate decisions in both studies Asadzadeh et al. (2015) and (RIMA (2016).

2.8.3. Approaches to resilience-oriented urban policy review

According to Lee et al. (2010), a review is a form of academic writing that defines and analytically evaluates the content, quality, meaning, and importance of books, newspapers, and magazines. On the other hand, evaluation is the collection, analysis, and interpretation of information about something as part of a recognized process of judging its effectiveness, efficiency, and outcomes based on predefined and appropriate criteria (Carter, 1994; Crompton, 1996).

In line with this, Hardin (2009) suggested that policy evaluation is a means to decide the significance and execution of policy objectives or narratives, development efficiency, effectiveness, and targeting of long-term achievements. Iglesias and Buono (2009) indicated that it may consist of a systematic and objective assessment of the policy and ought to provide reliable and valuable information, incorporating key takeaways learned into the community's future decision-making process by the government.

However, Folke et al. (2002); Godschalk (2003); Roberts (2006) claimed that any resilience-oriented policy evaluation might be conducted by applying certain evaluation criteria which define the characteristics found in a complex, resilient system such as cities.

Accordingly, Walker and Salt (2006) named nine qualities of resilience that ought to be considered while undertaking resilience-based policy evaluation. The criteria developed by these authors included diversity, variability, modularity, acknowledging slow variables, tight feedback, social capital, innovation, overlap in governance, and ecosystem services.

Schouten et al. (2012) asserted that these criteria could be applied to rural and urban settings, which constitute the major aspects of socio-ecological systems. However, in the urban context, resilience-oriented policy evaluation can be carried out by employing: reflectiveness, resourcefulness, robustness, redundancy, flexibility, inclusivity, and integration parameters of resilience (Arup, 2014; Bevilacqua et al., 2019; Figueiredo et al., 2018). These criteria are often referred to as principles by (Wardekker, 2018), whereas Meerow and Stults (2016); Sharifi and Yamagata (2014) connote them as characteristics of urban resilience.

An online document entitled 'Cities Resilience Framework (CRF)' published by Rockefeller Foundation in 2014 put the terms as qualities of a resilient urban system (Arup, 2014). Wardekker (2018) attached the practical application of the principles to give decision-makers a clench on how to design solutions/proposals and evaluate options and plans.

Concerning the spatial planning application of the principles, Fleischhaur (2008); Godschalk (2003) indicated, in advance, the use of all or a combination of the principles in policy evaluation, formulation, and urban spatial planning processes and implementation. Formulating the urban planning attributes of spatial resilience has motivated scholars to apply the criteria in various national, regional, rural, and urban resilience-oriented policy evaluations.

For instance, Schouten et al. (2012) applied the nine attributes of resilience developed by Walker and Salt (2006) to evaluate seven European rural development policies, focusing on the Netherlands. The thematic focus of the evaluation was to measure the contribution of the policies toward creating resilient rural areas by focusing primarily on economic dimensions of resilience.

Regarding urban application, three prominent studies have applied various but interrelated criteria to evaluate urban policies with differing thematic motivations. Within the contexts of the developed world, Eraydin and Taşan-Kok (2013) applied 'Recovery' and 'Capital building' as the major criteria to evaluate policies. The evaluation focused on financial, social capital, and legal issues of creating resilient cities. The study was conducted to see whether resilience features are well mainstreamed in rehabilitating old buildings in Oporto, Portugal.

Another study conducted in Greece applied redundancy, modularity, buffering, connectivity, and the existence of legally binding land-use or zoning plans as a guiding feature of the resilient urban system (Angelidou et al., 2018). The key focus of this study was the same as the previous one but applied the realization of resilience characteristics to the coastal city of Thessaloniki. The thematic focus was on urban policies and the physical dimension of resilience.

In developing countries, a salient study was conducted in Ghana, which applied adaptive capacity, inclusiveness/participation, social equity and learning, and spatial planning as the core criteria to evaluate five policy documents (Poku-Boansi and Cobbinah, 2018). The thesis showed the extent to which the policy documents embraced the concepts of urban resilience and the level of understanding of urban planners towards the practical application and endorsement within ten cities in Ghana. The table below shows the summary of these policy reviews.

However, with immense implications for spatial planning, resilience-based policy evaluation, formulation, and planning (urban land use planning) shall embrace the four major characteristics of urban resilience: redundancy, strength, diversity, and collaboration (Fleischhaur, 2008). These resilience principles are considered in this study due to their relevance to spatial resilience and planning. They are discussed in the subsequent section along with the pre-condition set for a review of Ethiopia's local urban spatial planning legal frameworks.

2.8.4. Indicators of spatial resilience

According to Ilmola (2016), operations, structures, planning, and resource are the four urban resilience indicators. The operation component encompasses culture, reaction speed, trust, and experience (or exercises) to disruptive incidents. On the other hand, structure deals with city structures and infrastructures. The planning is attributed to citizens' perception of the environment, the vulnerability of key strategies, and the city's focus (vision/mission). The fourth dimension, the resource, is partitioned into a mix of competencies, redundancy, diversity, and mobility

However, various scholars have widely elaborated and discussed the resilience attributes relevant to urban spatial planning frameworks. According to Lu and Stead (2013), promotion of compact cities models, resilient local urban spatial planning, duplication of critical urban support services, multiple accesses to urban land covers such as green areas, and infrastructures are some concerns of the multiplicity of urban functions and systems as an indicator to spatial resilience of cities.

In this context, Fleischhaur (2008) emphasized redundancy and diversity by diminishing high urban densities and promoting physical structure with multiple nodes. Cruz et al. (2013); Wardekker (2018) discussed that redundancy is associated with systems designed with multiple nodes/areas to ensure that one element's failure does not cause the whole urban system to flop. Based on Anderies (2014), this principle allows spatial systems to withstand disruptions by ensuring continuity through substitutes' availability.

Redundancy is connected to various functions within a system and the mix of groups that prevail in that system (Folke et al., 2002). It constitutes multiple components or nodes against a central node in urban contexts to protect a site-specific against potential threats (Fleischhaur, 2008).

Bevilacqua et al. (2019); Yamagata & Sharifi (2018) asserted that redundancy includes diversity, which implies heterogeneity in public participation and inclusiveness (Gharai et al., 2018). It is further attributed to land use zoning instruments/urban functional zones, the spatial heterogeneousness of main urban elements, resource diversification, and mobilization during hazard events (Wardekker, 2018).

Robustness is another principle relevant to local urban spatial planning. It determines the urban system's ability to survive external shocks (Taşan-Kok et al., 2013). It is a crucial component of spatial planning as it is linked to structural prevention measures as a part of building permissions and secures space availability for protective infrastructures (Fleischhaur, 2008). In line with this, Bevilacqua et al.

(2019) discussed the robustness principle as well as perceived, built, and implemented in physical assets of urban systems that can cope with disturbances without affecting any urban functions.

Robustness includes anticipating and assessing potential failures in urban systems. It is also concerned with the sustainability of physical structures, spacing, pattern and shape, and quality of urban blocks that define the form of cities (Gharai et al., 2018).

The integration principle is associated with a wide array of opportunities and incentives for enhanced participation of stakeholders (Cruz et al., 2013; Fleischhaur, 2008). It is the tendency to which various nodes are directly connected. It further embraces the physical dimension and the relationships between communities and institutions (Fleischhaur, 2008; Taşan-Kok et al., 2013).

The most valid aspect of this resilience attribute includes institutional reforms such as cooperation and integration among institutions, decentralized decision-making systems containing decision-making procedures, and transparency to the local community. It also encompasses sectoral and spatial inter-linkages (Gharai et al., 2018; Sharifi and Yamagata, 2014).

In spatial planning frameworks, redundancy and robustness are about pre-existing situations and are more attached to prevention or preparedness. Diversity lies in both circumstances and shows the preparedness for hazards and their integration into public dialogue processes (Figueiredo et al., 2018). On the other hand, integration is attributed to the concerted efforts of various stakeholders toward building the resilience of urban systems in an integrated and coordinated manner through consultation.

Table 2:4 describes local urban spatial resilience principles and the conditions set to undertake this study based on the characteristics and definitions of the resilience attributes discussed above.

Table 2:4 Description of spatial resilience principles and their pre-conditions used in this study

No	Resilience/principles	Pre-conditions/targets the review is expected to achieve
1	Redundancy	Multiple centers: main center and sub-centers
		Duplication of main-urban support services: reserve areas and protected forests
2	Diversity	Diversity of land use zoning instruments/ Diversity of urban functional zones
		The spatial diversity of main urban elements includes land uses, road networks, and hierarchies.
3	Robustness	Anticipation and assessment of potential failures in urban systems due to disruptions
		Sustainability of physical structures: roads and bridges
		Spacing, pattern, and shape of urban blocks: Promotion of quality urban blocks that define the form of cities
4	Integration	Public participation

Source: Computed by the author (2020)

2.8.5. The factors that affect spatial resilience to urban uncertainties

Cities face increasing challenges and apocalyptic risks, such as climate change, which has increased the popularity of the resilience concept (Carmin et al., 2012). The concept has been positioned as a desirable goal in response to research examining who benefits and loses from resilience regimes (Meerow et al., 2016).

According to Sharifi and Yamagata (2016), urban resilience constitutes five dimensions: materials and environmental resources, built environment and infrastructure, society and well-being, economy, governance, and institution. Razafindrabe et al. (2009) showed physical, social, economic, institutional, and hazard frequency and density as the significant dimensions of resilience concerning the urban disaster.

However, resilience to disaster requires safeguarding the physical integrity of the community, ensuring continuity of economic, business, and administrative operations, and ensuring the community has the resources it needs to survive (Paton and Johnston, 2001).

Regarding physical and environmental dimensions, Razafindrabe et al. (2009) further showed the factors/variables inherently affecting the resilience of cities against urban shocks and stresses: energy, water supply, sanitation, solid waste disposal, internal road network, housing, and land use, and community assets. The authors further determined that the type of urban shocks and disturbances a city is expected to be resilient, which form one pillar of spatial resilience, affects cities' resilience (Brunetta and Caldarice, 2020). The factors influencing spatial resilience further included the severity of urban uncertainties, environmental context, and response pathway.

Four severity ratings of risks: the scholarly works have introduced criteria such as minor, moderate, major, and severe to measure individuals' perceptions. In the environmental context, spatial resilience depends on the ability of an urban system to suggest pioneering bottom-up concepts and practices to be incorporated within consolidated institutional policies of spatial development. The ability to respond is attributed to how a system reacts to urban problems and threats (Benini, 2016).

Finally, the response pathway (coping capacity) indicated the range of possible solutions to the shocks and disturbances of an urban system. This factor considers the stages of intervention, including collapse, conservation, adaptation, and evolution (Brunetta and Caldarice, 2020).

Based on these discussions, this paper considered the following factors affecting the spatial resilience of secondary cities in Ethiopia (Table 2:5).

Table 2:5 Factors affecting spatial resilience considered in this study

Dimensions	**Factors**
Type of urban problems	Type of urban uncertainties: environmental and physical factors affect cities' spatial resilience. The urban problems could include natural(earthquakes, landslides, flooding) and anthropogenic (urban expansion, solid waste management, pollution, infrastructural failure,
	The severity of urban uncertainties: critical, severe, moderate, and minor
Environmental setting of an urban center	Material and resource consumption in the city, particularly forest and energy resources utilization. The biophysical conditions of a city include urban structures and infrastructure.
	Flood occurrence
Physical /Built environment and infrastructure/	Type, condition, and availability of drainage lines
	Availability of solid waste management infrastructures
	Condition of transportation systems: traffic accidents and congestion
Response (coping capacity)	Adaptation measures: planning and biophysical measures

Source: Computed by the author (2020)

2.9. Summary

This dissertation chapter was allocated to literature review: theoretical, conceptual, and contextual reviews. It has also deliberated on the state of the arts and methodological reviews.

The chapter neatly showed the theoretical basis of the study. Accordingly, resilience was first conceived in ecology with disturbances affecting ecosystems with a state of equilibrium, referred to as engineering resilience, emphasizing the physical attributes of the concept. Nevertheless, scientists introduced ecological resilience by highlighting time and criticizing functional determinism in response to ecosystem dynamics. In this theory, systems maintain their structure without being significantly affected by disturbances and, as a result, do not change into a new equilibrium state due to disturbances.

The third wave of resilience theory is SES, which focuses on dynamic non-equilibrium beckoning systems with no stable states. The theory has allowed the concept to enter into the urban discourses through the various dimensions, factors, and attributes of resilience, which framed the theoretical underpinning of the study along with resilience-based international, regional, and national policies.

The conceptual foundation of the study was presented with narrations on the concepts of spatial resilience, spatial planning, and its role in creating a resilient city; the various discourses, dimensions, and applications of urban resilience the conceptual base of the thesis is presented.

Urbanization and urban development in Ethiopia were the major discourses narrated to address the contextual basis of the thesis. Furthermore, this review addressed the relevance of spatial planning in creating a resilient city. Topics on the discourses, dimensions, and applications of spatial resilience were also the conceptual review's concerns, followed by the narrations on the nexus between spatial planning and resilience in Ethiopia. The thesis also highlighted the challenges of urban spatial planning, development, and resilience.

The current levels of researchassociated with the study were duly discussed in this section. The topics covered included urbanization and its challenges concerning disasters and challenges, the emergence of resilience thinking, and its attachment to urban spatial resilience.

The chapter undertook a review of the methodological aspects of the study as revealed through various literature. The section compared various resilience assessment frameworks, depicted urban spatial resilience assessments, showed the approaches to resilience-oriented policy review, and narrated the indicators and factors of spatial resilience.

CHAPTER THREE : RESEARCH METHODS AND MATERIALS

3.1. Introduction

This chapter is about the research methods and materials adopted for this study. It presents mixed research: qualitative and quantitative as the main research approach for the study. The study followed an interpretive paradigm, emphasizing constructivism or multiple realities to explain the subjective experiences of community members to the factors affecting the spatial resilience of secondary cities, exemplified by Kombolcha city.

The section started by describing the study area in its hinterlands and geographic contexts. Besides, methodological issues with research design, sampling techniques, sample size, data types and collection instruments, and analysis tools are discussed in this research section. Data interpretation and presentation also form part of this chapter.

3.2. Secondary cities in Ethiopia

Sub-Saharan Africa/SSA/ is the fastest urbanizing region globally, with a 4.1% annual rate of urbanization compared to the global 2.0% rate. It is part of the world, with significant urban development occurring in secondary cities (Githira, Wakibi, Njuguna, Rae, Wandera, Ndirangu, J.,., 2020). These cities are home to more than 46% of the urban population in SSA (United Nations Department of Economic and Social Affairs, 2016). They have unique features but share commonalities in urban growth, the extent of urban problems, and future opportunities (Perry et al., 2020; Roberts and Hohmann, 2014).

However, the scholarly contribution of Song (2013) indicated the absence of a globally accepted definition of the term ‘secondary cities.’ However, it refers to the next level in the city hierarchy after the primary city. It is contextually defined in terms of the number of inhabitants, geographic extent, and the political, economic, and historical significance of a system of cities lower than the primate cities within a country (Roberts and Hohmann, 2014). These authors further identified secondary cities as sub-national, city clusters, and economic corridors.

The UN-Habitat (1996) defined secondary cities as cities with populations between 100,000 and 500,000 persons. The Ethiopian Urban Good Governance Strategy document (2014) used the same criteria and classified such cities as intermediate urban centers in regional states that are relatively fast-growing in economic activity, population size, and socio-politics. Woldeyes and Bishop (2015) further showed that those cities that participated in Urban Local Growth Development Project /ULGDP/, except Addis Ababa city, are secondary cities. Namely; Adama, Kombolcha, Dessie, Mekelle, Bahir Dar, Gondar, Jimma, Dire Dawa, Hawassa, Harar, Bishoftu, Shashemen, Arba Minch, Dilla, Wolayta Sodo, Adigrat, Axum, and Shire Endasellassie (Figure 3:1).

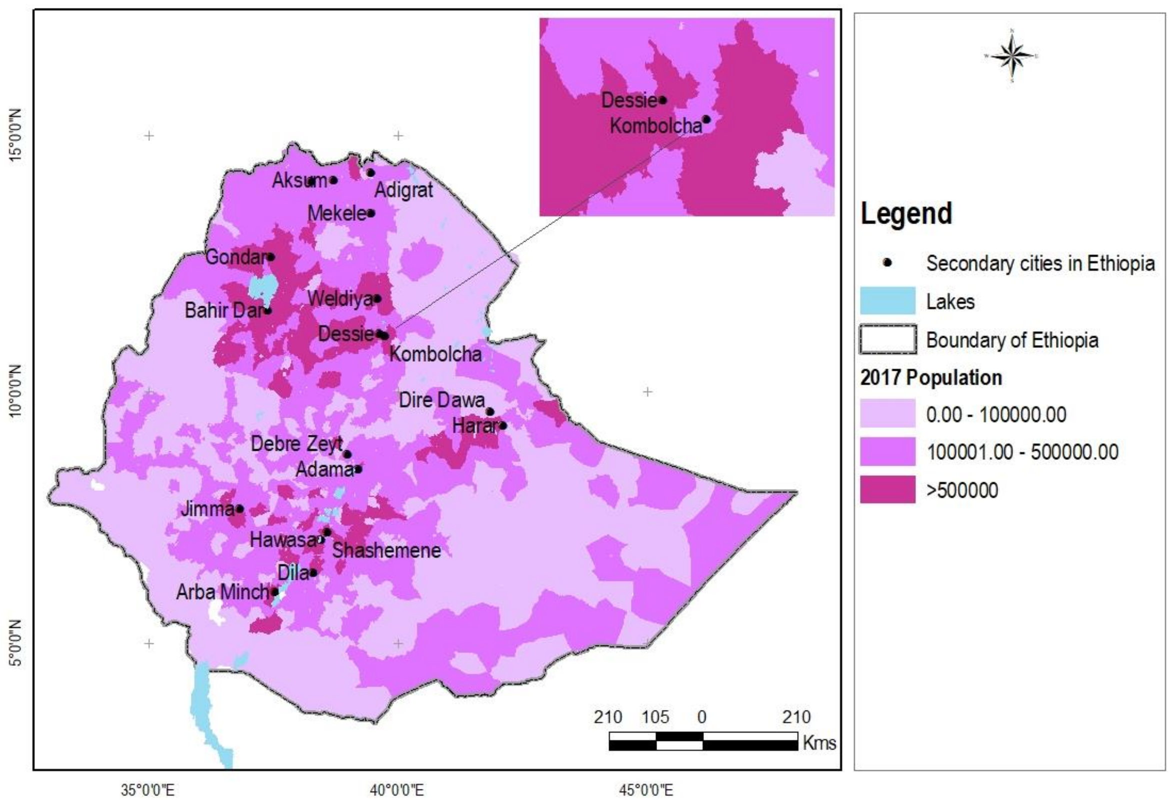

Figure 3:1 2017 Woreda level Population and secondary cities in Ethiopia
Source: OCHA (2022); Water and Land Resource Center/WLRC/, Ethiopia (2018)

According to Horst (2006), these cities are growing even faster than the primate city, Addis Ababa, but with fewer capacities to plan and manage urban development and promote employment and economic growth (Roberts and Hohmann, 2014).

3.3. Description of the study area: Kombolcha city

3.3.1. History and naming

Kombolcha is a roadside town, as are many other Ethiopian towns. Biraro was the name given to it by its first occupant. Kombolcha, on the other hand, is an Oromipha word that literally means thorny tree, referring to its acacia and semi-savannah plants (KCA, 2001;2011).

Its history begins in 1936, with the invasion of fascist Italian forces. The Fascist administration established a construction camp in Kombolcha for a highway built from Asmara and the port of Asseb to Addis Abeba, making it the converging point for three high ways: Tigray, Addis Abeba, and Djibouti (KCA, 2020).

After the fascist invader was defeated, Kombolcha grew as a roadside town until it was officially chartered and established as a municipality in 1943. However, its master plan was enacted in 1973, with a land area of nearly 1,600 hectares and hosting approximately 4,000 people (KcA, 2011).

3.3.2. Location of Kombolcha city

Kombolcha is found on the central Ethiopian rift's western escarpment. It is located in the eastern part of Amhara Regional State, specifically in the South Wolo Zone, with latitude and longitude coordinates of 11^{o}6' N and 39^{o}45' E, respectively (Damtew et al., 2019; WLRC, Ethiopia, 2018). It has a total land area of 12,450 ha and is divided into six urban and six rural Kebeles (KCA, 2011) (Figure 3:2).

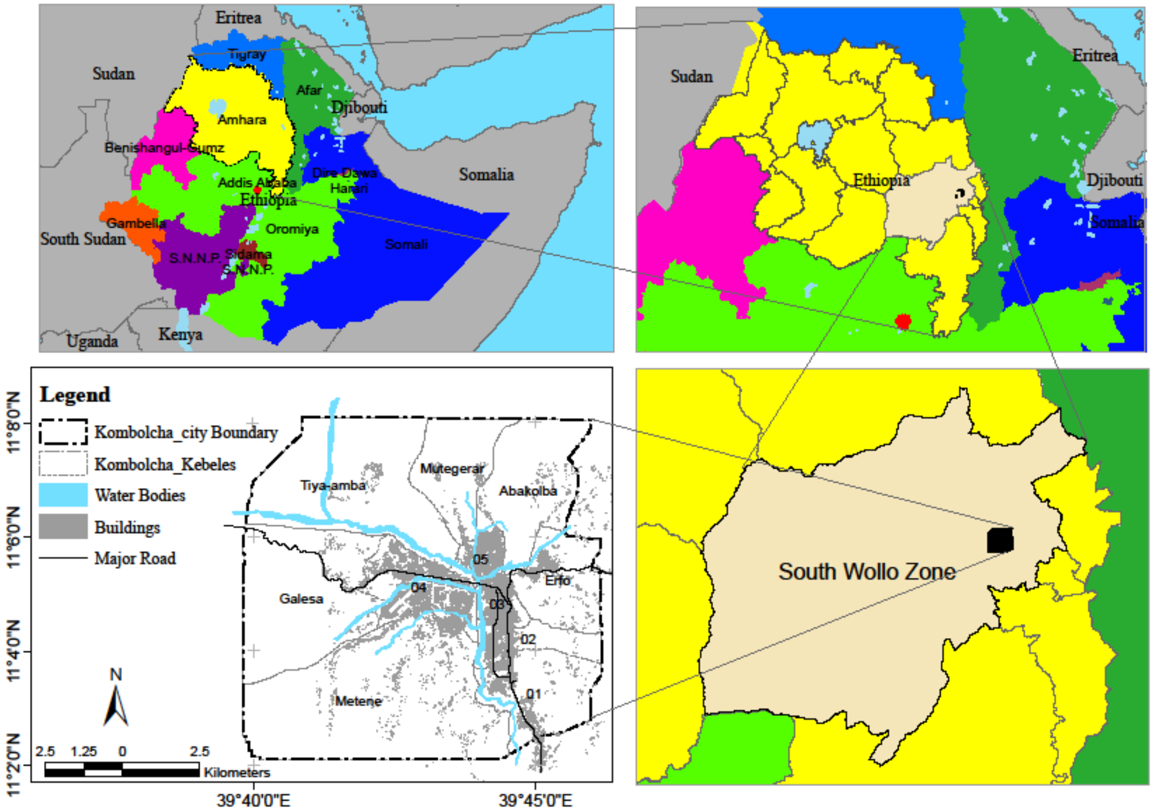

Figure 3:2 Location map of Kombolcha city
Source: Water and Land Resource Center, Ethiopia (2018); KCA, (2011)

3.3.3. Population and urbanization

The city's population has shown significant changes from 2007 onwards—consequently, rapid population growth of around 4% in 2015 and 6% in 2017. In 2020, the figure was expected to rise to 8% (Climate Development Knowledge Network /CDKN/, 2017; KCA, 2011; MoUDH, 2015b).

Table 3:1 Level of Urbanization of Kombolcha city

No	Year	Rural Population	Urban Population	Total Population	Level of urbanization
1	2007	26,700.00	58,667.00	85,367	68.72%
2	2017	32,701.00	104,792.00	137,493.00	76.22%
3	2020	33,503.00	122,637.00	156,140.00	78.54%

Source: Kombolcha City Asset Management Plan /KCAMP/ (2020)

Table 3:1 depicts that the city's urbanization level reached above 75% in 2017. At the same time, the proportion of the city's urban population increased by close to 10% from 2007 to 2020.

The 2020 Asset Management Plan indicated that the city had a 137,493 population in 2017. However, the 2013 Central Statistics Agency/CSA/ projection shows that the population was estimated to reach 149,787 inhabitants in 2021 (CSA, 2013).

According to MoUDH (2015b), Kombolcha's population is projected to more than double in the next one and a half decades, reaching 334,274 in 2035. Its population density is thus roughly will reach 1,115 inhabitants per square kilometer.

3.3.4. Physical characteristics of the city

3.3.4.1. Topography

Highland plateaus (to the east), plains, mountains, valleys, and the Borkena Graben in the center characterize the topography of the city and its surrounding areas (MoUDH, 2015c). The intense volcanic activities, *i.e.,* the Tertiary and Quaternary volcanism (Holocene) and the formation of very large lakes on the rift valley floor (during the Pleistocene fluvial times), are among the main geological events that shaped the present geomorphology of the study area. Generally, undulating topography, *i.e.,* hills and mountains, is a characteristic relief and landform feature of the surrounding territories until one encounters the vast Borkena plain where the city of Kombolcha is found (KCA, 2011).

The study area comprises the alluvial Borkena plain with a gentle to moderately steep slope. Its elevation varies between 1842 and 1915 meters above sea level (Figure 3:3). In contrast, the eastern part of the city, the Meja ridge, has very steep slopes vulnerable to landslide hazards, especially if severe seismic phenomena occur.

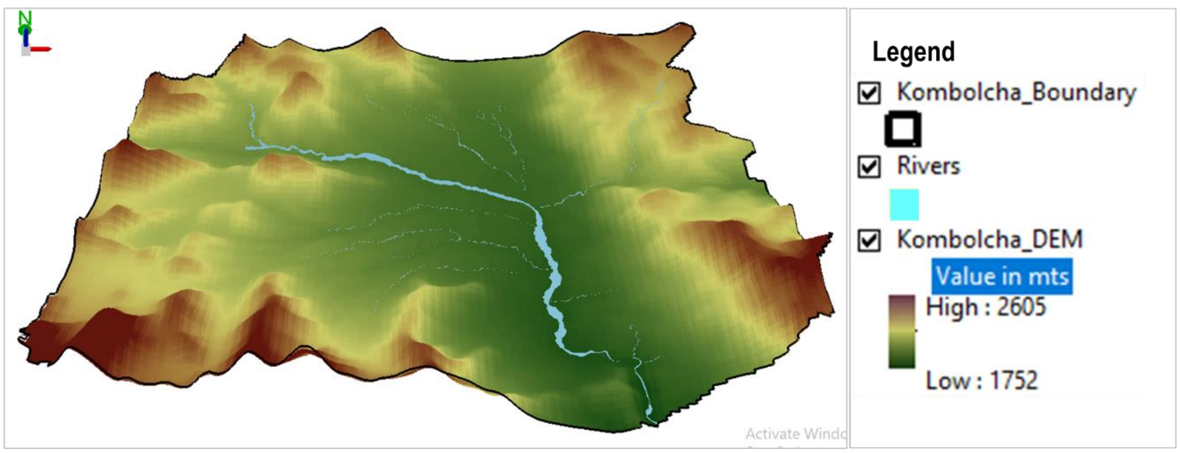

Figure 3:3 Digital Elevation Map(DEM) of Kombolcha city
Source: KCA (2011)

3.3.4.2. Geology

According to the city's 2001 Dp and 2011 SP report, rock formation along the Dessie-Kombolcha-Bati traverse is primarily the result of three major pre-rift volcanic cycles:

- The oldest Eocene Ashangi volcanic cycle dated at 48, 55, 66 m.y.;
- The Oligocene to Miocene Alaji rhyolitic series dated at 32 - 28 m.y. with local intercalation of basalts and basaltic dykes dated at 35-18 m.y.; and

- The overlying Tarmaber basalts (28 — 18 m.y.) the latter being emitted from a central volcano.

As per Figure 3:3, the rocks outcropping in the Kombolcha area belongs significantly to the Alaji rhyolitic and the Tarmaber basaltic series. Little outcrops belong to the Dessie basaltic formation. On the floor of the Borkena graben, a few kilometers south of Kombolcha, the Borkena River cuts deeply into the volcanic sequence where Tarmaber basalts overlay a series of Alaji rhyolite flows (KCA, 2001).

In the case of Berbere River, NE tip of Kombolcha town, the stratigraphy is represented from top to bottom by columnar jointed basalt, scoriaceous basalt, fractured and fragmented acidic lava, and rhyolites at the bottom. The whole sequence is cut by a basaltic dyke (FDRE Ministry of Mines, 2010; KCA, 2011).

Local structural observation reveals that the rocks beneath Kombolcha town and its environs have N-S-trending major lineaments, which can be interpreted as graben-forming faults and fractures. The contour lines on the maps also show sharp and linear topographic breaks, which can be interpreted as regional faults and fractures (graben margin) (Figure 3:4) (FDRE Ministry of Mines, 2010).

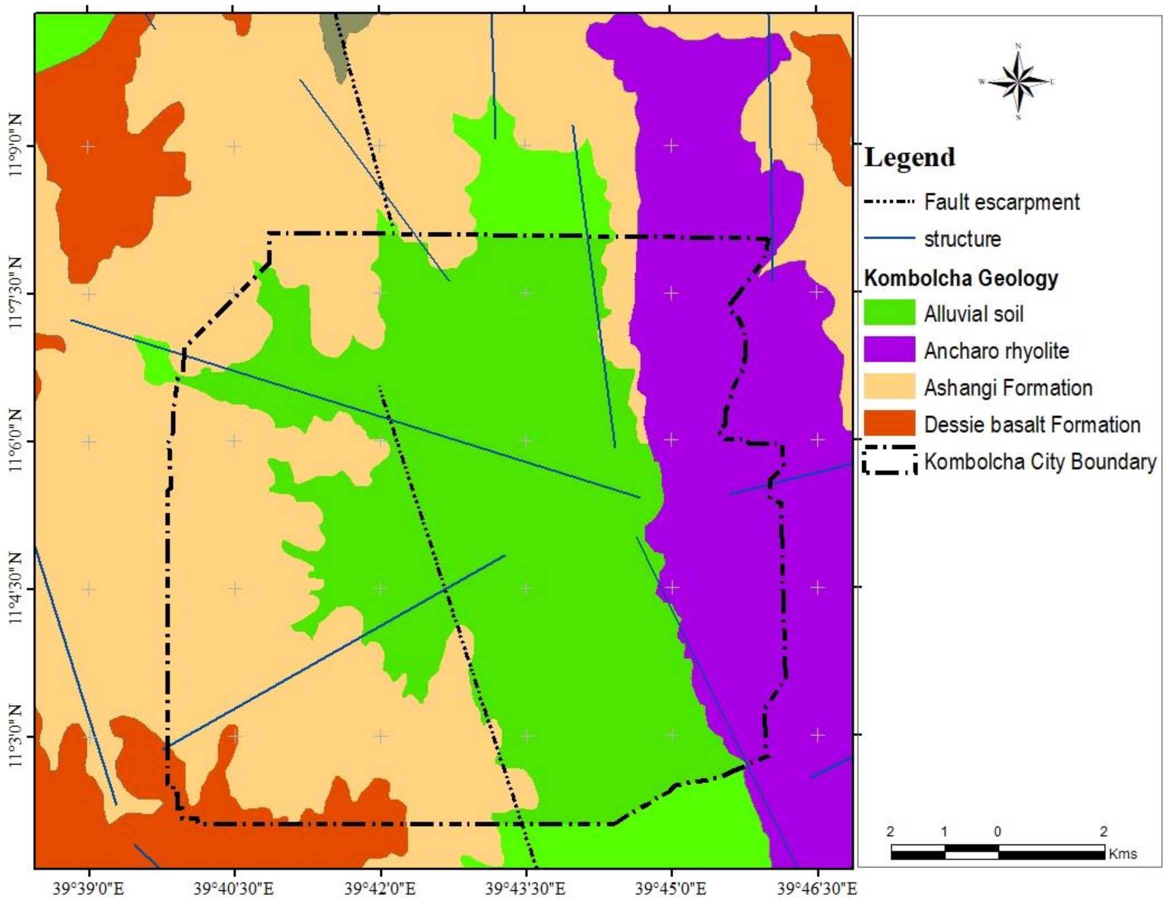

Figure 3:4 Lithological formation of Kombolcha city
Source: FDRE Ministry of Mines (2010)

3.3.4.3. Hydrology

The city's 2011 SP defined hydrology as the presence of rivers and streams, a high ground water table, and the frequency and extent of flooding during the rainy season. As per the 2001 DP, the city is characterized by bimodal rainfall patterns during July, August, and September. The highest rainfall record is in August, while the lowest rainfall is recorded in June and November.

The Borkena River basin is divided into upper, middle, and lower sections. The River has some significant perennial tributaries north of Kombolcha, the most important of which are the Arawale and Berbere Rivers. During the wet season, several dry streams drain into the Borkena River (KCA, 2001).

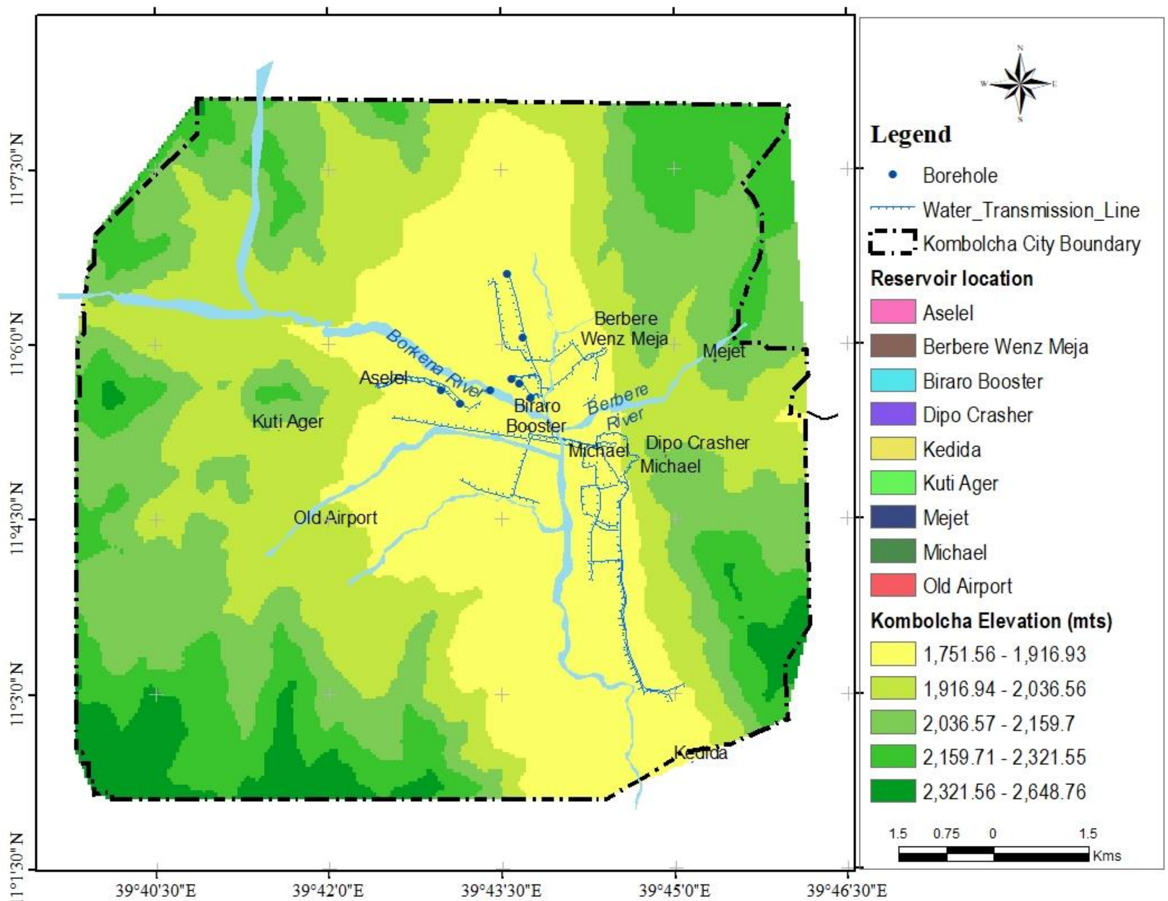

Figure 3:5 Hydrology map of Kombolcha city
source: KCA (2020)

Figure 3:5 depicts the city's hydrology composed of reservoirs, transmission lines, rivers, and boreholes. All of the boreholes are located along the Borkena River.

3.3.5. Urban Economy

Per the DP and SP, the city's urban economy constituted industries, businesses, services, and urban agriculture (KCA, 2001, 2011). As the unpublished environmental review report of the city, tannery, textile, bear, meat processing, flour, and steel manufacturing are the major industries in the city. KCA (2011) disclosed the presence of small-scale manufacturing, such as wood and metal workshops, Howllo concrete block manufacturing, and grain and oil mills.

Apart from these, informal trades, like selling fresh fruits, vegetables, cooked food items, homemade beverages, petty trades, urban agriculture, and a dry port with import and export potential support the city's economy.

3.3.6. Natural and manmade hazards.

The two spatial of the city have elaborated on natural and manmade urban problems affecting the city's resilience. The plans categorized the natural hazards as geological (earthquakes, landslides) and hydrometeorological (flooding)) or their combination (KCA, 2001; 2011). Furthermore, the characteristics of the Borkena graben could make these natural hazards inevitable. Furthermore, rainfall and flood-induced landslide occurred along the Meja escarpment and blocked the road in Kombolcha town (KCA, 2011).

Flooding in the city is linked to the Borkena, Arawle, and Berberie Rivers, which originate in the mountainous chains. In these areas, intense rainfall is accompanied by excessive surface runoff due to high impermeable steep slopes, implying maximum runoff, and floods in the valley are, in most cases, hazardous (KCA, 2001;2011). Some recorded flooding problems include loss of life, property damage, intense gully formation, siltation, and deterioration of urban roads, utilities, and drainage facilities.

The management of wastes and resulting pollution from industries have been named the city's top urban challenges, including poor sanitation (KCA, 2011; IPE global, 2017). The high unemployment rate, the concentration of slum dwellings, poor housing, infrastructure, and sanitary development characterize Kombolcha more than its few good features (KCA 2011).

3.3.7. Locational advantage and constraints of the city

The locational advantage of the cities lies in two premises. The first is the potential to grow as an industrial area, and the second is associated with transit centers. The Federal Government of Ethiopia has reinforced this by designating the city as an industrial growth center of regional and national importance. Aside from these, the city is home to one of the strategic development corridors that connect Kombolcha and Mekelle (Woldeyes and Bishop, 2015).

Accordingly, the city is home to major industries and a recently opened industrial park. The railway being constructed to make the city a dry port location is noteworthy that connects it to Djibouti and other parts of the country. The presence of an airport is another locational advantage of the city in the economic and political setting.

The city's locational disadvantage is attributed to its location within the seismic zone and vulnerability to earthquake and landslide hazards. In addition, the topography of the city is undulatingly characterized by rugged surfaces.

3.4. Investigating issues of urban spatial resilience

3.4.1. Research Design

The research applied descriptive, exploratory, and explanatory methods to various research inputs.

Descriptive research:

Resilience is a descriptive concept (Derissen et al., 2009). Thus, the research will describe the state of affairs as it exists. This method was employed to describe the physical and environmental factors affecting the spatial resilience of secondary cities and the responses of the sampled households. Further descriptions were made to examine the extent to which the principles of spatial resilience were incorporated in Ethiopia's local urban spatial planning legal documents. The practical implementation of the principles into the 2001 DP and the 2011 SP supplemented the narrations.

The thesis also described the collaboration of operators of the critical urban systems and the communication systems deployed toward disaster risk reduction endeavors in the city.

Exploratory research:

Exploratory research provides insights into and comprehension of an issue or situation. This method is particularly employed to explore the physical and environmental factors affecting the spatial resilience of the city towards urban uncertainties. The study design is used to validate the households' findings and understand the situation and magnitude of the urban problems.

Explanatory research:

This method is used to capture households' understanding of the factor affecting the spatial resilience of kombolcha while also demonstrating empirically why the problem exists in the city. The method also helps t examine and measure the extent to which the principles of spatial resilience are mainstreamed into the local spatial planning legal frameworks of Ethiopia and the various spatial plans of Kombolcha city, verified through the 2020 existing land use.

3.4.2. Data Types and Collection Methods

Cutter et al. (2010); Frazier et al. (2014); Miles (2014) have shown that any study on urban resilience should start with a discussion on the data types and data collection tools to be applied. Thus, this study applied a combination of primary and secondary data to achieve the thesis objectives.

a) Data Types and their Sources

Primary Data Types include the attributes of urban spatial resilience constituted in the local urban spatial planning legal frameworks, the collaboration of critical urban system operators, and data from various respondents through the interview, site observation, and questionnaire.

These data were obtained from the sampled households, key federal, regional, and city-level government offices/officials, and designated professional experts. Furthermore, the data were harnessed from local and international consultants working on urban planning and development in Ethiopia.

Secondary Data Types encompass data previously done by an academician, scientist, or government officials, which are available for use. These data were consulted from published and unpublished documents explaining urban planning attributes of resilience that enhance spatial planning in secondary cities. Thus, the data obtained in this context included urban policies and strategies.

The sources of these data sets are published and unpublished literature, structure, and local development plans and reports. The various strategies and policies directly relevant to local urban spatial planning activities were also included. Furthermore, relevant web-based, electronic libraries accessed either soft or hard copy literature was written, published, and accessible. The data obtained from Central Statistical Authority /CSA/ and government offices with ultimate association with the study topic also served as secondary data sources.

b) Data Collection Method

- ✓ **Primary Data Collection Method**

Observation:

Observation is a purposeful, systematic, and particular way of watching and listening to an interaction or phenomenon as it takes place (Smith, 2012). The study employed this primary data collection tool to identify and analyze resilience issues observed in the city.

Besides these, the task of exploring the practical implementation of the provisions of the policy documents towards the spatial resilience principles needs to be ascertained by the facts/practices observed at different locations in the city. Thus, field photographs and google earth images were used to supplement the thesis's findings. The preconditions set in Table 2:4 are the ultimate emphasis where the data through site observation was made. The sites visited included residential areas, industrial sites, locations in the city dominated by informal settlements, and the inner city where bridges are damaged. Furthermore, the nature and shape of the urban blocks were the focus of the site observation (Figure 3:6).

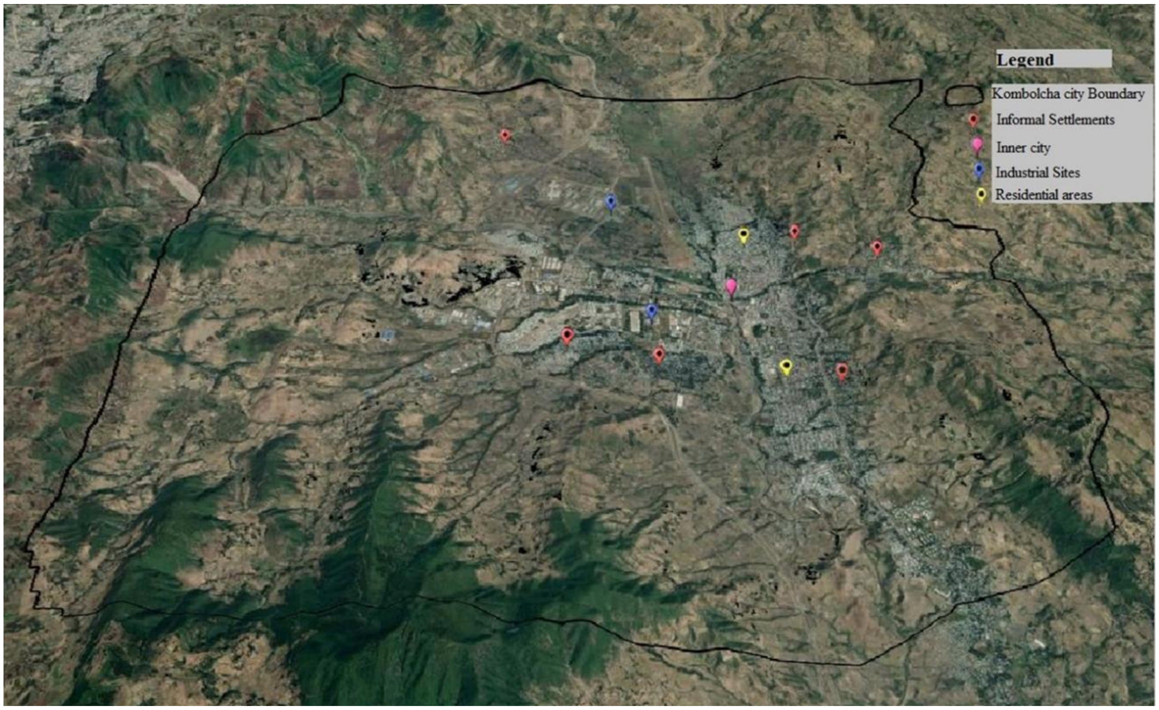

Figure 3:6 Sample points considered for site observation
Source: Google earth pro (2021)

The site observation enabled the thesis to cross-examine the proposals of the two plans (DP andSP) against the 2020 ELU and verify the data obtained through fieldwork. Furthermore, site observation is part of the qualitative analysis of land uses and resilience attributes.

Key informant Interview:

According to Monette et al. (2014), 'an interview involves an interviewer reading questions to respondents and recording their answers.' Whereas Dicicco-Bloom and Crabtree (2006) rephrase the term as a verbal interchange, often face-to-face, an interviewer tries to elicit information, beliefs, or opinions from another person. Structured and unstructured interviews were carried out in this study.

Thus, the research collected primary data from government officials and urban planning and development consultants on the possible contribution of the urban policies and strategies to enhance or deter the spatial resilience of secondary cities of Ethiopia. Further firsthand information was collected through this method to collect data from the community representatives and government officials found at the different tiers of administration to air their opinion on the resilience and sustainability of the city of Kombolcha with only physical and environmental dimensions.

The method helped the thesis gather data on identifying the possible level of integration of operators of critical urban systems in the study area. Accordingly, the detailed distribution of the key informants from the above sources included five from MoUDH, two from Un-habitat, one from UNDP, twelve from six consultants, fifteen from various departments, and case teams from the KCA. The total number of key informants purposively selected for this study is thirty-five.

Some of the questions posed to the KIIs include, but are not limited to, the following.

The study sought KIs' opinions on whether resilience principles are incorporated into Ethiopia's local urban spatial planning policy documents. The other request is to get their understanding of the policy provisions toward the principles practically reflected in Ethiopian cities' city-wide structure plan proposals. The author also raised concerns about the extent to which the various spatial plan proposals are implemented or not. They were also asked to identify the main obstacles impeding the implementation of the proposals concerning the practices of mainstreaming resilience principles.

Questionnaire:

The primary data collected using this method include the opinion of the government officials, the dwellers of Kombolcha city, and consultants engaged in urban planning and development in Ethiopia.

Furthermore, the research adopted a structured questionnaire design to collect data from the various respondents for this study. The respondent was asked to rate their responses on the urban resilience attributes, which significantly affects the city's overall development, by indicating their level of agreement or disagreement as indicated in the Likert scale: 1 strongly disagree up to 5 strongly agree.

- **Land Use Land Cover(LULC) change classification**

LULC that helps to evaluate change in the study area during ten years from 2010 to 2020 utilized Landsat 7 Enhanced Thematic Mapper (ETM+) image from 2010 and Landsat 8 Operational Land Imager (OLI) image from 2020, with a resolution of 30m. Both Landsat satellite scenes for Path/Row 168/52 were obtained from the United States Geological Survey (USGS) website. *Table **3:2*** presents the acquired images and their characteristics.

Table 3:2 Satelite images acquired and their characteristics

Satellite sensor	Sensor ID	Path/row	Acquisition date	Resolution
Landsat 7 ETM+	LE07_L1TP_168052_20100216_20200911_02_T1	168/52	16/02/2010	30m
Landsat 8 OLI	LC08_L1TP_168052_20200408_20200822_02_T1	168/52	08/04/2020	30m

Source: US Geological Survey (2022)

Data processing and Analysis

- **Image classification**

Assigning land cover values to pixels is called image classification. The study area boundary from the asset map prepared by kombolcha municipality and the Google earth high-resolution satellite image was used to assist the image classification. Supervised image classification was applied by picking sample pixels in the image representative of certain classes and then instructing ArcGIS 10.8 software to utilize these samples and classify the image accordingly. The image classification applied in this study comprised five classes: bare land, built-up, cultivation land, forest, and waterbody (Table 3:3). The Table presented descriptions for each LULC class used in this study.

Table 3:3 Descripion of LULC classes

LULC Class	Description
Bare Land	Land that exists with no vegetation cover and is open and includes exposed rocks
Built-Up	Land that has been developed, including buildings, roads, and other paved surfaces
Cultivation Land	Grass or green surfaces, agricultural lands, cemeteries, and small plants
Forest	Land covered by large trees, mostly perennial
Waterbody	Areas with water coverage, including rivers and ponds

Source: Computed by the author (2022)

- **Post classification**

Post classification improves classification accuracy and reliability of output maps. This step combined inaccurate pixels from multiple classes into a single class. The supervised image classification was generalized using ArcGIS and majority analysis to reduce classification errors.

- **Accuracy assessment**

As per Rwanga and Ndambuki (2017), accuracy assessment is the final stage in image classification, and repeated errors have been the major cause of the assessment (Congalton, 1991). The assessment of accuracy in this study involved an error matrix for both time frames. It shows the accuracy of the classification result by comparing it to control points representing the truth value on the ground. The kappa coefficient, producer and user accuracy, total accuracy, and errors of commission and omission are all reported in the error matrix.

Accuracy measures the proportion of correctly classified pixels, representing the map's correctness for the classes. Classification accuracy is good when the total accuracy value is more than 70%. The degree of agreement between categorization and ground truth pixels is evaluated by the kappa (k) coefficient (Equation 3:1). The kappa coefficient accounts for mistakes of omission and commission in contrast to total accuracy.

Perfect agreement is indicated by a kappa value of 1, while no agreement is shown by a value of 0. A kappa value higher than 0.75 can be considered an excellent or very good agreement (Thompson and Walter, 1988).

Kappa coefficient (*k*) = $$\frac{(TS*TCS)-\sum(Column\ total*Raw\ total\ )}{TS*TS-\sum(Column\ total-Raw\ total)}$$ **--------Equation 3:1**

Where:

TS = total sample points taken

TCS = total correct sample points

The Kappa coefficients calculated for the two temporal times of the image processing have been indicated in Annex 2 of this paper. The values are 0.88 and 0.823, respectively, for 2010 and 2020. According to Thompson and Walter (1988), these values indicate that the assessment is almost perfect.

- **LULC change detection**

In this study, LULC change detection was achieved by comparing the image classification results from 2010 and 2020. LULC change from each class of land covers into another class was quantified and presented using tables. Using the Geoprocessing intersection tool of ArcGIS, the LULC change within ten years was performed (Annex 1).

- ✓ **Secondary Data Collection Method**

Comprehensive but relevant literature was reviewed to provide a scientific base and extract the thesis's conceptual and theoretical frameworks. Besides these, the review is expected to draw scholarly gaps that this paper strives to fill. Thus, these data were collected through various techniques, including the following:

- Previous studies conducted on urban policies and strategies enacted
    - Review of relevant literature
- Reports from government offices
    - Reading and review of relevant published and unpublished documents
- Web browsing
    - E-Journals, e-books, and e-articles are accessed through electronic libraries.

3.4.3. Sampling Methods/techniques

Darkwah (2016) revealed that resource and time limitations had instigated researchers to dwell on sampling rather than focusing on the entire research population. Hence, institutions and households constitute the sampling units of this paper.

Institutional sampling procedure

The research used both non-probabilistic and probabilistic sampling techniques to this end. Thus, the thesis applied purposive sampling, a non-probabilistic sampling, to offer in-depth data from a smaller and more relevant number.

Guarte and Barrios (2007) disclosed that applying the purposive sampling method warranted the selection and involvement of institutions/experts with sufficient knowledge and experience about a research topic.

Therefore, the study intentionally selected federal-level institutions such as the Integrated Infrastructure Development Agency (IIDA), Environment, and MoUDH. Amhara Regional State Regional Urban Planning Institute (RUPI) and the Urban Development, Construction and Housing Bureau (UDCHB) represented the regional government. International organizations such as UN-Habitat and UNDP Ethiopia office were also purposefully chosen.

Likewise, the application of the method to local offices, such as urban plan implementation follow-up and feedback, agriculture office, environmental protection, construction, infrastructure, green, and water enterprise, were also considered in this context. The city manager's and mayor's offices were among the purposively selected institutions.

In addition to the purposive sampling, the thesis selected consultants and professional practitioners working on urban planning and development in a systematic random sampling approach. The sampling was based on the list of consultants obtained from MoUDH. The consultants considered for this study prepared urban plans of any kind for secondary cities of Ethiopia, as verified by MoUDH.

Household sampling procedure

Various data collection instruments existed to measure the perception, experience, and practices of individuals and communities towards resilience. The most preferred and authentic way is to use household surveys or questionnaires. Close-ended questions enable the amalgamation of scoring urban problems (shocks and stresses) and ease comparisons among the problems (OECD, 2013).

Accordingly, this study used closed-ended questionnaires with Likert scale measurements with five response items (Strongly disagree = 1, Strong agree = 5) and dispatched them to randomly selected households residing in different localities within Kombolcha city. Finally, each urban problem was individually compared and aggregated to form a single-collective score in the Analytic Hierarchy Process/AHP/.

Sample sizes

Berkowitz (1998) discussed that the sample size for descriptive research should be based on the required precision of the prevalence estimate, and it should be computed with attention to dropout rates. Hence, the thesis used categorical variables to classify resilience attributes into many ordinal variables based on resilience characteristics observed.

Based on the 2020 AMP of Kombolcha city, an estimated 27,400.00 residential houses were found in 2017. Therefore, for this defined population, the study applied Yamane's sample size determination Formula (Rahman et al., 2020) (Equation 3:**2**), which is applicable for a finite number of populations (Guwahat, 2013).

$$\mathbf{n} = \frac{\mathbf{N}}{\mathbf{1+N(e)^2}}$$ **--- Equation 3:2**

Where,

n is the sample size, N is the population size (i.e., 27,500), and e is the desired level of precision, usually 0.05 for a 95% confidence level (Guwahat, 2013). Thus, the sample size computed based on Equation 1 above is

$$n = \frac{27{,}500}{1+27500(0.05)^2} = 394.25$$

Hence, the total sample of households selected for this study was 400.

Spatial sampling units and frames

The spatial distribution of major urban problems, spatially explicit and site-specific characteristics, has set the sampling frame for selecting the sampled households in this study. The spatial categorization has been jointly done with the urban spatial planning and implementation and feedback case team experts (Figure 3:7).

Table 3:4 shows the spatial sampling units, the basic characters (urban problems affecting spatial resilience) that distinguish the units, and the number of households sampled.

Table 3:4 Spatial household sampling frameworks of the study

No	Spatial sampling unit	Land area (sqm)	Urban problems dominantly affect the spatial units	Sampled households selected
1	New Airport	18,424.08	The site is characterized by urban expansion with high pollution, traffic accident, and congestion.	52
2	Miti-kollo	9,907.78	Rugged topography, landslides, and flooding are the features of this area.	42
3	Asseb Ber	7,673.21	North-south mountainous ridges are susceptible to earthquakes, deforestation, landslide, and flooding. Poor drainage facilities and the site is covered by organic block arrangement and narrow roads.	30
4	Assenager	8,076.38	Inner-city, poor drainage facilities clogged with wastes, flooding, traffic congestion, and accident. pollution	32
5	Abishager	8,486.89	It is located in the inner city and is frequently affected by surface flooding, landslide, and poor waste management practices.	35
6	Wollo University	9,210.00	The city's southern expansion area is prone to flood-induced landslides with poor drainage facilities and deforestation	40

7	Kuteba sefer	8,811.20	Water and air pollution along with poor solid waste management practices.	35
8	Old Airport	8,839.18	The substandard landfill site in this spatial unit, poor drainage facilities, and pollution are the major urban challenges affecting the site.	36
9	Shesha-ber	18,727.01	A single main trunk road characterizes the spatial unit with high traffic accidents and congestion, pollution, poor solid waste management, and deforestation.	52
10	Industry park area	12,961.19	The newly introduced urban function profoundly generates high traffic accidents and congestion.	46
			Total sampled households	**400**

Source: Computed by the author (2022)

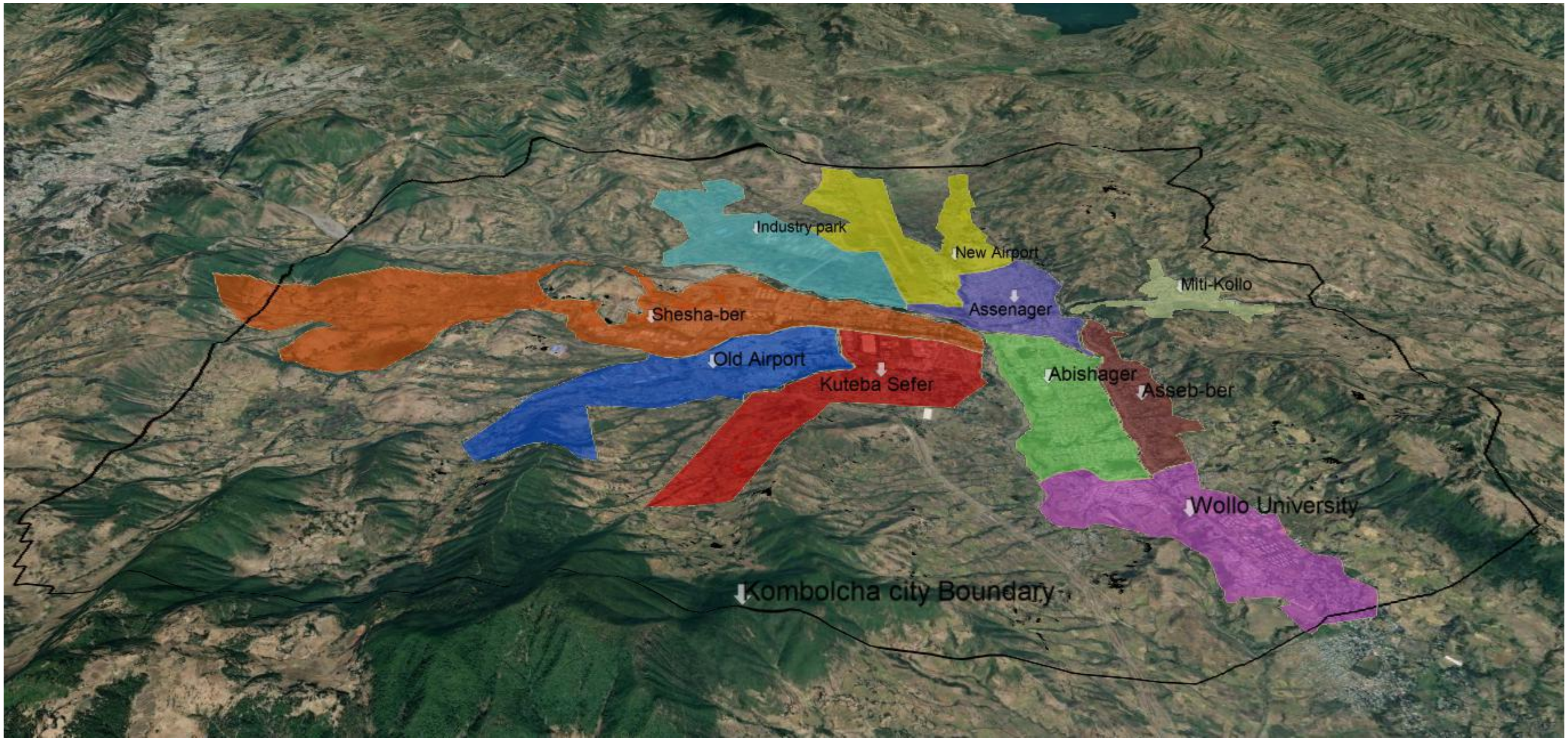

Figure 3:7 Spatial sampling units of the study
Source: computed by the author (2022)

Based on Figure 3:7, the spatial units for deploying the household survey were ten, reflecting the potential existence and distribution of urban uncertainties in the city.

3.4.4. Data analysis, interpretation, and presentation

3.4.4.1. Units of analysis

A unit of analysis is the most basic element of an examined phenomenon. Units of analysis in the research method refer to the ‘what ‘or ‘whom ‘being studied. It is also synonymously denoted as an observation unit (Patel, 1974).

Thus, the institutions selected for this study established the units of analysis at the institutional levels, the household heads formed, and the units of analysis at the household level. At the same time, the professional practitioners and consultants framed the units of analysis for this study.

Data Analysis

Quantitative and qualitative analysis methods were applied to analyze the data collected. Hence, **quantitative analysis** involves converting data to numerical forms and putting them into statistical analyses. Thus, the thesis utilized this method to analyze and describe the urban planning attributes of resilience observed in the city. Further analysis was also deployed to analyze data on the level of integration of operators of the critical urban systems of the city.

Qualitative Analysis: the thesis adopted semi-structured qualitative data analysis to explore the thesis's objectives in more depth. The analysis involved transcribing, organizing, and coding the data obtained through observation, interviews, questionnaires, parameter analysis, and document review.

This analysis allowed the thesis to conclude the recurring factors affecting the spatial of the secondary cities, particularly Kombolcha city, that need to be addressed in urban plans to bring about a resilient and sustainable city. Further, the analysis was conducted to explain the urban policies and strategies directly relevant to urban spatial resilience. It further helped the research elaborate on the integration levels of institutions operating various urban systems and qualitatively understand the communication systems deployed towards disaster risk reduction in the city.

3.4.4.2. Data Analysis Tools

The thesis deployed three different analysis software with qualitative and quantitative analysis. The tools used included Nvivo plus, SPSS, Analytic Hierarchy Process, and ArcGIS. The latter is applied for undertaking spatial analysis on spatial attributes of the study area. The details of each tool are discussed as follows.

Nvivo 12 plus software

The thesis applied NVivo 12 Plus software for content analysis. The analysis depended on context-based qualitative analysis of keywords that define the spatial resilience attributes. The software also produced quantitative results or scores for each attribute of resilience considered in the study and the reviewed spatial planning policy documents.

SPSS-based Statistical analysis: The study applied Statistical Package for the Social Sciences (SPSS) based statistical analysis consisting of factor analysis, spatial analysis, and Analytic Hierarchy Process/AHP to achieve the objectives set.

SPSS religiously used for statistical analyses. Coding of variables in quantitative research is essential for better interpretation of results. Using SPSS, the responses and questions were analyzed after being coded on the software. Excel and AHP supported this data analysis.

Factor analysis: this type of analysis depends on correlation among various variables considered for any study. In addition, it highly depends on the values obtained from Likert scale measurements, which show the level of agreement on a specific attribute on resilience questions.

Factor analysis is significant for this study; most importantly, it provides clues on prioritizing the most important factors of spatial resilience. Each factor of spatial resilience was analyzed to understand the extent of the problem, the impact it has induced, and the adaptive/mitigation measures introduced.

ArcGIS software: The thesis applied ArcGIS 10.8 software to undertake spatial analysis, which produced both quantitative and qualitative results. The software analyzes the city's 2001 DP, the 2011 SP, and the 2020 ELU. The software further helped analyze the various attributes of the 2011 SP proposal and the 2020 existing road networks of the city.

Analytic Hierarchy Process: Multi-attribute decision-support models could evaluate households' perceptions of urban shocks and stresses (Keeney and McDaniels, 2001). Therefore, this study deployed Saaty's decision-making support model, which enabled the researchers to apply the factor loading values indicated and evaluate the collaboration among operators of critical urban systems. According to (Feng and Chan, 2004; Saaty, 1988), this model could be applied to studies with variables less than or equal to twenty variables.

AHP software applies a pairwise comparison of factors, weighting, and setting alternatives to achieve certain decisions (Aburas et al., 2015; Hui and Lim, 2018). Consequently, this study applied pairwise comparisons to decide on the level of collaboration among operators of the critical urban systems and determine the factors that affected the spatial resilience of Kombolcha city towards urban problems. However, the applied Saaty's level of importance indifferently s discussed below.

- **Pairwise comparisons:**

Measuring the level of institutional collaboration

Measuring the level of collaboration among the operators of critical urban systems is subject to the direct application of Saaty's level of importance. Aburas et al. (2015); Feng and Chan (2004); Hui and Lim (2018) showed that the scales vary between 1 and 9 representing equal importance and extreme importance, respectively. The whole number found in between can be used to show intermediate values. However, Saaty (2008) applied high, medium, and low; flexible, not flexible, and impossible as alternatives to rate various criteria. Accordingly, this study has used excellent, very good, good, bad, and very- bad criteria to measure collaboration among the institutions considered.

Examining the factor affecting the spatial resilience of cities

According to Carrilho (2015), Saaty's level of importance is subject to a grading scale, which is applied to convert each urban risk's component factor loading values into a standard and normalized scale. The grading scales of 1 indicate the relatively most minor recurring urban problem and 10 for the frequently occurring urban challenges (Table 3:5).

Table 3:5 Grading values of purely spatial urban uncertainties

No	Description for grading	Grading values
1	Decision with extremely least possibility to occur	1
2	Decision with very least possibility to occur	2
3	Decision with the least possibility to occur	3
4	Decision with marginally least	4
5	It is indifferent to the final decision	5
6	Decision with moderately low possibility to occur	6
7	Decision with a moderately high possibility to occur	7
8	Decisions with a high possibility to occur	8
9	Decision with a very high possibility to occur	9
10	Decision with an extremely high possibility to occur	10

Source: Computed by the author based on Carrilho (2015)

The grading in Table 3:5 and the subsequent application of Equation 3:3 below allowed the factor analysis results to fit Saaty's fundamental scale, as illustrated in Table 3:4. However, these grading values require further adjustments to carry out a pairwise comparison of the variables and fit Saaty's fundamental scale. Carrilho (2015) proposed applying a formula (Equation 3:3), which uses absolute values to avoid negative values that fit the AHP model.

$$s(a_i, a_j) = \frac{8}{9} \mid v(a_i) - v(a_j) \mid + 1$$ ----------------------------------**Equation 3:3**

Where

a is one cell of index i, and j is the cell with index j that ∀ i, j Є R, I ≠ 1

v (a_i) and v (a_j) are the values of the cells a_i or a_j, respectively.

Table 3:6 Illustration of Equation 3:3 and factor grading to fit the AHP model

	Variables	Surface flooding(SF) (grading 8)	Erosion (E) (grading 3)	Landslide (LD) (grading 6)
A	Surface flooding /**SF**/ (factor value 0.866)	-	Reciprocal of the value of cell ESF = 1/ ESF = 1/6 = 0.1767	Reciprocal of the value of cell LDC = 1/3 = 0.333
B	Erosion/**E**/ (factor value 0.566)	**ESF** = 8/9(/grading of SF- grading of E/)+1 = 8/9(/8-3/)+1 = 5.44 ≈ 6	-	Reciprocal of the value of cell LDE = 1/4 = 0.25.
C	Landslide/**LD**/ (factor value 0.641)	**LDC**= 8/9(grading of **SF**- grading of **LD** /)+1 = 8/9(/8-6/)+1 = 2.777 ≈ 3	**LDE** = 8/9(/grading of E- grading of LD/)+1 = 8/9(/3-6/)+1 = 3.66 ≈ 4	-

Source: Computed by the author (2020)

Equations 3:3 and Table 3:5 are used to fit the AHP model with grading values from Table 3:5. Further, the table shows that the pairwise comparison of the same urban problem result is blank. The values above the empty cells are the reciprocals of the values indicated on the left side of these cells.

3.4.4.3. Data Interpretation and Presentation

Qualitative data was presented by categorizing the research data or emerging themes into different understandable formats. The interpretation could be made in maps, percentages, ratios, tables, graphs, and pictures (U.S. Department of Homeland Security, 2014). Therefore, the thesis applied all these data interpretation and presentation techniques throughout the thesis.

3.5. Adequacy and Statistical Validity of the data

3.5.1. Adequacy of the data

The thesis has checked the adequacy of the data collected from the city inhabitants before the data analysis. According to Cerny and Kaiser (1977), sampling adequacy for factor-analytic correlation can be computed by using Kaiser-Meyer-Olkin (KMO) Test. The data adequacy has been measured by measuring the scale to which the city of Kombolcha faces urban uncertainties or hazards as responded by sampled households. The test revealed that the data collected based on the sampling size of this research is meritorious, with a 0.891 value measured to 1.00.

Table 3:7:Data adequacy to measure the factors affecting the spatial resilience of Kombolcha city

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		**0.891**	Cronbach's alpha Test (Table 3:5)
Bartlett's Test of Sphericity	Approx. Chi-Square	3820.534	**0.934**
	df	190	
	Sig.	.000	

`Source: Computed by the author (2020)

3.5.2. The statistical reliability of the data

Zumbo et al. (2007) disclosed the presence and wide application of two equations to validate the reliability of statistical data in research settings. The equations mentioned are the Coefficient alpha and coefficient theta, commonly referred to as Armor's theta. The authors further indicated that the methods use correlations among variables despite the differences in their application.

The coefficient alpha is the best instrument given only a Pearson correlation matrix and a factor analysis model. Hence, the coefficient alpha from a factor analysis model can be computed.

$$\alpha = \frac{p}{p-1}\left[\frac{p(f)^2 - f^2}{p(f)^2 + u^2}\right]$$ -----------------------Equation 3:4

Where:

- P denotes the number of variables to be statistically to be checked.
- f is the average of the p factor loadings,
- f^2 is the average of the squares of the p factor loadings, and
- u^2 is the average of the p uniqueness.

Thus, the reliability test has been done with coefficient alpha to check the most pressing urban hazards that individuals raise, which requires establishing a Pearson correlation matrix and undertaking a factor analysis model.

Thus, Equation 3:3 was deployed, and SPSS automatically generated the value. The significance of the data for the statistical operation is 0.934 (Table 3:8). Thus, the data collected are reliable for undertaking factor analysis.

Table 3:8:Reliability statistics for plot-level hazards in Kombolcha city

Reliability Statistics		
Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	No. of Items
.939	.934	17

Source: Computed by the author (2020)

On the other hand, the coefficient theta is best suited to account for multidimensionality in a scale and is based on a principal components model. Coefficient theta for the single factor solution is computed with the following equation.

$$\boldsymbol{\theta} = \left[\frac{\boldsymbol{p}}{\boldsymbol{p}-\boldsymbol{1}}\right] * \left[\boldsymbol{1} - \left(\frac{\boldsymbol{1}}{\boldsymbol{\lambda_1}}\right)\right]$$ ---------------------Equation 3:5

Where

- P denotes the number of variables to be statistically to be checked.
- λ_1 represents the largest eigenvalue from the principal component analysis of the correlation matrix of the items involved in the composite

Thus, the study has adopted Armor's theta since the study used principal component analysis to identify the factors affecting the city's spatial resilience and set the recurrence of the urban problems. Thus, the corresponding results of the eigenvalues for each principal component or factor loadings with eigenvalues greater than one are indicated in Table 3:9.

Table 3:9 Principal component Eigenvalues (λ1)

Principal components (PC)	Eigenvalues (λ_1)	p	Remarks
PC1	7.758	17	Highest eigenvalue
PC2	1.973	17	Second largest eigenvalue
PC3	1.733	17	Third eigenvalue

Source: Computed by the author (2020)

Thus, the reliability of the statistics to carry out further analysis is

$$\theta = \left[\frac{17}{17-1}\right] * \left[1 - \left(\frac{1}{7.758}\right)\right] = 0.926.$$

Accordingly, the theta value, i.e., 0.926, reflects that the data are statistically reliable for carrying out the principal component analysis.

3.6. Source Maps

The thesis utilized base maps, urban development or SP, to verify how the city's spatial configuration has evolved. The spatial plans of the city were obtained from KCA and MoUDH. Moreover, the identification of urban spaces occupied by informal settlements was identified through the help of google earth pro images of 2021. The study used Landsat 7 ETM+ and Landsat 8 OLI satellite images to carry out land use/land cover analysis to supplement the study's findings.

3.7. The methodological framework of the study

IGI Global (2022) defined a methodological framework as a method for explaining and structuring how a given task is carried out. Consequently, the framework developed for this dissertation shows the relationship between the research questions, data type, sources, collection methods, analysis, and output (Figure 3:8).

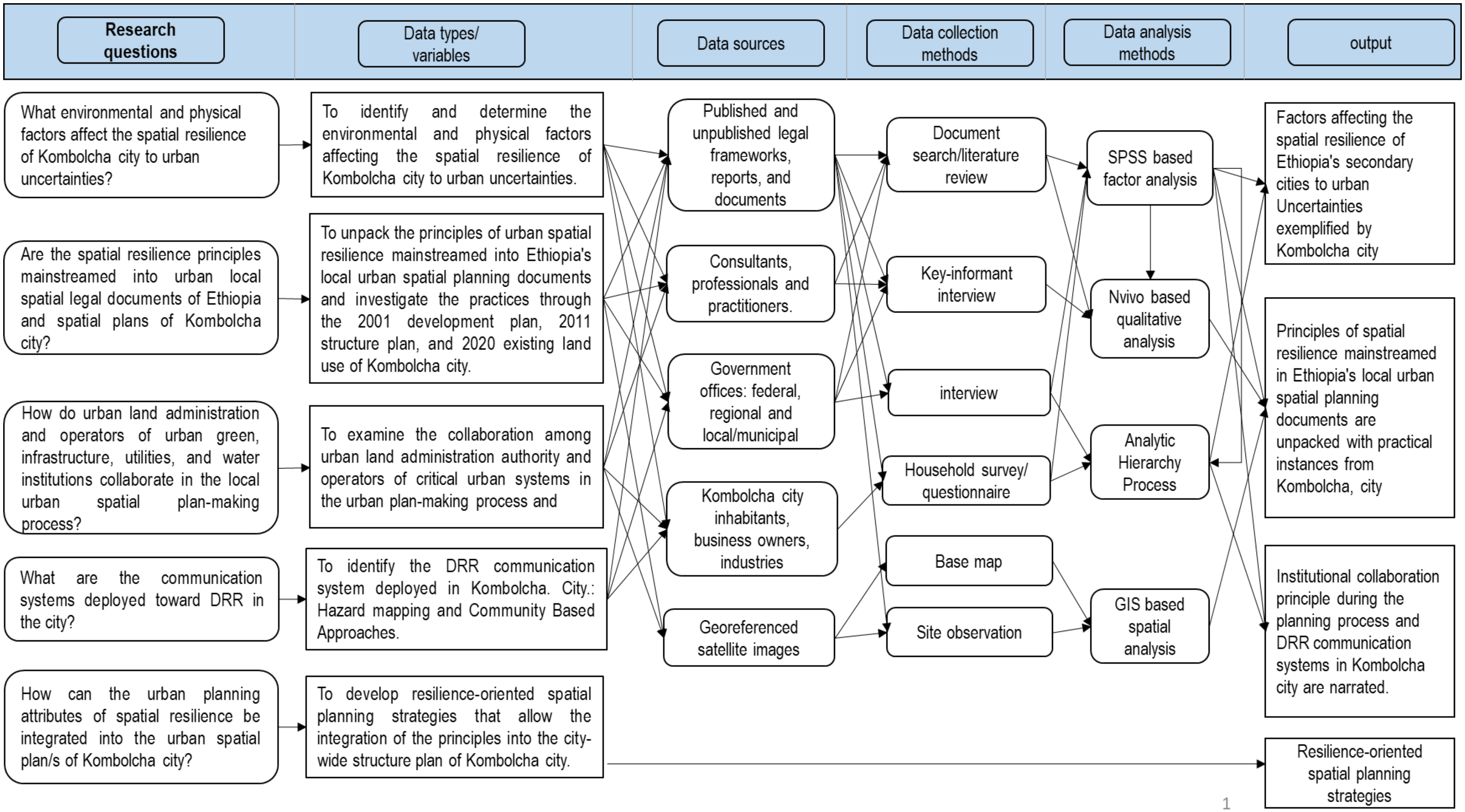

Figure 3:8 Methodological framework of the study
Source: Computed by the author (2020)

3.3. Summary

The methods and materials section of the thesis starts with descriptions of the study area and its regional importance and setting. Accordingly, the climatic settings of the city were presented along with discussions concerning its location, population, and level of urbanization. The city's topography was also among the features that describe the city.

The section described the research design: descriptive and exploratory research. The chapter also dealt with data types and their collection methods. This portion of the thesis also highlighted the sampling techniques deployed, which set the premises to determine how the respondents were chosen from whom the data were collected. The sample size determination was the following task shaping the number of respondents from study populations. The data analysis, interpretation, and presentation were covered in this section.

The methods and materials section of the thesis has also narrated the statistical reliability and validity of the data collected, analyzed, and interpreted through SPSS. The last section of the chapter is allotted to the thesis's source maps and methodological framework.

Figure 3:9 shows the overall framework of the study, starting from the concept of urban resilience, the indication of the research objectives, to the development of the resilience-based spatial planning strategies.

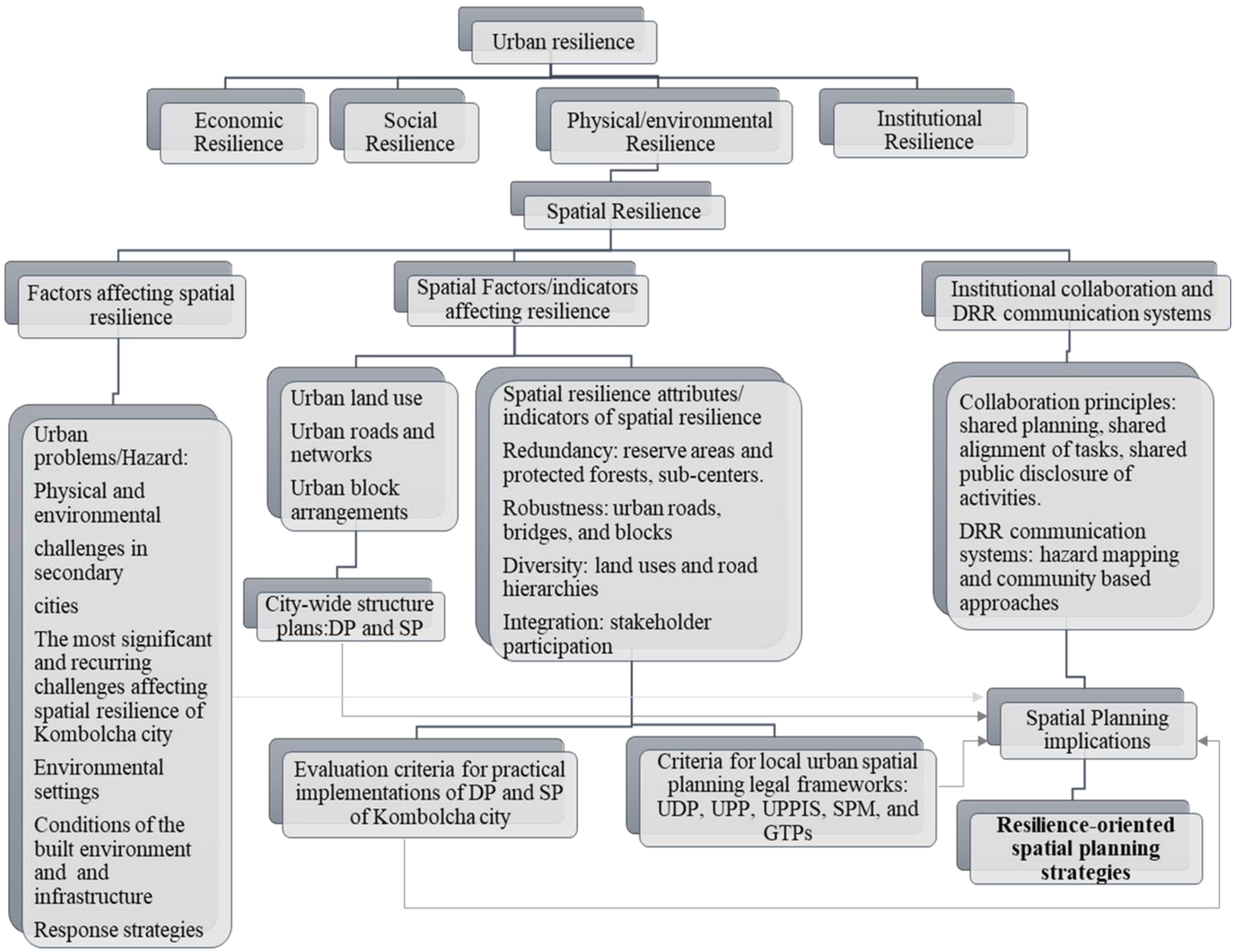

Figure 3:9 Overall framework of the PhD work
Source: Computed by the author (2020)

CHAPTER FOUR : RESULTS AND DISCUSSIONS

4.1. Introduction

This chapter aims to present the research findings and discuss the empirical investigation. The presented findings result from rigorous fieldwork, intensive interviews, and comprehensive household surveys conducted in Kombolcha and Addis Ababa. The findings of this study are based on data gathered through semi-structured interviews, observation of various sites in the city, review of policy documents, and structure plan reports. Text, tables, figures, and photographs presented the findings. Unless otherwise stated, all tables and figures in this chapter are the author's creation.

Photographs are also part of the original field data unless otherwise stated. Results from other scholars support a discussion and interpretation of the results of the empirical investigation. The findings are compared and contrasted with those from previous studies. On the other hand, the chapter began with a brief narration of the profile of the sampled household contacted for this study.

4.2. Profile of the sampled households in Kombolcha city

4.2.1. Demographic characteristics

The demographic characteristics of households are collected concerning their potential to adapt, cope, and recover from potential hazards the city may face and their capacity to engage themselves in mitigation or adaptive measures. Therefore, the data collected include family size, marital status, level of educational attainment, employment, and source income. Moreover, access to services and utilities form part of this particular discussion.

a) Family size of the sampled households

The data collected on the family size of the sampled households revealed the following result.

Table 4:1: Average family size of sampled households

No	**Family size**	**Frequency**	**Percentages (%)**	**Cumulative**	**Average**
1	Less than or equal to 2	43	10.75%	2*43 = 96	The mean value is $\frac{1994}{400}$ = 4.98 i.e., close to five persons per household.
2	3-5	160	43.00%	4*160 = 640	
3	6-8	135	35.00%	7*135 = 945	
4	8-10	41	10.25%	9*41 = 369	
5	Greater than 10	4	1.00%	10*4 = 40	
	Total (N)	400	100.00	**1994**	

Source: Computed by the author (2020)

Based on Table 4:1, the mean figure obtained is very close to the national urban family size declared by the Central Statistical Agency of Ethiopia in 2019, which is 5.00.

b) Marital status

Data on the marital status of households were collected and tabulated in Table 4:2.

.

Table 4:2 Marital status of household heads

No	Marital Status	Frequency	Percentage
1	Married	353	88.25%
2	Single	28	7.00%
3	Widowed	12	3.00%
4	Divorced	7	1.75%
	Total	400	100.00%

Source: Computed by the author (2020)

Based on Table 4:2, close to 88% of the sampled household heads are married, while single-headed families account for 7%. Widowed and divorced take about 3.00% and nearly 2%, respectively.

4.2.2. Education

The educational achievements of the questionnaire respondents were collected, and about 65% of them have completed tertiary education: either graduated from a University, College, or TVET institution (Figure 4:1).

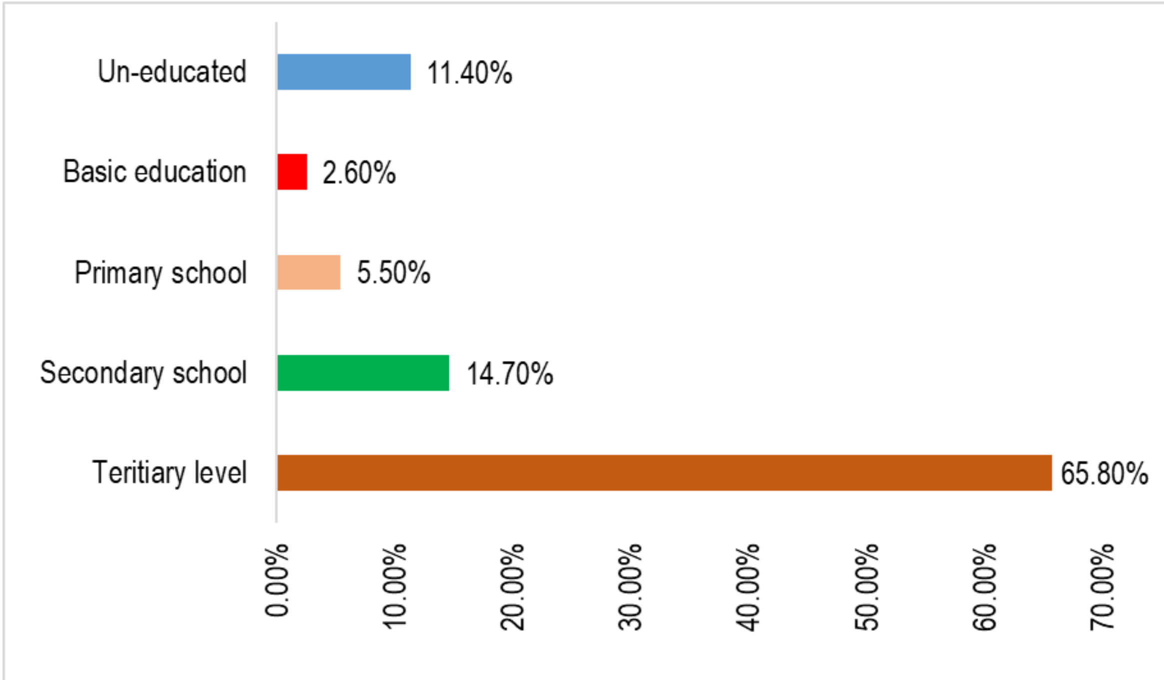

Figure 4:1 Educational achievements of sampled household heads
Source: Computed by the author (2020)

Based on Figure 4:1, the proportion of household heads completing primary and basic education is about 5.5% and 2.6%, respectively. The Figure further depicts that about 66% of the households have attended tertiary education (University, College, and Technical and Vocational Education Training(TVET), and close to 15% have completed secondary school. However, close to 11% of the household heads do not have formal educational achievements and are un-educated, i.e., unable to read and write.

4.2.3. Employment

Those sections of the society with a tertiary level of education got employment at different institutions, and Figure 4:2 reveals the respondents' employment status.

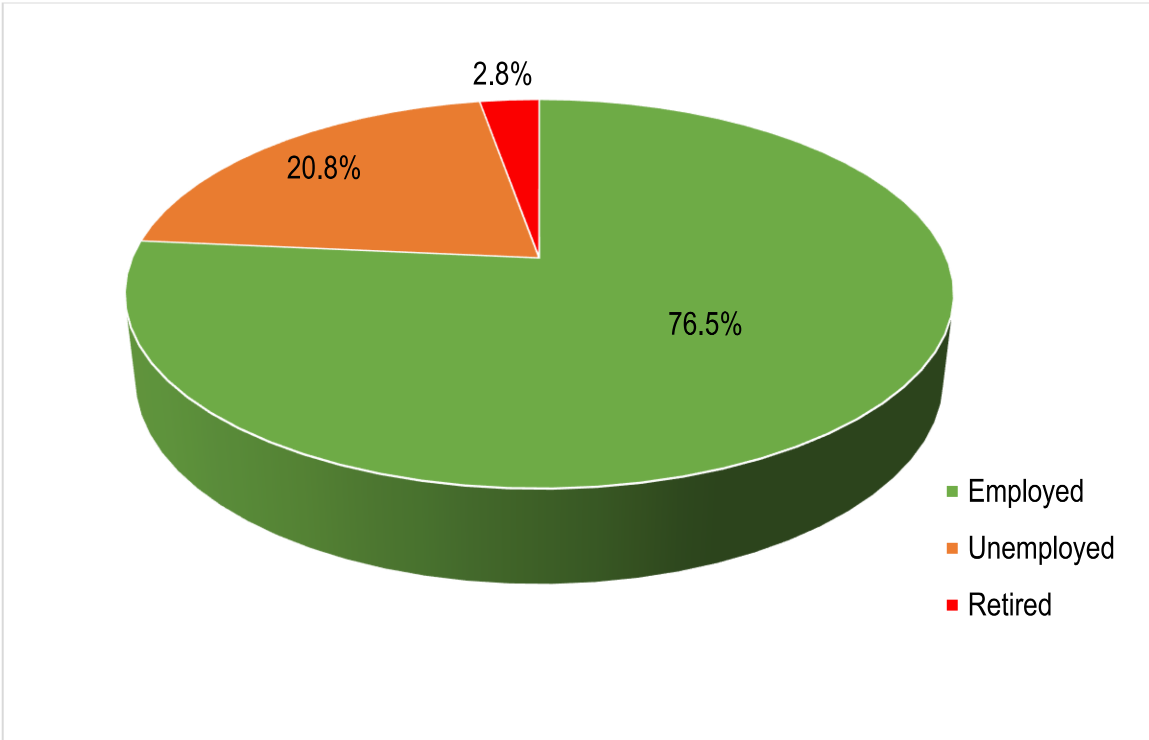

Figure 4:2 Employment status of sampled household heads
Source: Computed by the author (2020)

Figure 4:2 reveals that about 77% of the household heads included n the questionnaire survey are employed, while the rest are formally unemployed.

Currently, the households are engaged in various economic activities and earn their livelihoods in various employment opportunities (Figure 4:3).

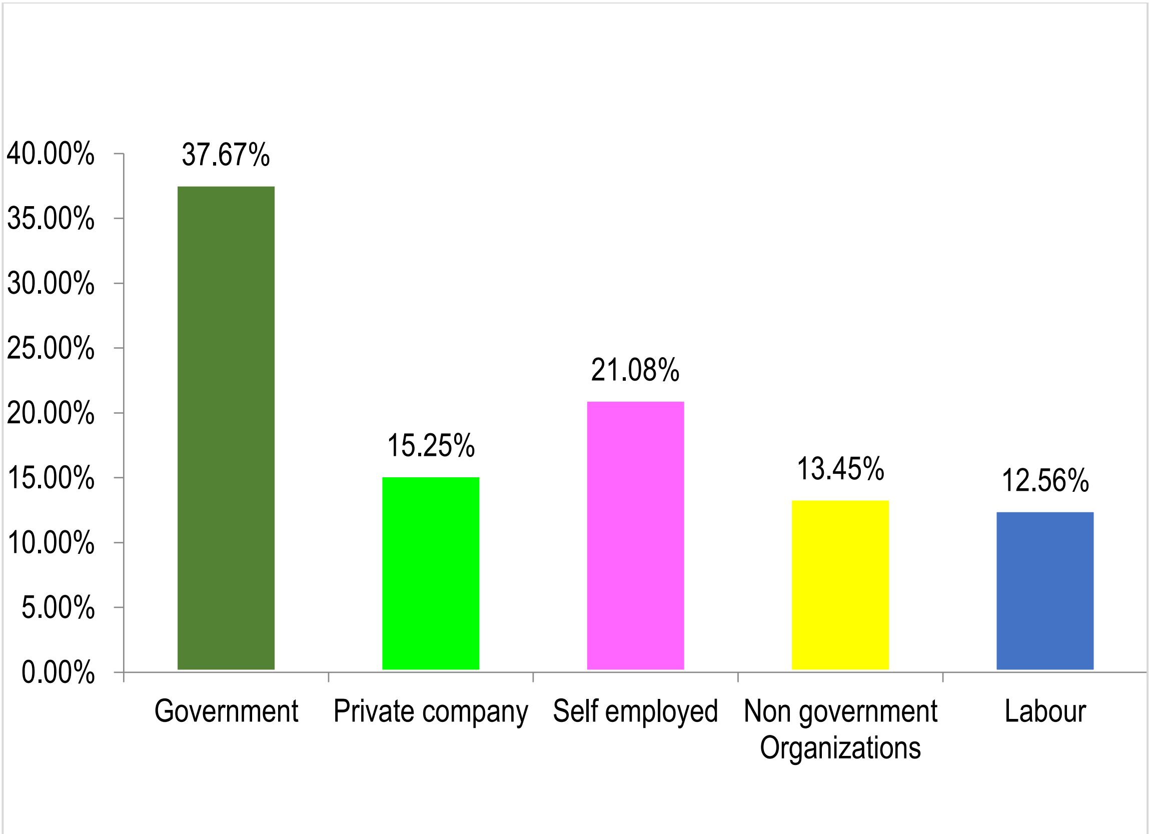

Figure 4:3 Source of income for household heads
Source: Computed by the author (2020)

Based on Figure 4:3, nearly 37% of the sampled household heads are government employed, while about 21% are self-employed. Those household heads employed in a private company, NGOs, and daily laborers are nearly 15%, 135, and 13%, respectively.

4.2.4. Access to basic infrastructures by the sample households

i. Sanitation services

Sanitation services included waste disposal sites, sewage systems, and pollution of rivers. The study results accounted for all these has found that about 30% of the sampled inhabitants of Kombolcha city revealed that they do not have the basic sanitation services at their disposal.

ii. Utilities: electric and water

Electric supply, potable water, and fixed-line telephone systems are utilities directly linked with urban uncertainties.

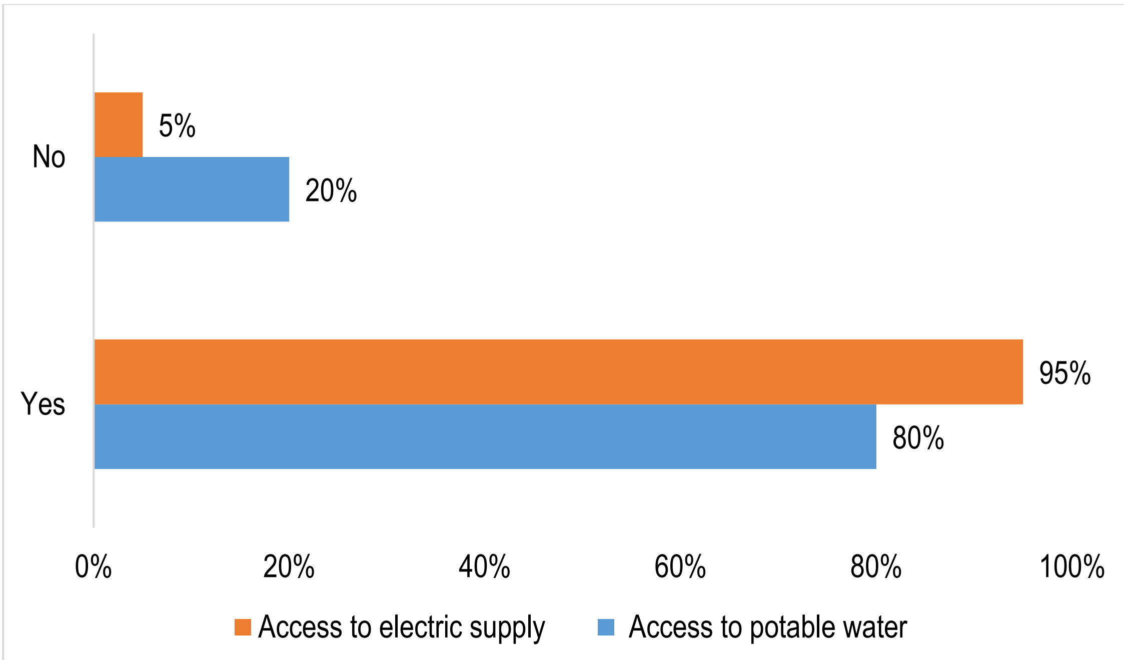

Figure 4:4: Access to utilities by households in Kombolcha city
Source: Computed by the author (2020)

Figure 4:4 indicates that nearly 95% of the sampled households have direct access to grid-based electric supply. In comparison, about 80% of them disclosed that their plot has direct access to potable water provided by the municipality.

4.3. Results

Environmental and physical factors affecting the spatial resilience of Kombolcha city The sampled households' perceptions are considered to reveal the most significant and recurring environmental and physical urban problems affecting the city's development and its inhabitants' well-being. However, the country's 2017 UCRS and the 2018 resilient Addis project office documents on urban problems in Ethiopia are used to extract the resilience issues used for analysis.

The factor loading values, computed for principal component analysis, facilitated the grading of the urban problems to rank the urban challenges (Table 4:3), explaining the city's vulnerability to the hazards as high, moderate, and low to the related problems.

Table 4:3 depicts Carriho's grading scale, dependent on the factor loadings of the variables considered, to establish a standardized and normalized scale that fits the AHP model.

Table 4:3 Grading of the environmental and physical urban challenges in Kombolcha city

No	**Environmental and physical urban challenges**	**Factor loading values (vulnerability)**			**Grading (score 1 -10)**
		1 (High)	**2** (Moderate)	**3** (Low)	
1	Poor sanitation	.912	.060	-.270	10
2	Poor waste management	.911	-.170	.191	9
3	Poor drainage facilities	.903	.101	-.248	9
4	Urban pollution	.901	.195	-.145	8
5	Traffic accidents	.897	.082	-.199	8
6	Traffic congestion	.889	-.034	.245	8
7	Poor infrastructure	.878	-.174	.289	7
8	Urban expansion	.872	.005	-.305	6
9	High wind	.865	.158	-.151	6

10	Water scarcity	.852	-.069	-.195	6
11	Earthquake hazard	.835	-.200	.021	5
12	Flood hazard	.831	-.056	.267	4
13	Lack of green spaces	.817	-.120	-.307	4
14	Lack of public parks	.817	-.171	.282	3
15	Landslide hazard	.798	.418	.083	3
16	Deforestation	.767	.448	.087	2
17	Fire outbreak	.738	-.425	.176	1

Source: Computed by the author (2020)

Table 4:3 further shows that the factor loading values for all the urban problems fall under the high vulnerability of the city to all the problems identified. The highest grading score is assigned to the urban problems with the highest factor loading, and vice versa is true for the lower values. Consequently, the Table shows that poor sanitation takes the highest score with 10, followed by poor waste management and poor drainage facilities with a grading value of 9.

The table depicts three urban problems: urban pollution, traffic accidents, and traffic congestion graded as 8, while the loading value for poor infrastructure is 7. Grade score six is constituted by urban expansion, high wind, and water scarcity urban challenges, whereas earthquake hazard is assigned with a score value of 5. The flood hazard and lack of green spaces account for a grade tally of 4. According to the Table, the lower grade is constituted by deforestation and fire outbreaks with a respective 2 and 1 grading rank.

4.3.1.1. Level of the urban uncertainties in Kombolcha city

The grading in Table 4:3 has enabled the thesis to apply Equation 3-2 in section 3.3.4.2 of this paper and provided the results in Table 4:4 to compute a pairwise comparison among the environmental and physical variables and convert the problems grading values to fit the AHP model.

Table 4:4 Results of grading of environmental and physical urban problems based on Equations 3-2

No	Physical and environmental urban problems	**Water scarcity**	**Wind**	**Fire**	**Earthquake**	**Urban growth**	**Lack of Green spaces**	**Lack of Public Parks**	**Traffic accident**	**Traffic congestion**	**Poor sanitation**	**Urban Pollution**	**Poor Infrastructure**	**Landslide**	**Surface flooding**	**Deforestation**	**Poor drainage facilities**	**Poor solid waste**
No	**Carrilho Grading**	**6**	**5**	**1**	**5**	**6**	**3**	**4**	**8**	**8**	**10**	**8**	**9**	**3**	**4**	**2**	**9**	**9**
1	Water scarcity	**0.00**	0.18	0.11	0.18	0.22	0.14	0.16	0.36	0.36	1.00	0.36	0.53	0.14	0.16	0.12	0.53	0.53
2	Wind	5.44	**0.00**	0.11	0.18	0.22	0.14	0.16	0.36	0.36	1.00	0.36	0.53	0.14	0.16	0.12	0.53	0.53
3	Fire outbreak	9.00	9.00	**0.00**	0.18	0.22	0.14	0.16	0.36	0.36	1.00	0.36	0.53	0.14	0.16	0.12	0.53	0.53
4	Earthquake	5.44	5.44	5.44	**0.00**	0.22	0.14	0.16	0.36	0.36	1.00	0.36	0.53	0.14	0.16	0.12	0.53	0.53
5	Urban growth	4.56	4.56	4.56	4.56	**0.00**	0.14	0.16	0.36	0.36	1.00	0.36	0.53	0.53	0.16	0.12	0.53	0.53
6	Lack of Green spaces	7.22	7.22	7.22	7.22	7.22	**0.00**	0.16	0.36	0.36	1.00	0.36	0.53	0.14	0.16	0.12	0.53	0.53
7	Lack of Public Parks	6.33	6.33	6.33	6.33	6.33	6.33	**0.00**	0.36	0.36	1.00	0.36	0.53	0.14	0.16	0.12	0.53	0.53
8	Traffic accident	2.78	2.78	2.78	2.78	2.78	2.78	2.78	**0.00**	0.36	1.00	0.36	0.53	0.14	0.16	0.12	0.53	0.53

No	Physical and environmental urban problems	Water scarcity	Wind	Fire	Earthquake	Urban growth	Lack of Green	Lack of Public	Traffic accident	Traffic congestion	Poor sanitation	Urban Pollution	Poor	Landslide	Surface flooding	Deforestation	Poor drainage	Poor solid waste
	Carrilho Grading	**6**	**5**	**1**	**5**	**6**	**3**	**4**	**8**	**8**	**10**	**8**	**9**	**3**	**4**	**2**	**9**	**9**
9	Traffic congestion	2.78	2.78	2.78	2.78	2.78	2.78	2.78	2.78	**0.00**	1.00	0.36	0.53	0.14	0.16	0.12	0.53	0.53
10	Poor sanitation	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	**0.00**	0.36	0.53	0.14	0.16	0.12	0.53	0.53
11	Urban Pollution	2.78	2.78	2.78	2.78	2.78	2.78	2.78	2.78	2.78	2.78	**0.00**	0.53	0.14	0.16	0.12	0.53	0.53
12	Poor Infrastructure	1.89	1.89	1.89	1.89	1.89	1.89	1.89	1.89	1.89	1.89	1.89	**0.00**	0.14	0.16	0.12	0.53	0.53
13	Landslide	7.22	7.22	7.22	7.22	7.22	7.22	7.22	7.22	7.22	7.22	7.22	7.22	**0.00**	0.16	0.12	0.53	0.53
14	Surface flood	6.33	6.33	6.33	6.33	6.33	6.33	6.33	6.33	6.33	6.33	6.33	6.33	6.33	**0.00**	0.12	0.53	0.53
15	Deforestation	8.11	8.11	8.11	8.11	8.11	8.11	8.11	8.11	8.11	8.11	8.11	8.11	8.11	8.11	**0.00**	0.53	0.53
16	Poor drainage facilities	1.89	1.89	1.89	1.89	1.89	1.89	1.89	1.89	1.89	1.89	1.89	1.89	1.89	1.89	1.89	**0.00**	0.53
17	Poor waste management	1.89	1.89	1.89	1.89	1.89	1.89	1.89	1.89	1.89	1.89	1.89	1.89	1.89	1.89	1.89	1.89	**0.00**
	Sum	**74.67**	**69.41**	**60.44**	**55.33**	**51.10**	**43.69**	**37.61**	**36.41**	**33.99**	**39.11**	**30.93**	**31.27**	**20.27**	**13.94**	**5.50**	**9.83**	**8.47**

Source: Computed by the author (2020)

The vertical sum in Table 4:4 reveals the highest value for water scarcity and the lowest value for deforestation, with 74.67 and 5.50, respectively.

The sum of the values for each of the urban problems corresponding to Carrilho's grading is considered for pairwise comparison made among the variables in AHP, and the analysis is indicated in Table 4:5.

.

Table 4:5 Pairwise comparison and ranking of the environmental and physical urban challenges affecting spatial resilience of Kombolcha city

No	**Physical and environmental urban problems**	**Water scarcity**	**Wind**	**Fire**	**Earthquake**	**Urban growth**	**Lack of Green spaces**	**Lack of Public Parks**	**Traffic accident**	**Traffic congestion**	**Poor sanitation**	**Urban Pollution**	**Poor Infrastructure**	**Landslide**	**Surface flood**	**Deforestation**	**Poor drainage facilities**	**Poor waste management**	**Weights of recurrence**	
																			Values	**Percentages**
1	Water scarcity	**0.000**	0.003	0.002	0.003	0.004	0.003	0.004	0.010	0.011	0.026	0.012	0.017	0.007	0.011	0.022	0.054	0.063	0.015	1.48%
2	Wind	0.073	**0.000**	0.002	0.003	0.004	0.003	0.004	0.010	0.011	0.026	0.012	0.017	0.007	0.011	0.022	0.054	0.063	0.019	1.89%
3	Fire outbreak	0.121	0.130	**0.000**	0.003	0.004	0.003	0.004	0.010	0.011	0.026	0.012	0.017	0.007	0.011	0.022	0.054	0.063	0.029	2.92%
4	Earthquake	0.073	0.078	0.090	**0.000**	0.004	0.003	0.004	0.010	0.011	0.026	0.012	0.017	0.007	0.011	0.022	0.054	0.063	0.029	2.85%
5	Urban growth	0.061	0.066	0.075	0.082	**0.000**	0.003	0.004	0.010	0.011	0.026	0.012	0.017	0.026	0.011	0.022	0.054	0.063	0.032	3.19%
6	Lack of Green spaces	0.097	0.104	0.119	0.131	0.141	**0.000**	0.004	0.010	0.011	0.026	0.012	0.017	0.007	0.011	0.022	0.054	0.063	0.049	4.87%
7	Lack of Public Parks	0.085	0.091	0.105	0.114	0.124	0.145	**0.000**	0.010	0.011	0.026	0.012	0.017	0.007	0.011	0.022	0.054	0.063	0.053	5.27%
8	Traffic accident	0.037	0.040	0.046	0.050	0.054	0.064	0.074	**0.000**	0.011	0.026	0.012	0.017	0.007	0.011	0.022	0.054	0.063	0.035	3.45%
9	Traffic congestion	0.037	0.040	0.046	0.050	0.054	0.064	0.074	0.076	**0.000**	0.026	0.012	0.017	0.007	0.011	0.022	0.054	0.063	0.038	3.84%
10	Poor sanitation	0.013	0.014	0.017	0.018	0.020	0.023	0.027	0.027	0.029	**0.000**	0.012	0.017	0.007	0.011	0.022	0.054	0.063	0.022	2.20%

No	Physical and environmental urban problems	Water scarcity	Wind	Fire	Earthquake	Urban growth	Lack of Green spaces	Lack of Public Parks	Traffic accident	Traffic congestion	Poor sanitation	Urban Pollution	Poor Infrastructure	Landslide	Surface flood	Deforestation	Poor drainage facilities	Poor waste management	Weights of recurrence	
																			Values	Percentages
11	Urban Pollution	0.037	0.040	0.046	0.050	0.054	0.064	0.074	0.076	0.082	0.071	**0.000**	0.017	0.007	0.011	0.022	0.054	0.063	0.045	4.52%
12	Poor Infrastructure	0.025	0.027	0.031	0.034	0.037	0.043	0.050	0.052	0.056	0.048	0.061	**0.000**	0.007	0.011	0.022	0.054	0.063	0.037	3.66%
13	Landslide	0.097	0.104	0.119	0.131	0.141	0.165	0.192	0.198	0.212	0.185	0.233	0.231	**0.000**	0.011	0.022	0.054	0.063	0.127	12.70%
14	Surface flood	0.085	0.091	0.105	0.114	0.124	0.145	0.168	0.174	0.186	0.162	0.205	0.203	0.312	**0.000**	0.022	0.054	0.063	0.130	13.02%
15	Deforestation	0.109	0.117	0.134	0.147	0.159	0.186	0.216	0.223	0.239	0.207	0.262	0.259	0.400	0.582	**0.000**	0.054	0.063	0.197	19.73%
16	Poor drainage facilities	0.025	0.027	0.031	0.034	0.037	0.043	0.050	0.052	0.056	0.048	0.061	0.060	0.093	0.135	0.343	**0.000**	0.063	0.068	6.82%
17	Poor waste management	0.025	0.027	0.031	0.034	0.037	0.043	0.050	0.052	0.056	0.048	0.061	0.060	0.093	0.135	0.343	0.192	**0.000**	0.076	7.59%
	Sum	**1.000**	**1.000**	**1.000**	**1.000**	**1.000**	**1.000**	**1.000**	**1.000**	**1.000**	**1.000**	**1.000**	**1.000**	**1.000**	**1.000**	**1.000**	**1.000**	**1.000**	**1.000**	**100.00%**

Source: Computed by the author (2020)

A pairwise comparison in Table 4:5 put deforestation, surface flooding, landslides, poor solid waste management, and inadequate drainage facilities with weights of about 20%, 13%, 12.70%, 8%, and 7% as the top five urban problems in the city. Lack of public parks and green spaces follow with 5.27% and 4.87% values, respectively.

The Table further reveals that urban pollution (4.58%), traffic congestion (3.84%), poor infrastructure (3.66), traffic accidents (3.45%), and urban growth (3.19%) are the urban problems that the households' marked necessary next to lack of public parks and green spaces with a tally of 5.27% and 4.87%, correspondingly.

The Table also attests that fire outbreaks, earthquakes, and poor sanitation, are among the urban problems, with corresponding weights of 2.92%, 2.85%, and 2.20% recurring in the city. The last but not the minor urban problems are ranked, based on Table 4:5, are wind-related and water scarcity challenges with respective recurring weights of 1.89% and 1.48%.

4.3.1.2. Rating the severity of the environmental and physical factors in Kombolcha city

The city's vulnerability to the urban shocks and stresses ranked in Table 4:5 is also measured in their severity level: critical, severe, moderate, and minor (Table 4:6).

Table 4:6 Decision criteria to determine the severity of the environmental and physical urban challenges affecting the spatial resilience of Kombolcha city.

No	Decision criteria	Water scarcity	Wind	Fire	Earthquake	Urban growth	Lack of Green spaces	Lack of Public Parks	Traffic accident	Traffic congestion	Poor sanitation	Urban Pollution	Poor Infrastructure	Landslide	Surface flood	Deforestation	Poor drainage facilities	Poor waste management	MMULT (Water scarcity: poor solid waste management (sum of the row in Table 4.6), ($ water scarcity: $ poor waste management (a fixed sum of weights column in Table 4.5)	
1	Severe	67%	12%	46%	54%	33%	49%	47%	48%	33%	62%	14%	63%	59%	51%	70%	11%	47%	**49.48%**	Highest is recommended
2	Major/ significant	33%	40%	31%	46%	36%	40%	40%	29%	36%	38%	37%	37%	41%	35%	30%	40%	37%	36.19%	
3	Moderate	0%	26%	13%	0%	17%	6%	6%	15%	17%	0%	18%	0%	0%	4%	0%	28%	5%	6.85%	
4	Minor	0%	22%	10%	0%	15%	5%	7%	7%	15%	0%	32%	0%	0%	10%	0%	21%	10%	7.48%	
	Sum	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	

Source: Computed by the author (2020)

Table 4: shows that Kombolcha city is severely and significantly affected by urban problems specific to spatial resilience, with respective values of close to 49.48% and 36.19%. In comparison, close to 6.85% and 7.48% of the respondents recognized the moderate and minor occurrences of the urban problems, respectively.

4.3.1.3. Urban environmental setting as a factor affecting spatial resilience of Kombolcha city

Primary and secondary data sources are used to validate the combined results of the factor analysis and AHP. Household energy sources, building materials for constructing residential houses, data on informal settlements, solid waste management, and previous flood events in the city were prominent data used.

4.3.1.3.1. **Material and resource consumption: forest and energy resources**

Under oath, the former Red-Cross society Kombolcha branch manager notes that Yeguf Mountain covering the Northern escarpment of the city has lost its natural appeal due to the intense cutting of trees. The agents in this regard are community members and public institutions.

The 2010 and 2020 Land Use Land cover change detercted for the city reveal the occurrence of intnese deforesttion for various purposes (Figure 4:5).

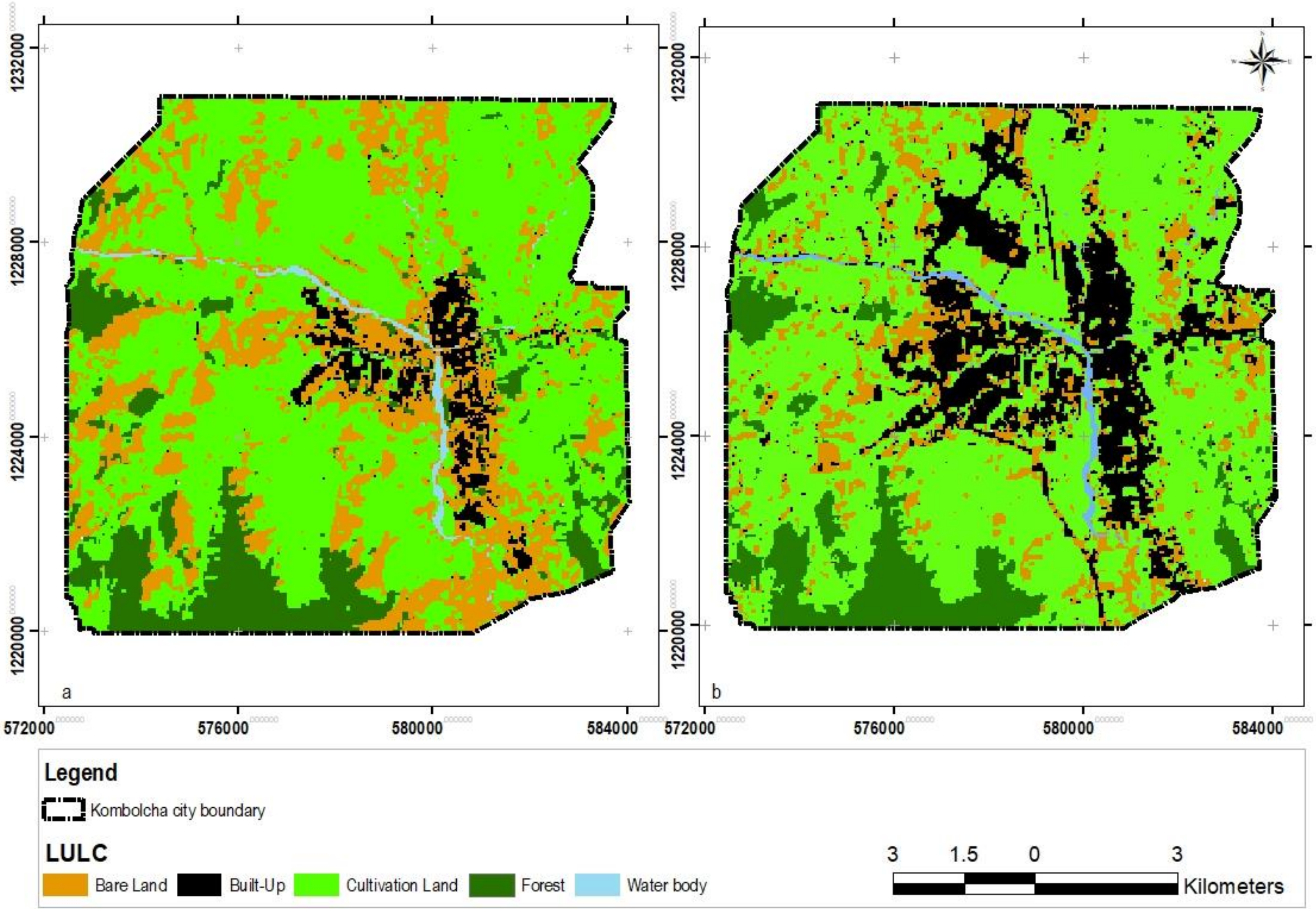

Figure 4:5 the 2010 (a) and 2020 (b) LULC map of Kombolcha city
Source: Landsat 7 ETM+ and Landsat 8 OLI accessed on June (2022)

Figure 4:5 shows the land cover/use map of Kombolcha city in 2010 and 2020. The map depicts significant changes in the built-up spaces and a reduction in cultivation land (Table 4:4).

Table 4:4 2010 and 2020 land use/cover analysis of Kombolcha city

LULC Class	**LULC 2010**		**LULC 2020**		**Change**
	Area (Ha)	**Percentage (%)**	**Area (Ha)**	**Percentage (%)**	**(2010 - 2020)**
Bare Land	2988.00	24.00%	1668.3	13.40%	11% Reduction
Built-Up	498.00	4.00%	1899.87	15.26%	**11% Increment**
Cultivation Land	7345.50	59.00%	7470	60.00%	1% Reduction
Forest	1494.00	12.00%	1287.33	10.34%	2% Reduction
Waterbody	124.50	1.00%	124.5	1.00%	No change
Sum	12450.00	100.00%	12450.000	100.00%	

Source: Computed by the author (2020)

Based on Table 4:4, the bare land has decreased by 11%, and the inverse is true for the built-up area, which increased by the same proportion. The forest area shows a reduction of close to 2%. As per Annex 1, this land cover has been used to construct buildings and roads.

Simultaneously, a study conducted by IPE Global in 2017 backs the assertions made by the key informant. The IPE study depicts deforestation and poor soil, and water conservation measures contribute significantly to the city's severe landslides, soil erosion, and flooding challenges. The construction office head elucidates that the main reasons for cutting the forest products are household cooking, heating, and construction of residential buildings.

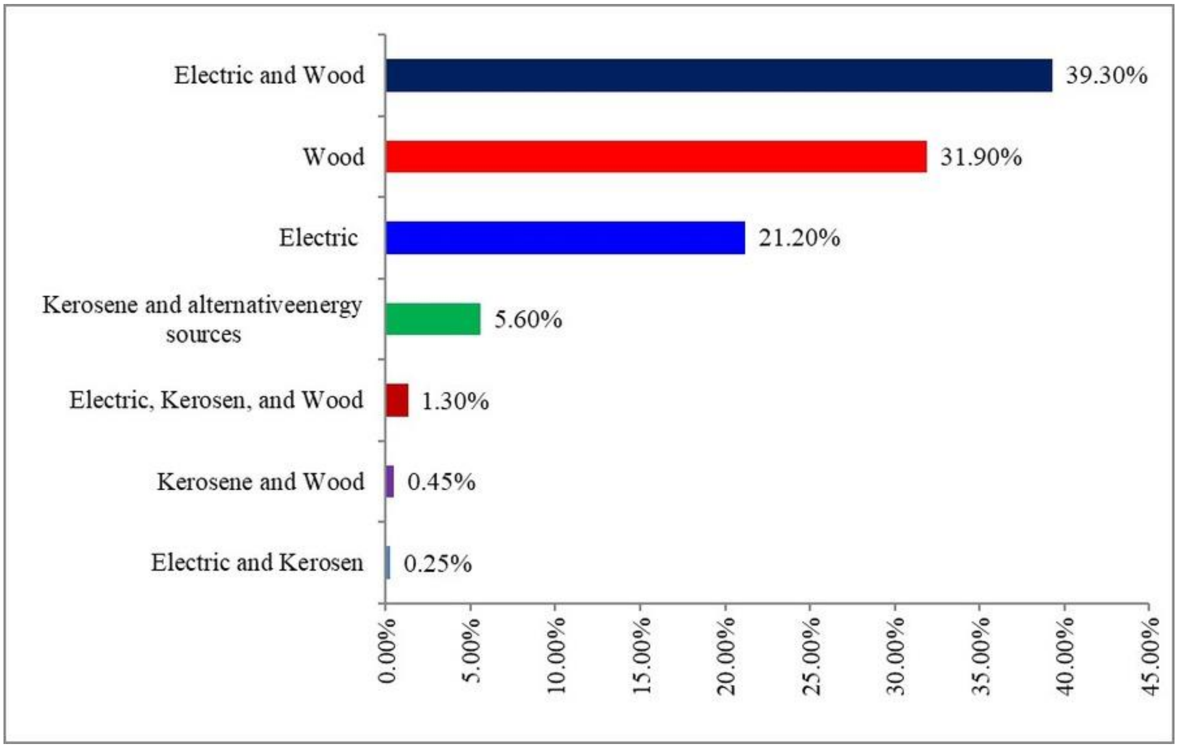

Figure 4:6 Proportion of energy resources used for cooking and heating purposes by the sampled households
Source: Computed by the author (2020)

Figure 4:6 depicts that more than one-third of the sampled households depend on wood, a traditional energy source, for cooking and heating purposes. However, the proportion is above this figure because the households use combined energy sources: wood with electricity and kerosene.

It is illustrated in Figure 4:6 that the simultaneous use of both wood and electricity constitutes about 39% of the energy sources. Figure 4:6 also depicts that nearly 20% of households depend on grid-based electricity for cooking and heating purposes.

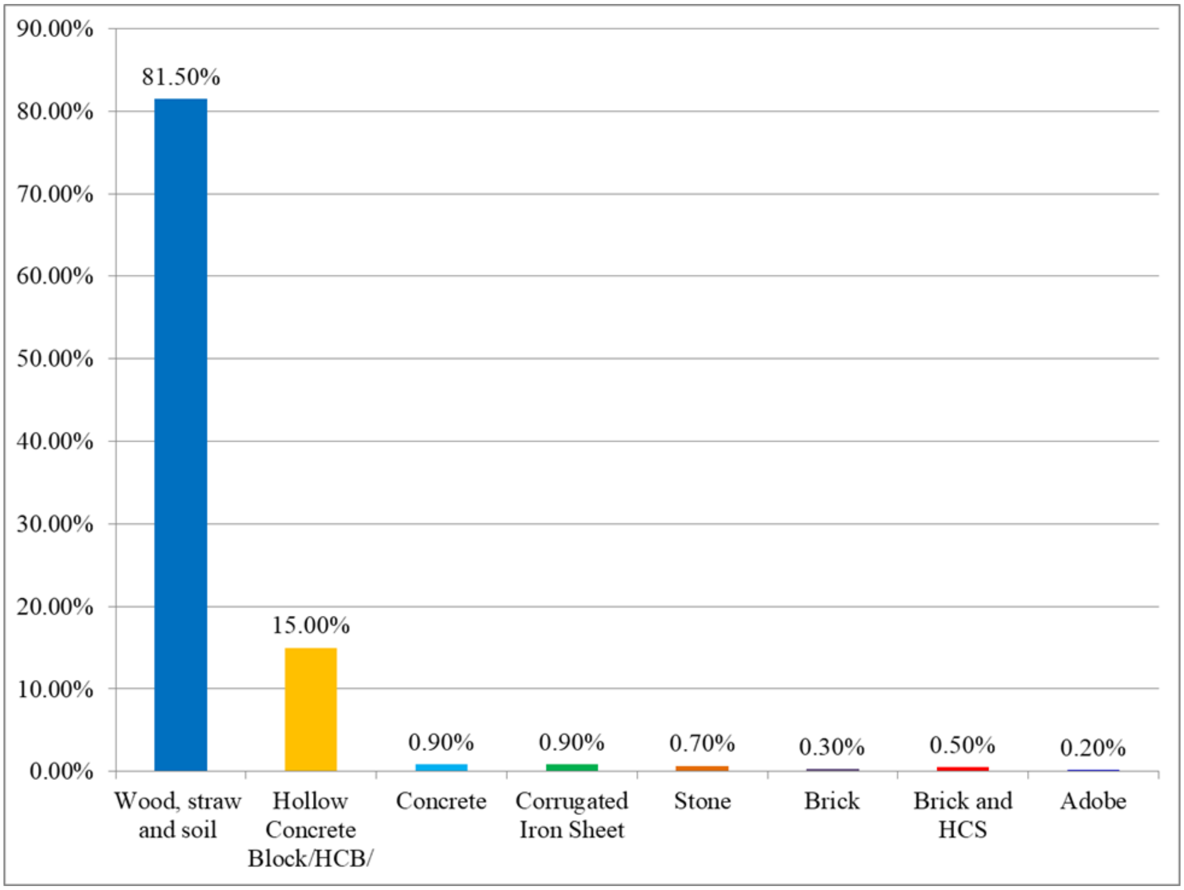

Figure 4:7 Proportion of construction materials used for constructing low-rise residential houses by the sampled households Source: Computed by the author (2020)

Concerning the use of forest products to construct residential low-rise buildings, Figure 4:7 demonstrates that more than 80% of the sampled households use wood and straw to construct their houses. The figure also shows that only 15% of the households use Hollow Concrete Blocks/HCB/ to construct their residential units.

Regarding the construction material uses, the key informants from the Urban Plan Implementation, Follow-up, and feedback Case Team explicate that informal settlements contribute greatly to depleting the forest's natural resources. The 2011 Structure Plan attests that one-ninth of the residential units in the city were informal in 2010. The city's Asset Management Plan ArcGIS document shows that close to 60.12 ha of the protected forest areas proposals of the SP are invaded and occupied by informal settlements in 2020. The forest products are supplied with two options: purchasing and cutting trees.

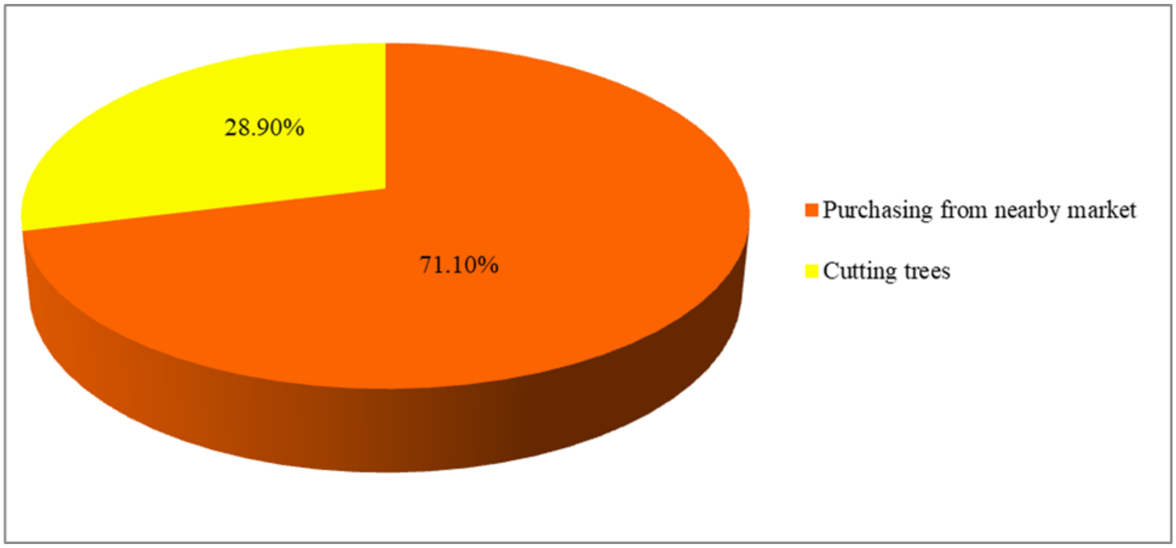

Figure 4:8 Proportion of options available to obtain the forest products in Kombolcha city
Source: Computed by the author (2020)

According to Figure 4:8, nearly 29% of the study participants obtain tree products from cutting trees found on their premises, nearby mountainous areas, or villages. More than 70% of households obtain wood from nearby markets. In this vein, the city environmental protection and urban agriculture office's key informant revealed that Kombolcha city and the adjoining rural areas are the major contributors to local forest products marketing in the city.

4.3.1.3.2. **Flood occurrence**

The Key informants from environmental protection, urban agriculture, urban planning, implementation, and follow-up case teams reveal that surface flooding is another urban problem in the city. In this circumstance, the 2013 drainage master plan of the city indicates that surface flooding affects urban settlements found at the foot of the Mountains. The main consequences in these urban areas included the destruction of fences and sedimentation of residential premises and buildings. In line with this, the Kombolcha city communication affairs office claims that a flooding event in April 2017 caused damages to the city's urban properties (Figure 4:9).

Figure 4:9 Households (a,b,d) and fences (c) affected by flooding and clearing the mud sediments (a,b)
Source: Computed by the author (2020)

Figure 4:9 shows the flooding event that destroyed fences (c) and affected individual households (a, b, and d). The Red Cross Society discloses that flooding in 2002 killed four people in another setting.

As per Figure 4:5, the land cover changes of the city show a significant increase in the impervious layers by 11%, which indicates the potential inundation of the city with flooding. Annex 1 also shows that about 2% of the land cover of the river banks is changed into built-up areas dominated by residential buildings.

4.3.1.4. Physical /Built environment and infrastructure/ as a factor affecting spatial resilience of Kombolcha city

4.3.1.4.1. Type, condition, and availability of drainage lines

The physical infrastructures considered in this specific part of the thesis are drainage facilities and roads that greatly contribute to the spatial resilience of the study area. Thus, the study results revealed that only nearly one-third of households have access to drainage facilities to accommodate stormwater in the rainy season. At the same time, the proportion of households with direct access to either earthen, gravel, flagged stone, cobblestone, or asphalt road is about 75% (Figure 4:10).

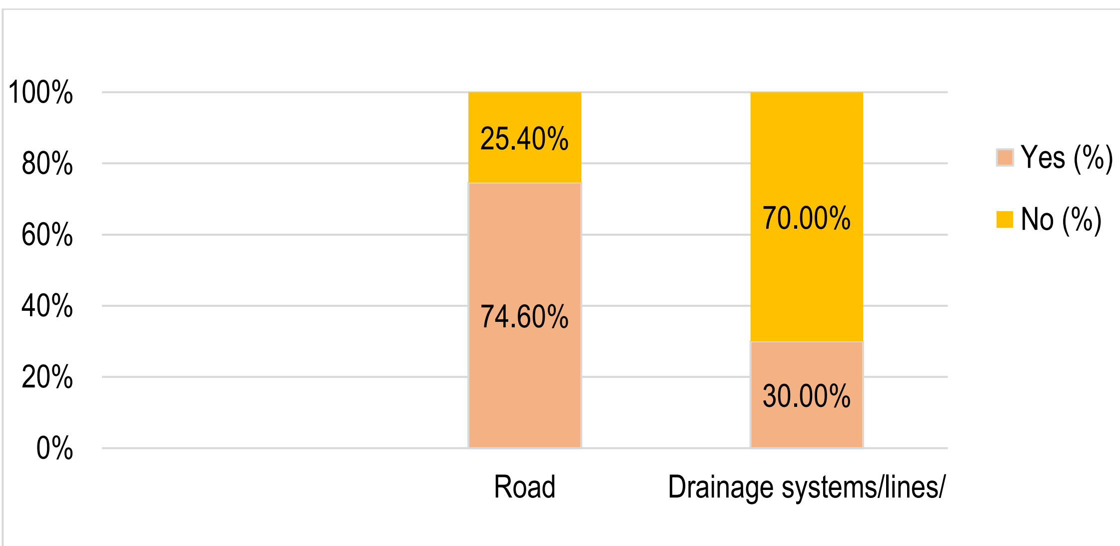

Figure 4:10 Access to physical infrastructures by the sampled households
Source: Computed by the author (2020)

As per Figure 4:10, about 45% of the sampled households with access roads also lack the provision of urban drainage systems that facilitate rainwater discharge. The site observation and the AMP (2020) of the city showed that the existing drainage system of the city is characterized as closed and open ditches (Figure 4:11).

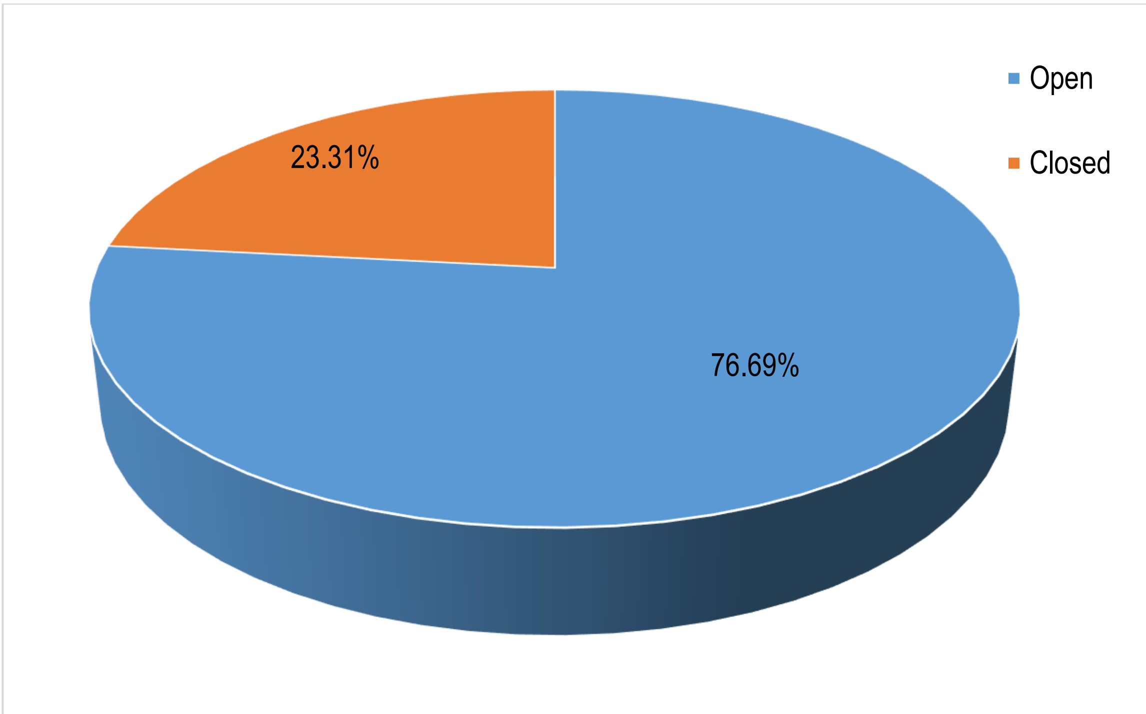

Figure 4:11: Drainage systems of Kombolcha city
Source: Computed by the author (2020)

According to Figure 4:11, the Open ditches cover about three-fourths of the existing drainage coverage of the city. However, the AMP depicts that only 30% of the roads in the city have either closed or open ditches.

The AMP depicted that the materials used for the construction of the drainage lines are masonry, concrete, and earthen (creation of channels on earthen roads)

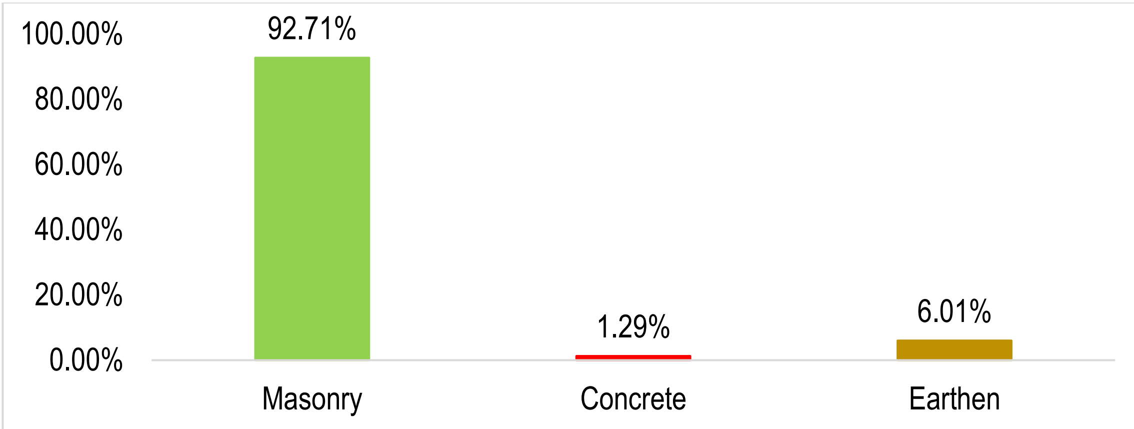

Figure 4:12: Materials used for the construction of the existing drainage lines in Kombolcha
Source: Computed by the author (2020)

The same document alludes to the existing drainage lines' conditions, as shown in Figure 4:13 and Figure 4:14. Classifying the drainage lines as bad is attributed to the need for new construction of either open or closed ditches. The moderate condition is associated with clearing the waste clogging the drainage system and undertaking maintenance. The good condition reveals that the drainage lines' construction is not damaged and can serve for more years (Figure 4:13).

Figure 4:13 depicts the condition of drainage lines in Kombolcha city, as revealed from the site observation made in 2019.

Consequently, Figure 4:14 divulges that close to 40% of the drainage line in the city are in poor condition, and about 43% are in good condition. The AHP assured that more than 50% of the drainage systems need timely and periodic maintenance.

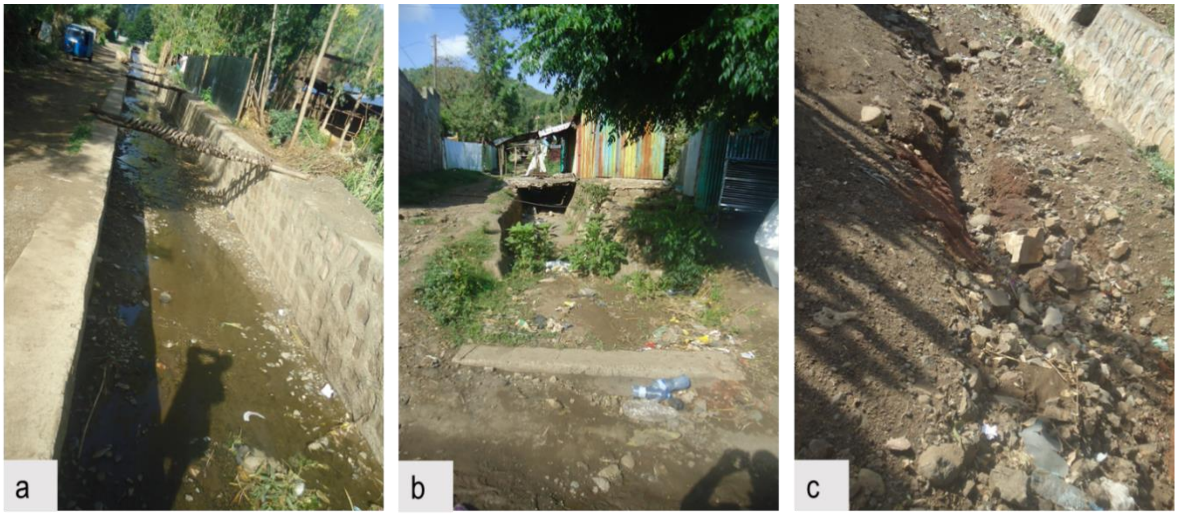

Figure 4:13 conditions of the existing drainage lines: good (a), moderate (b), and bad (c)
Source: Field visits (2020)

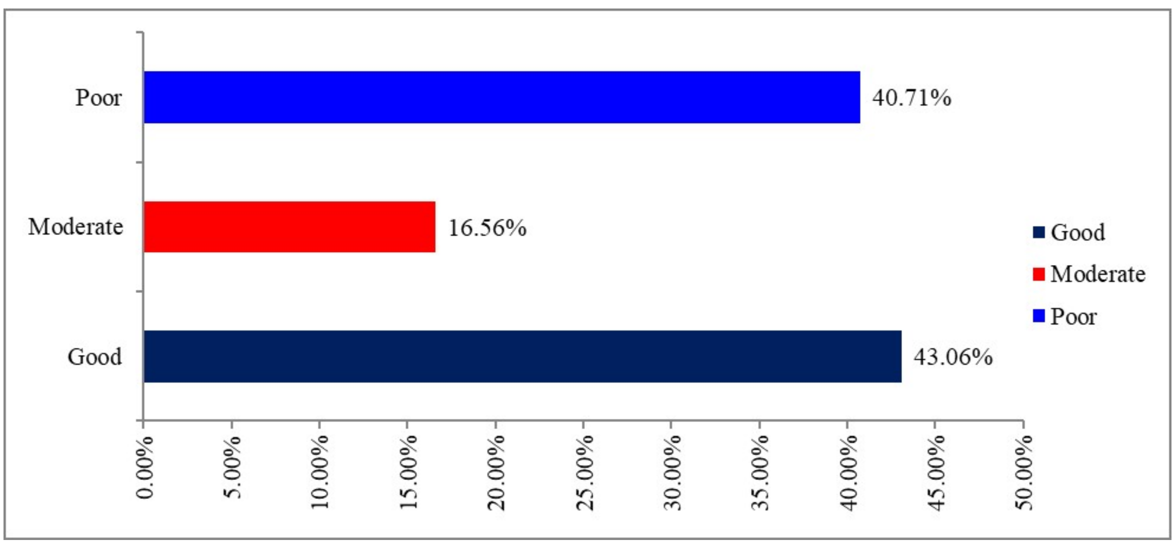

Figure 4:14 Proportion of drainage lines conditions in Kombolcha city
Source: Computed by the author (2020)

4.3.1.4.2. **Solid waste management infrastructures**

Yimer and Sahu (2014) present that the city's daily solid waste generation rate is 0.179kg per day. Consistently, a study conducted by Construction Design Share Company /CDSCo/ in 2005 reveals that the city's solid waste collection efficiency is only 15%. The remaining wastes are dumped into open spaces, drainage lines, and river channels.

Flooding is also attached to poor solid waste management and inadequate drainage facilities, claim the key informants from the city environmental protection office. Figure 4:15 reveals that riverbanks and open spaces in the city serve as waste disposal sites. The existing drainage lines, particularly the open ditches, are the elements of poor solid waste management practices (Figure 4:15 a).

Figure 4:15 Open ditches filled with solid wastes
Source: Computed by the author (2020)

The AMP (2020) indicates that the landfill site is constructed to serve for twenty years starting from 2006, with four compartments for five years each, and when one compartment exhausts, the second will start serving (KCA, 2020). However, the site visit reveals that the site is full of solid waste dispersed all over the compound, and the surrounding open places are used for solid waste dumping (Figure 4:16 a).

Based on Figure 4:16b, riverbanks, Borkena river in particular, still serve as solid waste dumping locations in the city. Furthermore, Figure 4:16c indicates that the riverbanks are places to locate substandard waste transfer stations. The figure further reveals the layers (Figure 4:16d) created by poor solid waste management, affecting the riparian ecosystem.

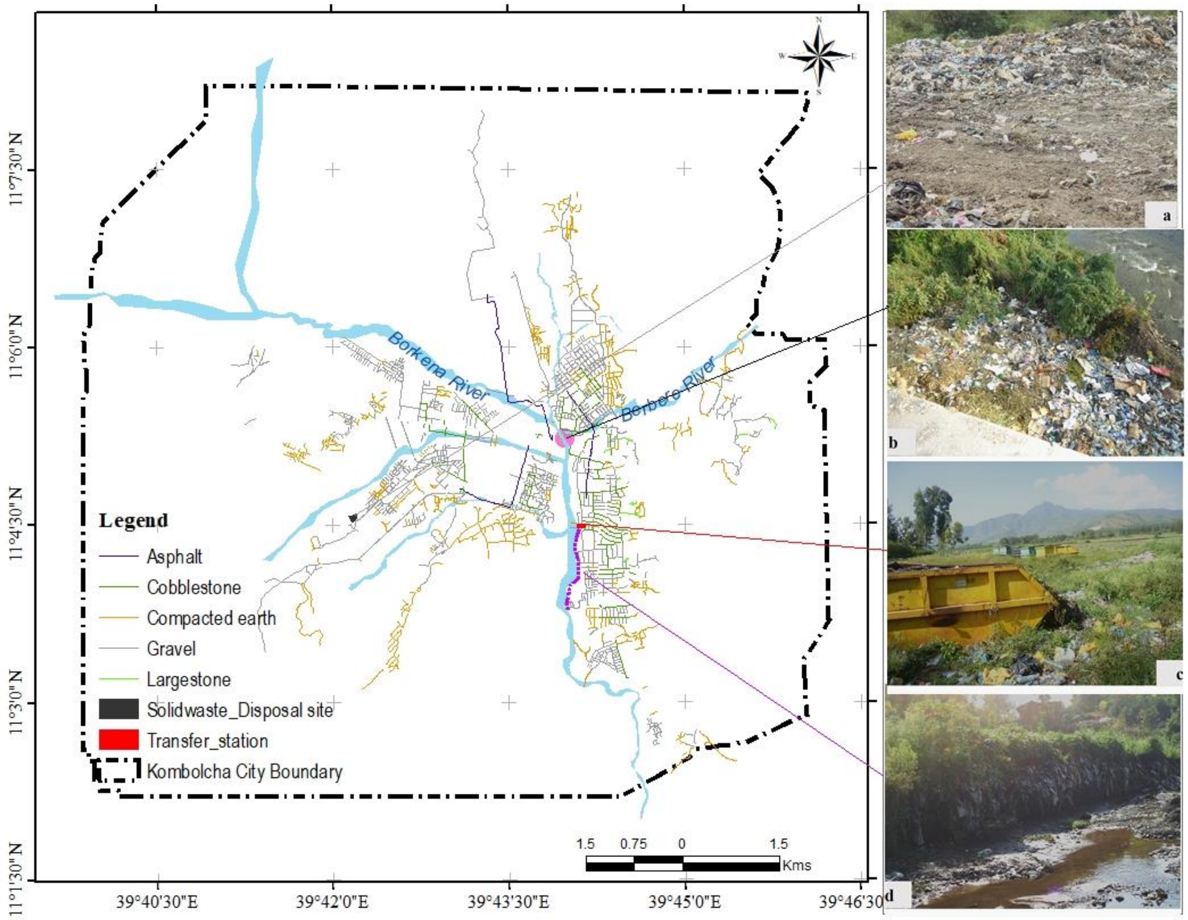

Figure 4:16 Solid waste management infrastructures in Kombolcha city: landfill site (a), open dumping (b), transfer station(c), and solid waste layers along river banks (d)
Source: KCA, (2020) and filed visit (2019)

Figure 4:16 shows various locations in the city that are being used for dumping solid wastes generated by various urban functions of the city. In this vein, KCA (2020); Yimer and Sahu (2014) concluded that the open dumping, substandard landfills, and waste transfer station are becoming a health concern for the city residents through the land, water, and air pollution of the surrounding areas. Yimer and Sahu

(2014) quoted that inadequate solid waste collection service and the Presence of litter and inappropriate piles of solid waste as the main health-related problem of the households in the city.

4.3.1.4.3. Traffic accidents and congestion

The 2011 Structure Plan of the city indicated that the city center's open market, bus station, and livestock market are generating high traffic in the city. Furthermore, the key informant from the Urban Plan Implementation Case team and the city residents acknowledged that the industrial park, the new dry port, and the airport had become a new hub for traffic accidents and congestion in Kombolcha city.

This key informant further claims that the land-use changes made by the regional and federal institutions have contributed a lot to introduce the unanticipated urban problem. The informant notes that the 2011 city's structure plan proposals had been highly compromised due to such intervention and imposition. It is raised that the mixed-use and residential proposal were changed into industrial and dry port functions in 2016 and 2017 (Figure 4:17).

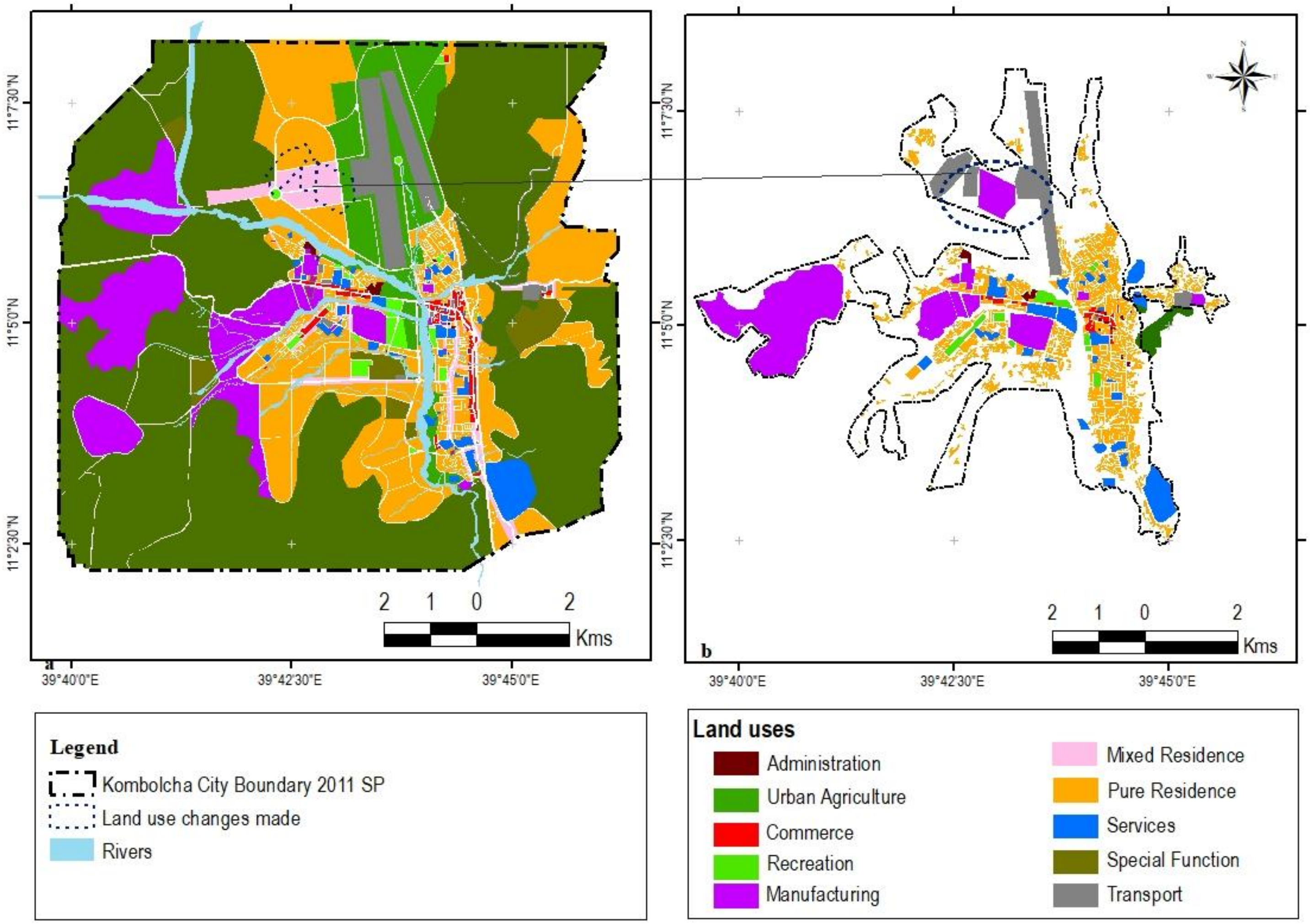

Figure 4:17 The 2011 Structure Plan land-use proposals (a) and 2020 existing land- uses (b)
Source: KCA (2011);(2020)

Figure 4:17 reveals that three major land uses of the 2011 Structure Plan proposals, Mixed-use, Pure Residence, green recreation, and forest areas, have been converted into industrial parks and dry port sites. The Water Service enterprise of the city has also declined to accept the changes made due to the waterlogging nature of the areas where major boreholes are located. The head fears that the city may be non-water resilient shortly.

The key informant from the infrastructure case team notes that these urban functions have overburdened the existing road networks, which are not redesigned and upgraded to accommodate the demand generated from these uses. The problem is further aggravated by poor and inadequate infrastructure, such as narrow and unpaved roads. According to the AMP, about one-third of the city's existing road surface material is earthen or unpaved roads, with approximately 65% measuring less than six meters wide.

The 2011 SP of the city indicates that traffic congestion in the city is worsened by the lack of alternative roads to be used by freight vehicles. In this context, the city transport office asserts that the urban problem is attributed to the daily high volume of freight transport vehicles originating and departing from the dry port and various industrial establishments and warehouses. On-street parking of heavy items and trucks also aggravated the urban problems.

The traffic accident and congestion problem are further exaggerated by the absence of an alternative bridge on the Borkena River. The Structure Plan and the report by CDKN (2017) attest to multiple transport modalities: inter-regional, inter-urban and intra-urban buses, trucks, mini-busses, taxis, and three-wheeler cars/Bajajs, and carts share the same, few, and narrow streets with pedestrians.

The plan further shows that the proximity of the main market area or public market, the cattle market, and the bus station contributes to serious traffic congestion, particularly on marketing days (Figure 4:18).

Figure 4:18: major land uses generating traffic congestion
Source: Google earth pro (2021) and author (2021)

4.3.1.5. Responses to the urban problems: Adaptation measures

4.3.1.5.1. Planning measures

Enhancing the spatial resilience of Kombolcha city through various intervention mechanisms is the ambition set in the vision statement of the 2011 Structure Plan. They include delineating specific areas for protected forests and provisions of recommendation for the preparation and implementation of supportive plans, such as drainage master plans. Accordingly, the drainage master plan of the city was prepared in 2013 with major shifts in increasing the proportion of drainage lines in the city and enhancing their capacity to handle surface runoffs.

The plan notes the spatial attributes of resilience through runoff coefficients, representing the integrated effects of many drainage basin parameters, determined by land use, soil groups, and land slope. The plan is based entirely on the city's existing land use/morphology and indicates the interventions for gully formation by demonstrating four gully fall and one chute outfall structure.

4.3.1.5.2. Biophysical measures

The sampled households perceive that the urban problems in the city did not force them to evacuate from their area of residence, and they attempt to adapt through the various mechanisms. Accordingly, close to 54% of them reply that they are prepared to adapt to the urban problems. In comparison, about 40% reveal that they are not prepared for any existing and potential future threats, natural and man-made, the city faces. Those households who reveal their preparedness assert three forms of disaster adaptation measures: particularly the bio-physical measures (Table 4:5). However, they do not assert marking evacuation routes and early warning systems.

Table 4:5 Percentage of the household perception of the biophysical measures deployed

No	Adaptation Measures	Percentage of the household perception of the measures deployed
1	Planting Trees	45.30%
2	Physical measures: retaining walls and gabions	28.70%
3	Terracing	26.00%
	Sum	**100.00%**

Source: Computed by the author (2020)

As per Table 4:5, about 28.70% of the sampled households perceived the application of physical measures: gabions and retaining walls along river banks, elevated lands, and gully formations. On the other hand, nearly 45% of the households reveal that the biological measures constituting tree planting were implemented to restore degraded mountainous areas. According to the South Wollo Zone Agriculture Office (SWZAO)(2019), these areas are one of the spatial locations to implement terracing and trench activities in Kombolcha city, along with agricultural fields and gully formations.

In this context, the office asserts that the respective rehabilitation of 4.2, 10.1, and 13.6ha of land contributes to making the city spatially resilient. However, the office discloses that the terracing activities in the city lack supportive and compulsory works such as drainage lines, water retention ponds, soil and water conservation strategies, and channelization of gully formations.

The physical measures, which are the component of the terracing activity, had been implemented to protect the river systems from erosion. In this vein, the city Asset Management plan shows about 10.5 km of masonry retaining walls and 2.5km of meshed gravel-based gabions. The retaining walls along river banks constitute only about one-fourth of the total length constructed, and 75% are erected to avoid land subsidence from mountainous areas (Figure 4:19). All gabions are constructed along river banks and are affected by flooding.

Figure 4:19 Retaining wall constructed to protect soil subsidence from mountainous areas (a) and river banks (b)
Source: Field visit (2019) and computed by the author (2020)

4.3.1.6. Urban resilience issues in secondary cities of Ethiopia

This section presents the urban resilience issues that are threatening or occurring in secondary cities of Ethiopia to validate the environmental and physical factors affecting the spatial resilience of Kombolcha city. The 2017 UCRS strategy document archives the urban problems inherent in all urban centers in Ethiopia, including secondary cities.

The urban problems are categorized into three distinct and overlapping dimensions of urban resilience. The categorization accounts for the urban problems' explicit, non-explicit, and implicit potential to affect the spatial resilience of secondary cities.

The key informants have categorized the first grouping with the social, economic, and political dimensions to fall under implicit urban challenges with no or little effect on the spatial resilience of the cities. The second category provides the list of urban uncertainties falling under the environmental and physical category with an explicit nature to affect resilience. The third one presents urban problems with both explicit and implicit nature (Table 4:6).

Table 4:6 Urban resilience issues in secondary cities in Ethiopia.

Social, economic, and political (implicit)	**Environmental and physical (explicit)**	**Both (significance to spatial and non-spatial dimensions)**
Access to Quality Education	Earthquake	Informal settlements
Access to quality Health Service	Landslide	Political instability
Economic Crisis (Inflation)	Surface flooding (Pluvial)	Infrastructure or building failure
Corruption	Urban Fire outbreak	Internally Displaced persons
Drug and alcohol abuse	Urban Pollution	Food insecurity
High unemployment	Water shortages/scarcity	Homelessness
Lack of Up-to-date and relevant data for future planning.	Traffic Accident	Energy insecurity
Economic inequality	Inadequate public parks and recreational place	Terrorism
Lack of affordable housing	Inadequate waste management systems	Poor governance regulatory Climate.
	Poor sanitation System	Environmental degradation
	High wind	Population growth (over population)
	Inadequate drainage	Poverty
	Overburdened Infrastructure	Drought
	Unprecedented urban expansion	Disease Outbreak
	Traffic Congestion	Lack of Integrated Spatial Planning

	Uncontrolled growth/lack of green space	Internal Migration
	Deforestation	Conflict
		Temperature
		Unreliable transport system

Source: Computed by the author based on the responses of the KIIs (2019)

Table 4:6 presents nine urban problems associated with urban resilience's implicit or social, economic, and political dimensions, with no spatially explicit nature. However, nineteen urban uncertainties are listed under the non-spatially explicit and implicit spatial implications resulting from social, political, and economic pressures.

The Table further reveals the results from the key informants that determined seventeen environmental and physical urban problems explicitly affecting the spatial resilience of secondary cities in Ethiopia, including Kombolcha city.

4.3.2. The integration of the spatial resilience principles into urban local spatial planning documents

4.3.2.1. Integration into urban local spatial planning legal frameworks of Ethiopia

4.3.2.1.1. Results from the key informant interview

The experts representing various professional backgrounds are presented with a question to measure their attitude towards incorporating the spatial resilience principles into Ethiopian local urban spatial planning legal frameworks: UDP, UPP, SPM, UPPIS, GTP I, and II.

Accordingly, the participants in this study's key informants interview offered differing views on how the concepts of resilience, expressed in the four attributes, are mainstreamed into Ethiopia's local urban spatial planning/city-wide structure plan/ policies. In addition, they provided their understanding as yes, no, and binary (with both yes and no) responses (Figure 4:20).

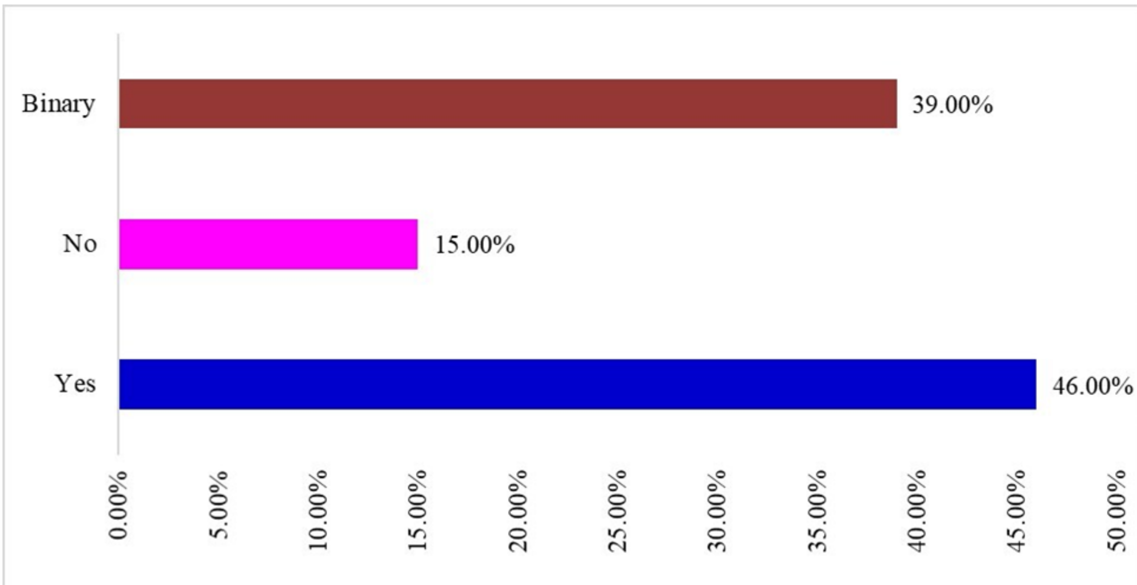

Figure 4:20 Views of the key informants on the integration of urban resilience principles
Source: Computed by the author (2020)

Figure 4:20 reveals that 46% of the experts have recognized that Ethiopia's local urban spatial planning policy documents mainstreamed the resilience principles. According to these respondents, the principles are incorporated in the policy documents' through guiding principles and procedural sections. They testify that the practices can be traced mostly in the vision statements of the reports of cities' local urban plans. Furthermore, they also attest that the procedural manuals have illustrations and narrations on urban problems, uncertainties, risks, hazards, and disasters, which constitute the topics of spatial resilience.

According to Figure 4:20, 15% of the experts disagree with the concise and bold incorporation of the urban spatial resilience principles into the policy documents. The main reason forwarded by these respondents is that the policy documents are outdated and failed to capture the central themes of resilience in general and its spatial planning attributes, in particular. However, 39% of the respondents lie in limbo with the two answers. These respondents fall under the binary response, claim that the principles are not consistently mainstreamed throughout the policy document, and express concern about a lack of efforts to undertake period reviews sensible to the evolving contemporary urban issues.

4.3.2.1.2. Review results of the Ethiopian local urban spatial planning legal documents

The above results from the experts' are supplemented by evaluating Ethiopia's selected local spatial planning legal frameworks based on the redundancy, robustness, diversity, and collaboration attributes of spatial resilience as outlined in Table 2.4 of this paper. Thus, Nvivo 12 plus software review reveals significant variations in total scores for each policy document associated with the four spatial resilience principles, ranging from 18.5 to 57.74. Furthermore, the overall values for mainstreaming resilience attributes in Ethiopia's respective local urban spatial planning policy documents range from 31.83 to 67.22 (Table 4:7).

Table 4:7 Scores of urban resilience principles against the local urban spatial planning policy documents

No	Local urban spatial planning documents of Ethiopia		Urban spatial Resilience principles				Total
			Redundancy	Diversity	Robustness	Integration	
1	Urban Policy and proclamation	UDP (2005)	4.85	2.88	3.91	**8.62**	*20.26*
		UPP (2008)	**9.58**	7.72	2.16	5.23	***24.69***
2	Local Urban Spatial Plan Manual and Strategy	SPM (2006) revised in 2012	6.03	**6.41**	4.17	6.02	***22.63***
		UPPIS (2014)	4.02	4.91	3.95	**5.62**	*18.5*
3	National Development Plans	GTP I (2010 - 2014)	**20.65**	11.75	5.63	16.25	***54.28***
		GTP II (2015 - 2020)	9.08	11.17	**12.01**	**25.48**	***57.74***
Total			***54.21***	***44.84***	***31.83***	***67.22***	

Source: Computed by the author (2020)

Based on Table 4:7, the integration principle received the highest total coefficient of 67.2. It is followed by the redundancy principle, which has a value of 54.21. In Ethiopian urban spatial planning policy documents, the diversity attribute ranks third with a 44.84 total sum, while the robustness principle ranks last with a 31.83 tally.

However, regarding policy documents, the GTP I and II of the National Development Plan have mainstreamed the principles with 54.28 and 57.74 values, respectively. The GTPs are followed by the UPP and the SPM, with respective values of 24.64 and 2.63. The 2005 UDP, on the other hand, received a score of 20.26, whereas the 2014 UPPIS obtained a point of 18.50.

The table's matrix also shows criterion-specific results for each policy document. As a result, the redundancy and diversity principles are rated the highest in the GTP I document, with 20.65 and 11.75 points, correspondingly. On the other hand, the robustness and integration principles receive the highest records in GTP II, with 12.01 and 24.48 results consecutively.

4.3.2.2. Practices of integrating the principles into spatial plans of cities

4.3.2.2.1. The views from experts.

The sector-based involvement of key informants has allowed capturing how the resilience principles were mainstreamed in the practical implementation of city-wide structure plans. Consequently, experts who provided a 'yes' or 'binary' answer (in section 4.3.2.1above) were also requested to forward their views on the practical implementation of the policy provisions concerning the resilience principles (Figure 4:21).

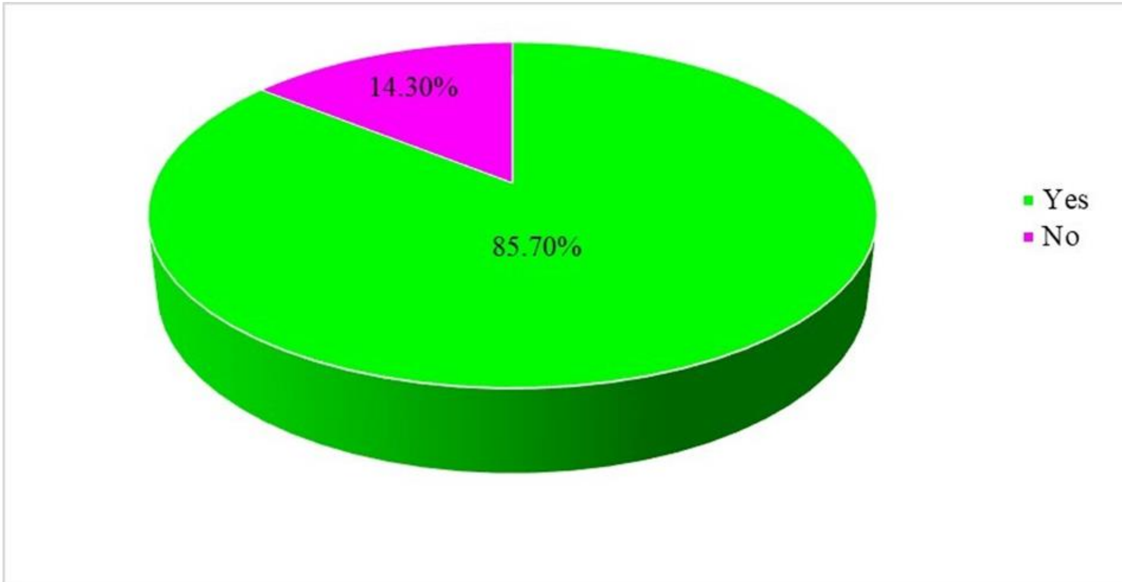

Figure 4:21 Views of the key informants on the integration of spatial resilience principles into city-wide structure plans of cities
Source: Computed by the author (2020)

According to Figure 4:23, nearly 86 percent of key informants agree that the principles are adequately mainstreamed into Ethiopia's urban local spatial planning documents, particularly legal frameworks.

4.3.2.2.2. Urban spatial resilience principles, DP and SP proposals, and the 2020 ELU of Kombolcha city

- **Land uses**

This paper has evaluated the 2001 DP and the 2011SP against the sub-principles indicated in *Table 2**:4*** of this paper.

The report of the DP has indicated two centers. The main center is in the city's central business district with diversified commercial activities. On the other hand, the sub-center is proposed in the 'expansion areas of the city. However, these sites are not provided with separate local development plans showing the distribution and location of various urban functions (Figure 4:22).

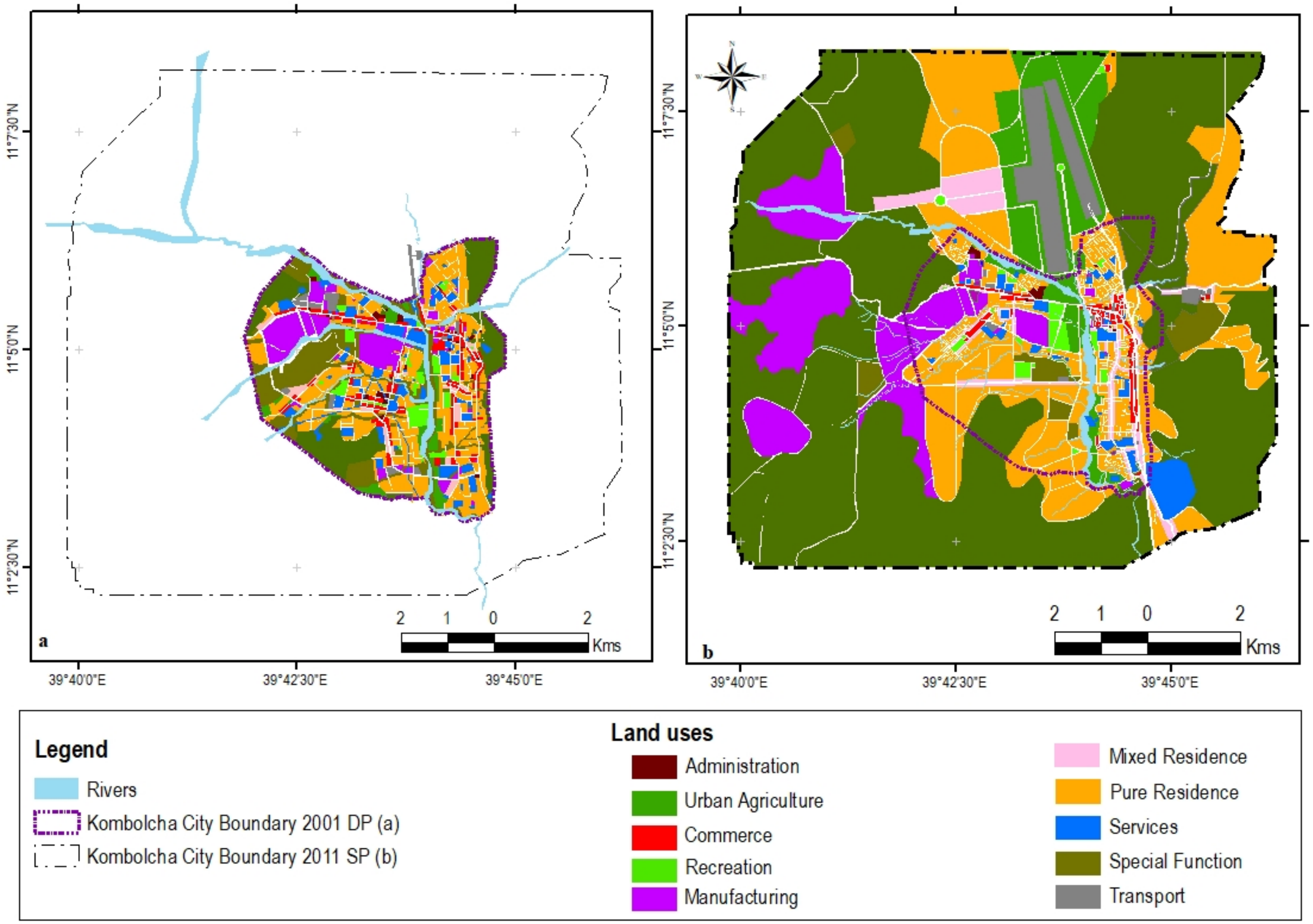

Figure 4:22 The 2001 DP (a) and the 2011 SP (b) proposals for Kombolcha city
Source: KCA (2001); (2011)

Table 4:8 Land allocation in the DP and SP

Land use	Detail land use	**DP**		**SP**		General land allocations
		Area (ha)	Percentage	Area (ha)	Percentage	
Administration	Government and non-governmental organizations	18.93	0.84%	13.70	0.11%	
Commercial	Business activities	110.38	4.92%	69.72	0.56%	Buildings
Manufacturing	Factories and warehouses	194.87	8.69%	1080.66	8.68%	
Residence	Pure and mixed-use	617.2	27.52%	2513.66	20.19%	
Services	Social services	173.79	7.75%	205.43	1.65%	
Sub-total		***1115.17***	***49.73%***	***3883.16***	***31.19%***	
Special function	Special function	161.39	7.20%	0.00	0.00%	
	Reserved areas	**261.18**	**11.65%**	**215.39**	**1.73%**	
Urban agriculture	Poultry and husbandry	75.65	3.37%	689.73	5.54%	Green
Recreation	Playgrounds	68.81	3.07%	80.93	0.65%	
Forest	Forest and green areas	0.00	0.00%	247.76	1.99%	

	Protected forest	**329.89**	**14.71%**	**5578.85**	**44.81%**	
	Nursery	7.24	0.32%	600.09	4.82%	
	Green along gully formations, gorges, stream, and river banks/ buffer	0.00	0.00%	250.25	2.01%	
Sub-total		***904.16***	***40.32%***	***7662.98***	***61.55%***	
Transport	Terminal, airstrips, and dry ports	43.01	1.92%	354.83	2.85%	Infrastructure
Road	Road infrastructure	180	8.03%	549.05	4.41%	
Sub-total		***223.01***	***9.95%***	***903.87***	***7.26%***	
Area (ha)		**2,242.34**		**12450.00**		

Source: Computed by the author (2020); KCA (2001); (2011)

Based on Table 4:8, both of the local urban spatial plans of Kombolcha city incorporated the two basic redundancy attributes of resilience: reserved areas and protected forests in the land-use proposals. The DP has allocated about 261.18 ha (11.65%) and 329.89 ha (14.71%), respectively, out of 2242.34 ha of urban land. From the 12450 ha designated urban boundary in 2011, the SP has allocated 215.39ha (1.73%) and 5578.85ha (44.81%), respectively. The land allocations aimed to accommodate future development pressures resulting from hazards and population growth.

A cross-examination of the two spatial development plans of the city, against the redundancy principles, reveals a 10% decline in reserve areas and an increase in protected forests of just over 30%. However, in terms of total land allocation, the SP apportions a higher proportion of land than the DP for the two sub-themes of redundancy.

The land allocated to road and transport during the two planning periods, constituting the robustness principle, shows a diminishing trend in the SP with about 2.69%. However, this cannot suggest that the SP provides infrastructure at lower coverage than the DP. According to the interviewee, the actual implementation of the SP, road networks, and associated amenities had been spatially constrained by the rippling topography of the city.

Concurrently, the SP has proposed three centers (Figure 4:23). The main center (Figure 4:23a) proposed during the DP, which covers 21.46 ha, is maintained. Additional main centers are located at the central market (Figure 4:23b), with 113.99 ha of land. The other two sub-centers are located in the inner city market area with an area of, and one sub-center (Figure 4:23c) with 23.60ha was proposed in the Western part of the city.

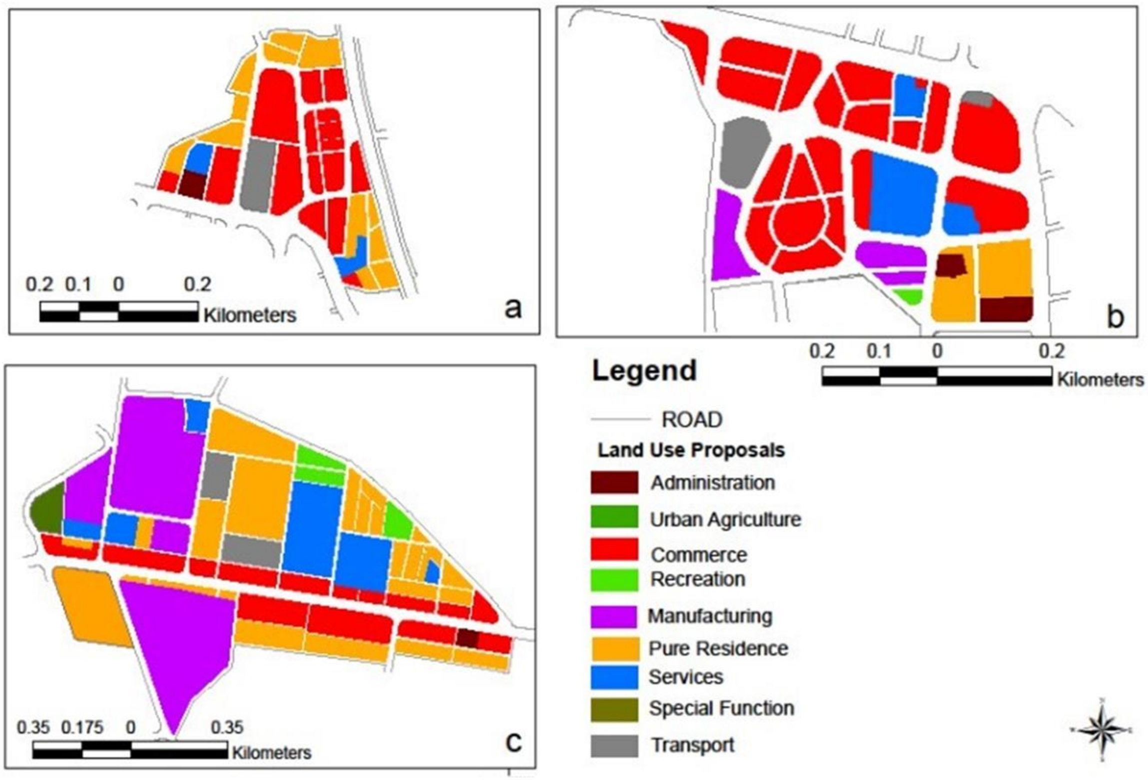

Figure 4:23 The main and sub-centers of Kombolcha city proposed in the 2011 SP
Source: KCA (2001)

The thesis has also inevitably examined the practical implementation and mainstreaming of the resilience sub-principles proposed in the SP into the 2020 existing land use of the city (Figure 4:24).

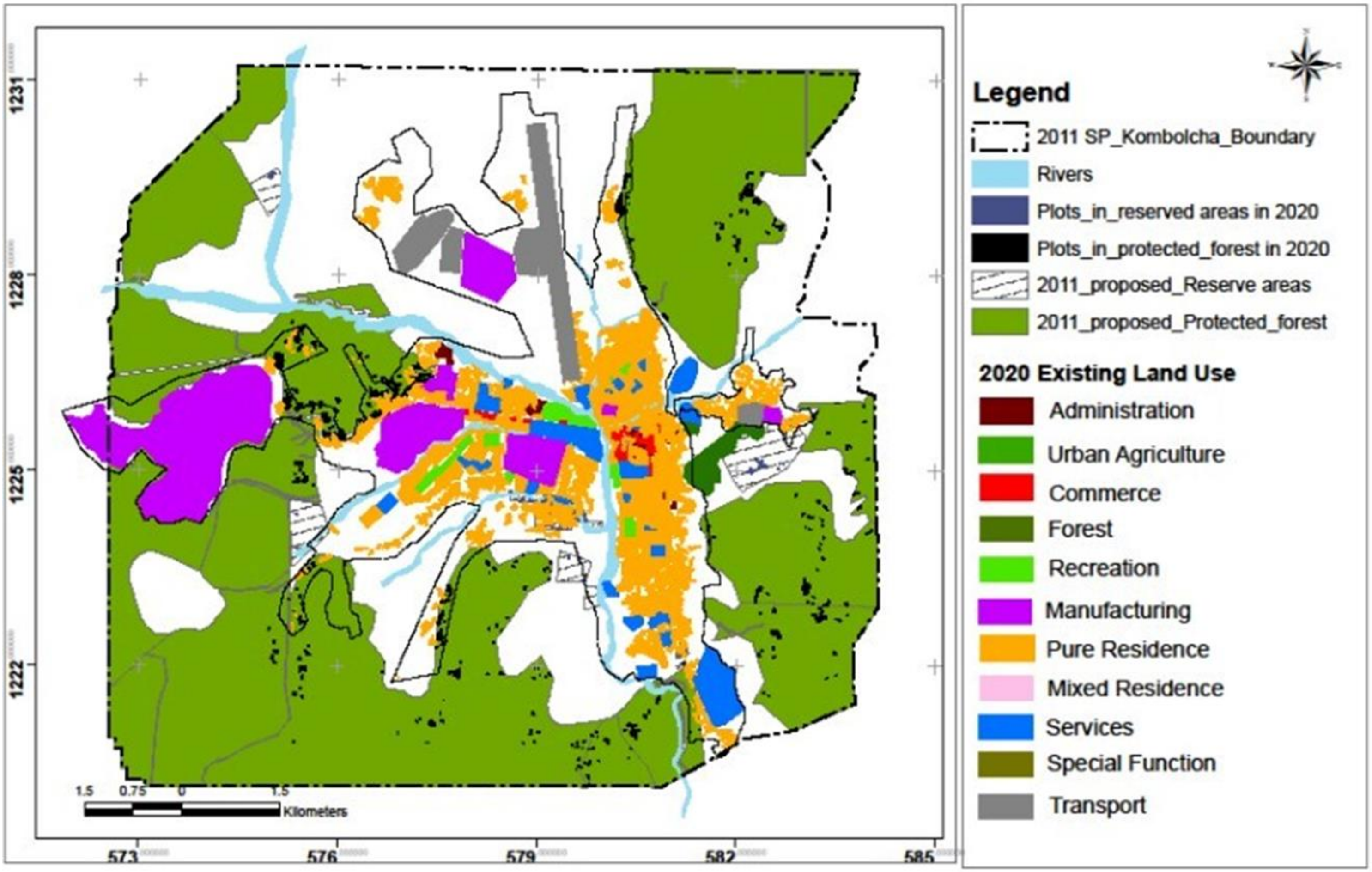

Figure 4:24 The 2011 SP reserved areas and protected forest proposals and their situation in the 2020 existing land use of Kombolcha
Source: Computed by the author (2020) based on the 2011 SP of the city

Based on Figure 4:24, the 2011 SP proposals are violated by the occupation of the sub principles of redundancy (reserve areas and protected forest) by various other land uses in 2020, dominantly by residential uses (Table 4:9).

Table 4:9 Proportion of reserved areas and protected forests proposed in the 2011 SP and occupied by other urban functions in 2020

No	2020 land use	Reserved areas		Protected forest	
		Area (ha)	Percentage of land occupied	Area (ha)	Percentage of land occupied
1	Residential	26.92	13.18%	60.12	1.14%
2	Manufacturing	6.6	3.23%	0.00	0.00%
3	Forest	44.06	21.54%	0.00	0.00%
	Sub Total	**77.58**	**37.95%**	**60.12**	**1.14%**
4	Non-occupied land	126.73	62.05%	5230.55	98.86%
	Total	**204.31**	**100.00%**	**5290.67**	**100.00%**

Source: Computed by the author (2020)

Table 4:9 shows that residential establishments have converted about 13.18% from reserve areas and 1.14% of the land allocated to protected forests. The key informant at the city administration attests to land conversion as formal (through land allocation by the local government) or informal (individuals grabbing the land). Nevertheless, the informal land occupation outweighs the formal. Thus, environmentally sensitive areas like forest areas are invaded, usually significantly creating scattered and corridor-like developments along the existing road (Figure 4:25 and Figure 4:26).

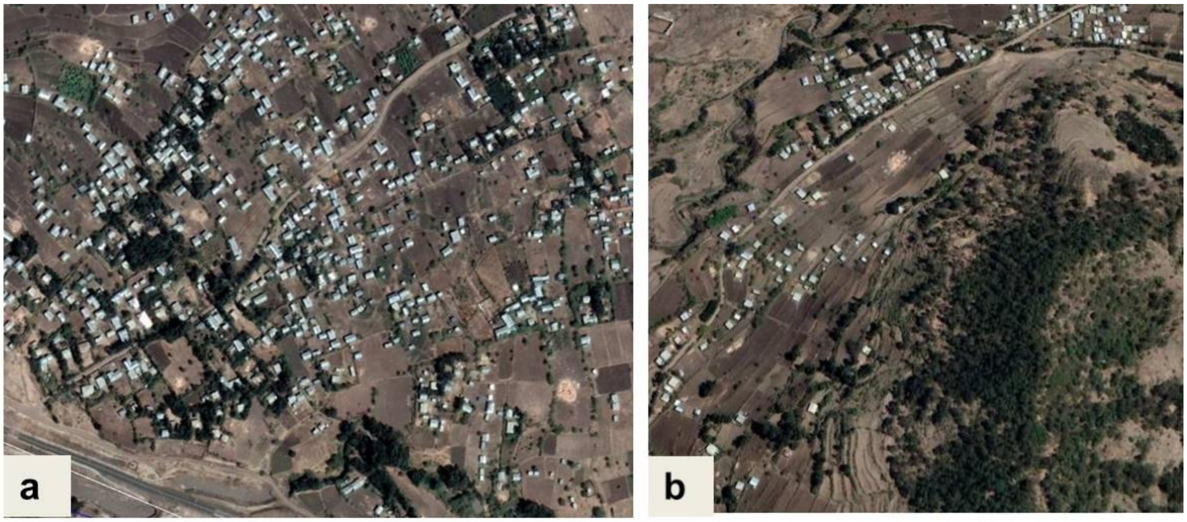

Figure 4:25 Google earth pro image showing informal residential buildings built in reserve areas (a) and protected land (b)
Source: Google earth pro (2021)

As per Figure 4:25, informal settlements grow haphazardly in agricultural fields and near remnants of forest covers. The pavement of the access roads is of poor quality, and the pattern is organic.

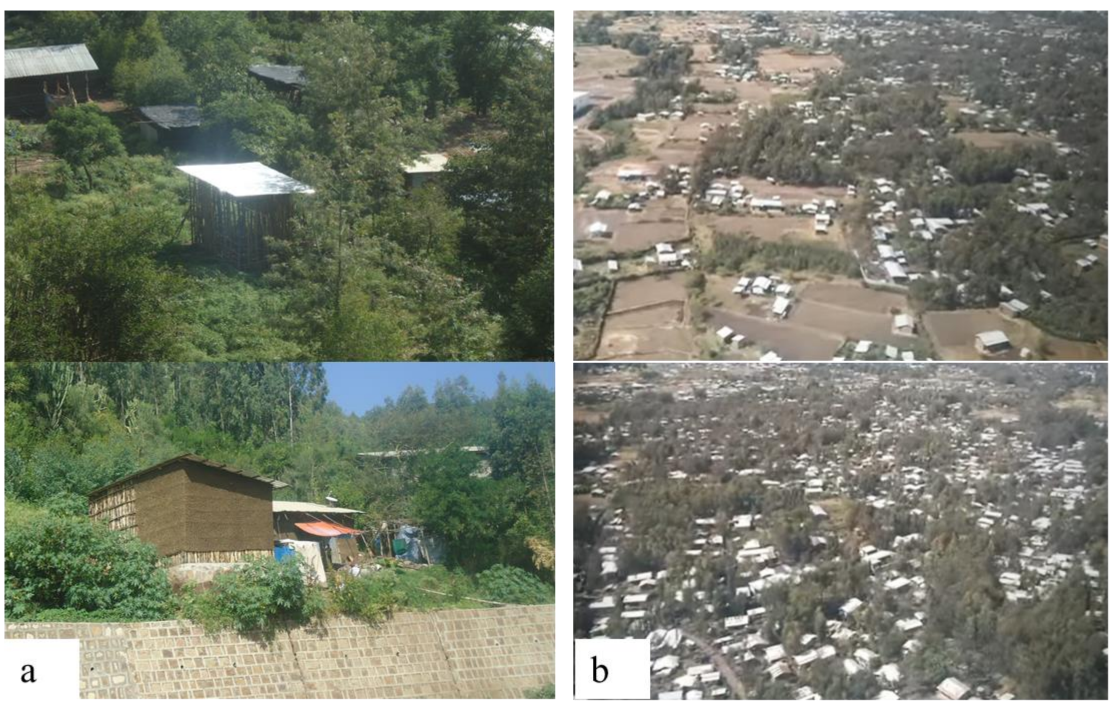

Figure 4:26 Typical informal residential buildings built on protected forests (a) and reserved sites(b)
Source: Computed by the author (2020)

Figure 4:26 depicts the quality of informal residential buildings as rectangular-shaped substandard houses that exploit the forest trees found near the site. These areas are deprived of basic infrastructures such as access roads and sanitation services.

The respondent from the city administration further replies that such action also affects the proportion of land use heterogeneity. The respondent asserts that the dominancy of residential among the entire urban element increases the susceptibility of reserve areas and protected forest areas to human encroachment, which the existing land use testifies (Figure 4:27).

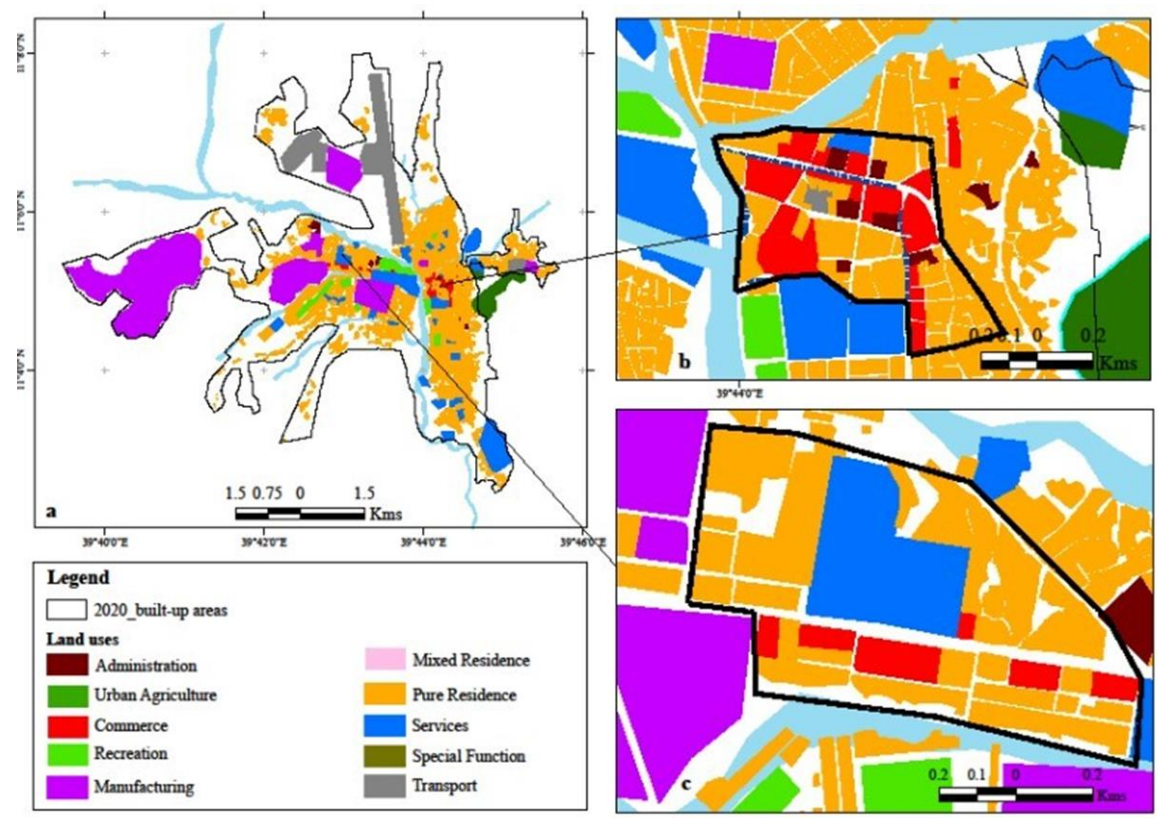

Figure 4:27 ELU of Kombolcha city in 2020 (a), main city center (b), and sub-center (c)
Source: Computed by the author (2020)

Figure 4:27 shows that residential and manufacturing land uses cover 16.71% and 15.51% of the built-up areas, respectively. The plan further confirms the efforts towards introducing two centers: the main center (Figure 4:27(b)-Borchele and market area) and the Sunny-side sub-center (Figure 4:27(c) against the 2011 SP proposals. These sites are significantly allocated for commercial activities.

- **Road networks, hierarchies, and urban blocks**

Land conversion has implications and effects on resilience's redundancy, diversity, and robustness principle. These are also characterized by urban roads, determining the urban forms/blocks, accessibility, connectivity (bridges), and road hierarchy. Accordingly, the 2011 SP has proposals on road hierarchy and networks to facilitate mobility and connectivity.

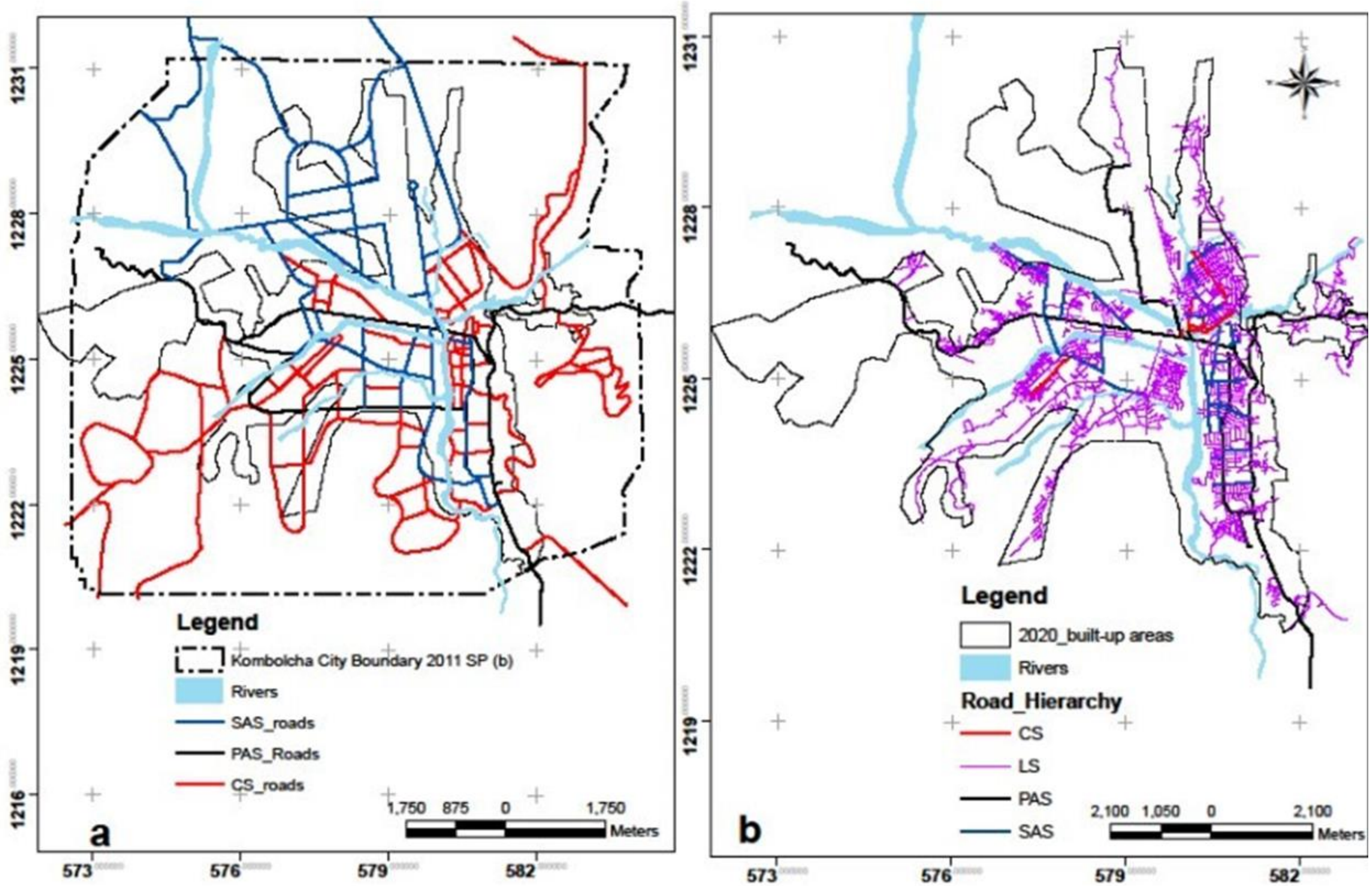

Figure 4:28 The 2011 SP proposal (a) and the 2020 existing (b) road hierarchies and networks map of Kombolcha city.
Source: KCA (2011)(a);KCA (2020) (b)

The road hierarchies include Principal Arterial Street /PAS/, Sub Arterial Street /SAS/, Collector Street /CS/, and Local Streets /LS/. The SP showed that all these roads are networked appropriately to facilitate mobility and access to various parts of the city (Figure 4:28a). Besides, this plan had proposed the construction of five, including the existing ones, bridges along PAS and SAS roads that avert the connectivity problems created due to the Borkena River. On the contrary, the existing road network shows a rare consideration of the road hierarchies (Figure 4:28 b), dominated by local streets, with no additional river bridge connecting the eastern and western parts of the city.

Table 4:10 Land allocated to various road Hierarchies proposal of Kombolcha city

Road Hierarchy	**Width (m)**	**Length (m)**	**Area (m^2)**	**area (ha)**	**the percentage from the total area of the city(12540.00)**
PAS	40	29,280.16	1,171,206.59	117.12	0.99%
SAS	30	32,554.22	976,626.59	97.66	0.83%
	25	38,764.26	969,106.59	96.91	0.82%
CS	20	92,514.33	1,850,286.59	185.03	1.57%
	15	15,964.44	239,466.59	23.95	0.20%
Total			**5,206,692.96**	**520.67**	**4.41%**

Source: Computed by the author (2020)

The road hierarchy proportion indicated in Table 4:10 shows that the SP allocated close to 4.41% of the land to urban roads with varying widths, excluding the local streets. Nevertheless, the road networks and the structure plan's proposed hierarchies have not been implemented in the past ten years. Table 4:11 and Figure 4:29 reveal these findings.

Table 4:11 Existing road hierarchies of Kombolcha city

No	Existing Road hierarchy	Road size	Area (ha)	Percentage form the built-up spaces
1	PAS	Greater than 40 meters	4.881765	0.13%
2	SAS	25-30 meters	16.10175	0.44%
3	CS	15 – 20 meters	153.4129	0.12%
4	LS	Below 15 meters	127.9153	3.48%
	Total		**153.41**	**4.18%**

Source: Computed by the author (2020)

As indicated in Table 4:11, the total road coverage of the city in 2020 is about 4.00% of the built-up areas. The LS, which is not considered part of the SP's road hierarchy proposals, takes the large portion with 3.48%, followed by SAS, which constitutes about 0.44%. Finally, PAS and CS have 0.13% and 0.12% scores, respectively.

The PAS road is significantly attributed to the trunk road that connects the Eastern and Western parts of the city with one single bridge on River Borkena, which bisects the city east and west (Figure 4:29a).

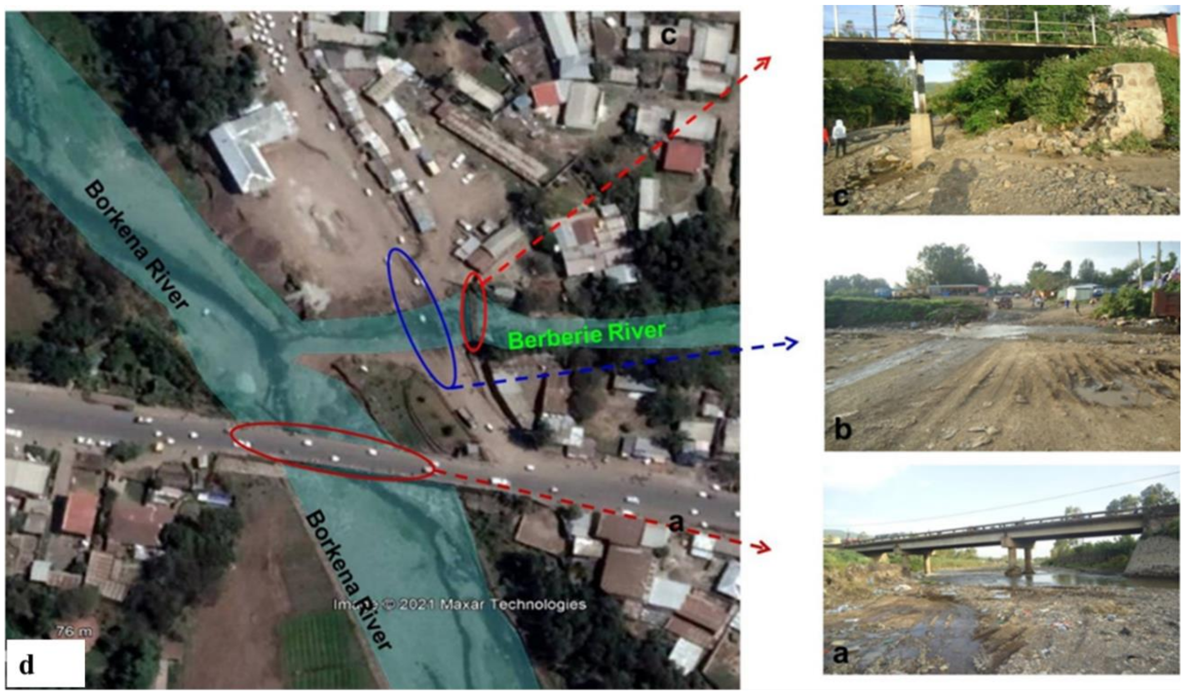

Figure 4:29 Connectivity issues in Kombolcha city
Source: Google earth pro (2021) (d) and the Author (2021)(a,b, and c)

A lack of adequate bridges also hampered the city's traffic mobility. According to Figure 4:29 (b), during the summer, vehicles in the city cross the River Berberie, which is inoperable during the rainy season. Furthermore, the pedestrian bridge along the Berberie River is poor due to flooding (Figure 4:29c). According to the 2020 Kombolcha City Asset Management Plan/KCAMP/ report, nearly 30% of urban roads are unpaved or poor. The city's urban form is organic and haphazard, with inconsistent block spacing and shape (Figure 4:30).

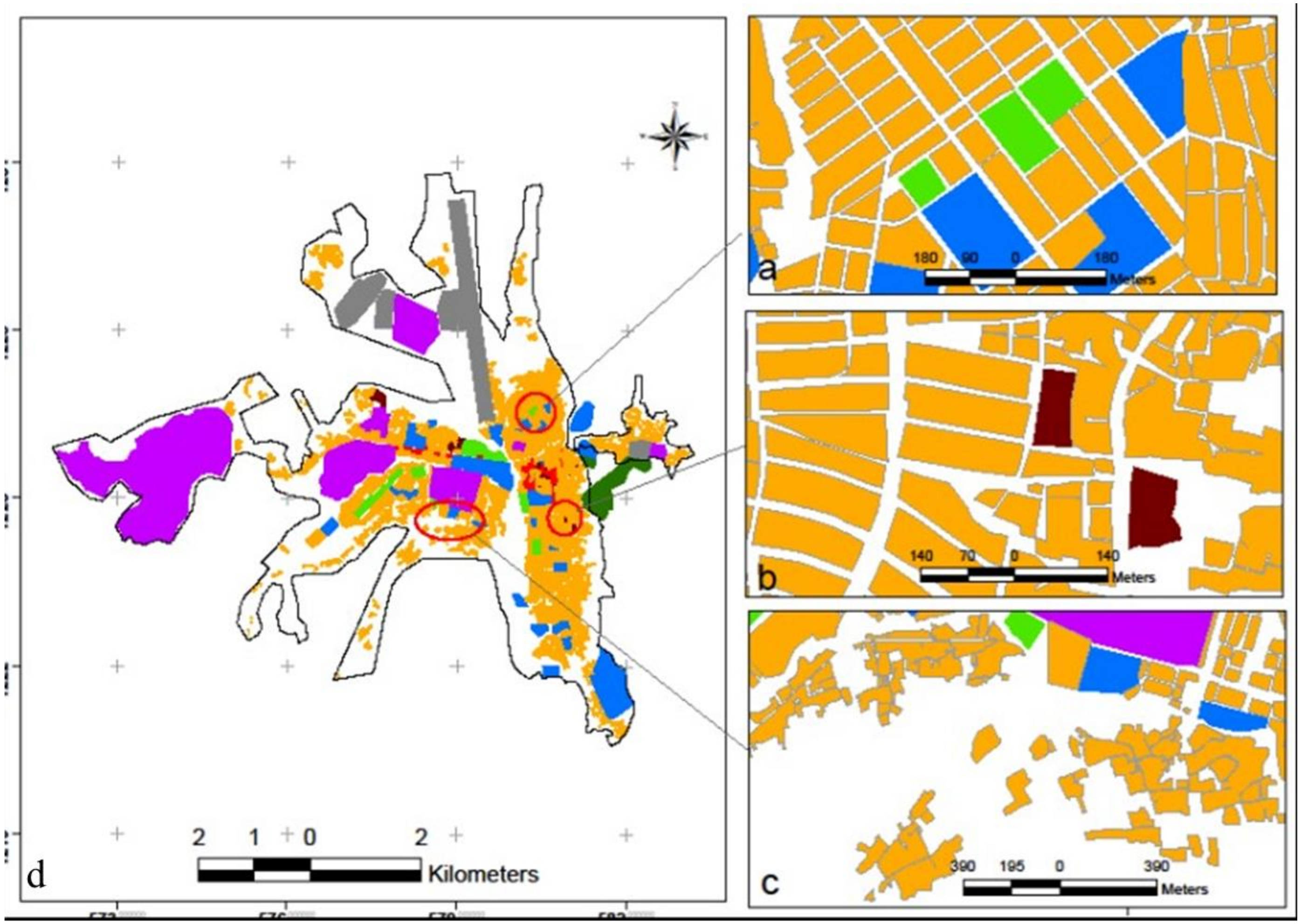

Figure 4:30 Inconsistent urban block arrangements in Kombolcha city in 2020 (d) a grid pattern (a), mixed pattern (b), and inorganic pattern (c)
Source: Computed by the author (2020)

The oldest settlements in the city have well-marked and defined urban roads, although there are relatively regularized blocks along the eastern escarpments (Figure 4:30a and b). Conversely, there are locations in the city dominated by inorganic urban forms characterized by very narrow roads and blurry blocks and spacing (Figure 4:30c).

4.3.2.3. Challenges hampering the practical implementation of the proposals of the spatial plans

The study has raised the third question to the professionals attached to identifying the root causes that hampered the practical implementation of city-wide structure plans in secondary cities, particularly Kombolcha city. Accordingly, the thesis presented four factors, which the experts assert as the critical challenge affecting the implementation of spatial plans towards attaining resilience (Figure 4:31).

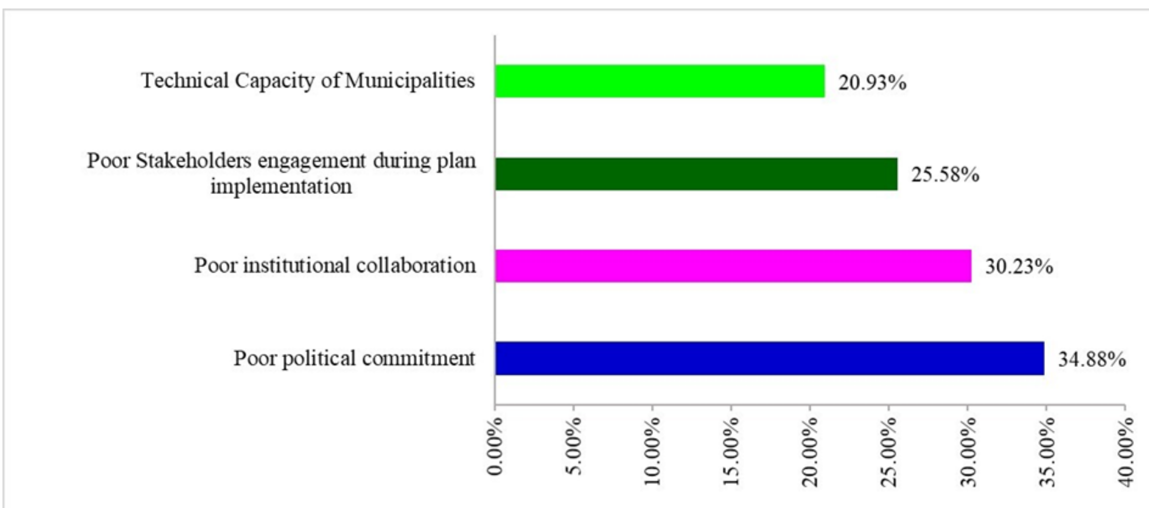

Figure 4:31 Major factors affecting the implementation of local urban spatial plans toward resilience
Source: Computed by the author (2020)

Based on Figure 4:31, close to 35% of the experts reveal that poor political commitment at the federal, regional, and local levels have exacerbated the poor implementation of spatial plans in Ethiopian cities. The experts emphasize that land-use zoning change imposed by either the federal or regional government manifests the political intervention affecting the real realization of spatial plan proposals. The response further shows that Local Development Plans/LDPs do not support mere intervention.

With about 30% response rate, poor institutional collaboration is the second most significant challenge, followed by poor stakeholder engagement, accounting for more than 25% of the response from the experts.

The fourth issue contributing to the poor implementation of the spatial plans is the insufficient technical capacity of municipalities, accounting for about 21% of responses. In this context, the architects and planners air that the plan implementing offices are not well staffed with the required professional qualification and staff.

4.3.3. Collaboration among institutions during local urban spatial planning processes

- **Pairwise comparison of the institutions**

The key informants' responses were recorded on AHP excel-based software, and the weights of each institution are shown in Table 4:12. The Table demonstrates the significance of urban land administration in influencing the locational decisions and spatial planning of other urban systems.

Table 4:12 Pairwise comparison of the collaboration among operators of critical urban systems

No	**Urban systems**	Land administration	Green and environmental	Water and sewerage Enterprise	Infrastructure	Utility	**Weights**
1	Land administration	**0.000**	0.345	0.722	0.379	0.495	**0.388**
2	Green and environmental protection	0.227	**0.000**	0.114	0.029	0.077	**0.089**
3	Water and sewerage Enterprise	0.287	0.187	**0.000**	0.329	0.374	**0.235**
4	Infrastructure	0.218	0.290	0.068	**0.000**	0.055	**0.126**
5	Utility	0.267	0.178	0.096	0.263	**0.000**	**0.161**
	Total	**1.000**	**1.000**	**1.000**	**1.000**	**1.000**	**1.000**

Source: Computed by the author (2020)

However, the key informant was asked to provide their responses in the following categories: excellent, very good, good, bad, and severely bad. However, the final result for this section is a combination of the last fields/columns of Table 4:12 and Table 4:13.

Table 4:13 Factor normalized matrix

Criteria	Land	Green and environmental protection	Water and sewerage	Enterprise Infrastructure	Utility	**Sum**	**Percentages**
Excellent	0.078	0.054	0.029	0.048	0.026	0.235	4.70%
Very good	0.256	0.190	0.265	0.285	0.157	1.153	23.06%
Good	0.333	0.351	0.324	0.238	0.236	1.482	29.64%
Bad	0.256	0.351	0.294	0.381	0.474	1.756	**35.12%**
Very bad	0.077	0.054	0.088	0.048	0.107	0.374	7.48%
Sum	1.00	1.00	1.00	1.00	1.00	**5.000**	**100.00%**

Source: Computed by the author (2020)

However, the final result for this section is a combination of the last fields/columns of Table 4:12 and Table 4:13. Figure 4:32 reveals the proportion of the consolidated scores for each criterion. Figure 4:32 reveals the proportion of the consolidated scores for each criterion.

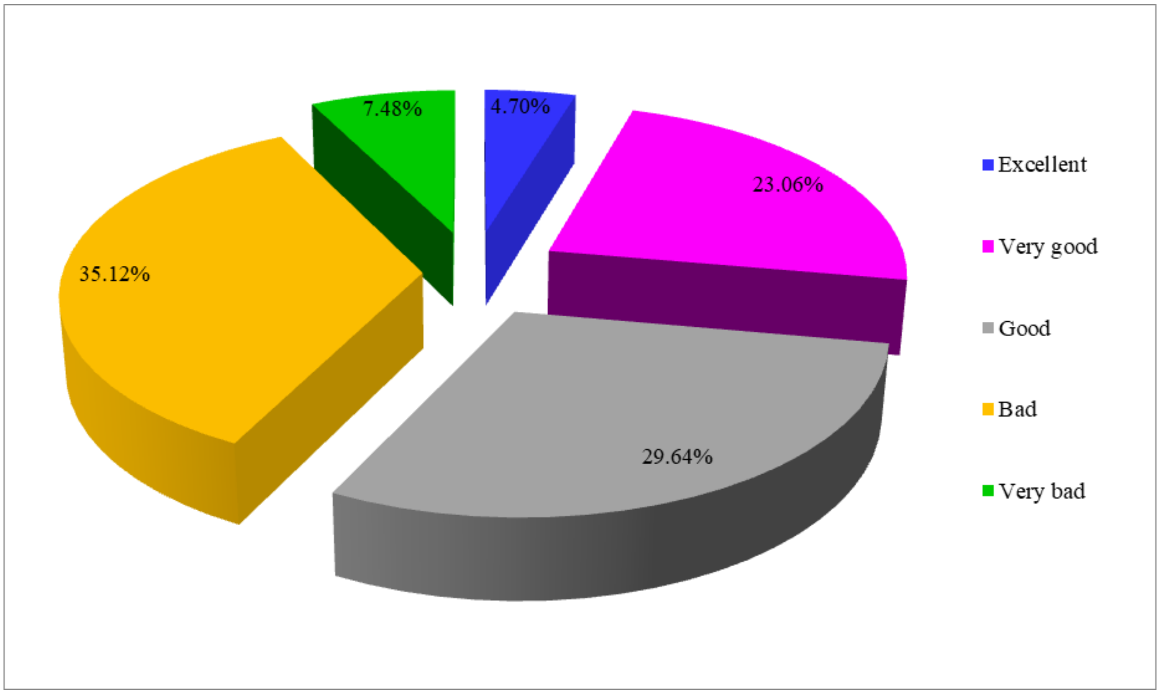

Figure 4:32 Consolidated scores for each criterion
Source: Computed by the author (2020)

With a response rate of 35.12%, *Figure 4:32 sh*ows that the institutions' communicative planning is bad. The excellent and very-bad scores are less than 5% and 10%, respectively. The good and very good criteria response rate was approximately 29.64% and 23.06%, respectively. However, these criteria did not accurately reflect the situation in the city. As a result, additional decision criteria are added for reaching the final decision by employing the three principles of communicative planning identified by AACA, 2019 and Booher & Innes, 2010 (see Figure 4:33).

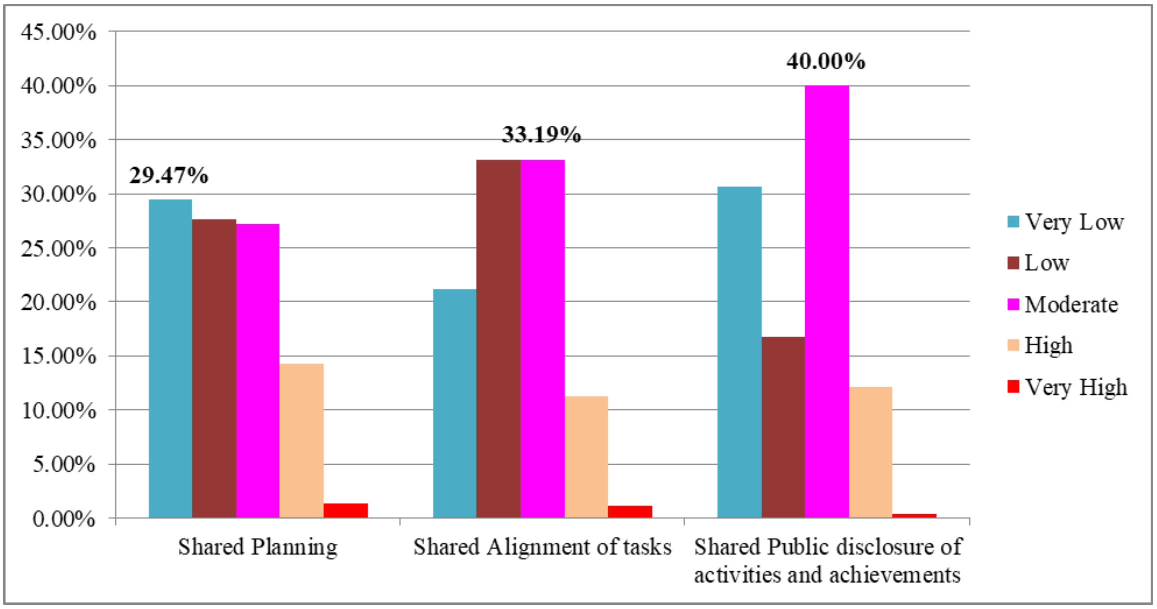

Figure 4:33 Application of communicative planning principles
Source: Computed by the author (2020)

According to Figure 4:33, the collaboration of institutions to produce shared plans and align their tasks with conformity with the city's structure plan is low, scoring around 30% and 33%, respectively. According to the responses of approximately 40% of the participants, the operators of critical urban systems communicate, collaborate, and integrate very poorly to disclose their shared tasks, plans, and achievements.

Participants in the study believe that such communicative planning practices directly or indirectly exacerbate the city's recurrence of urban hazards and disasters. Nonetheless, the extent to which it exacerbates the problems is shown in Figure 4:34.

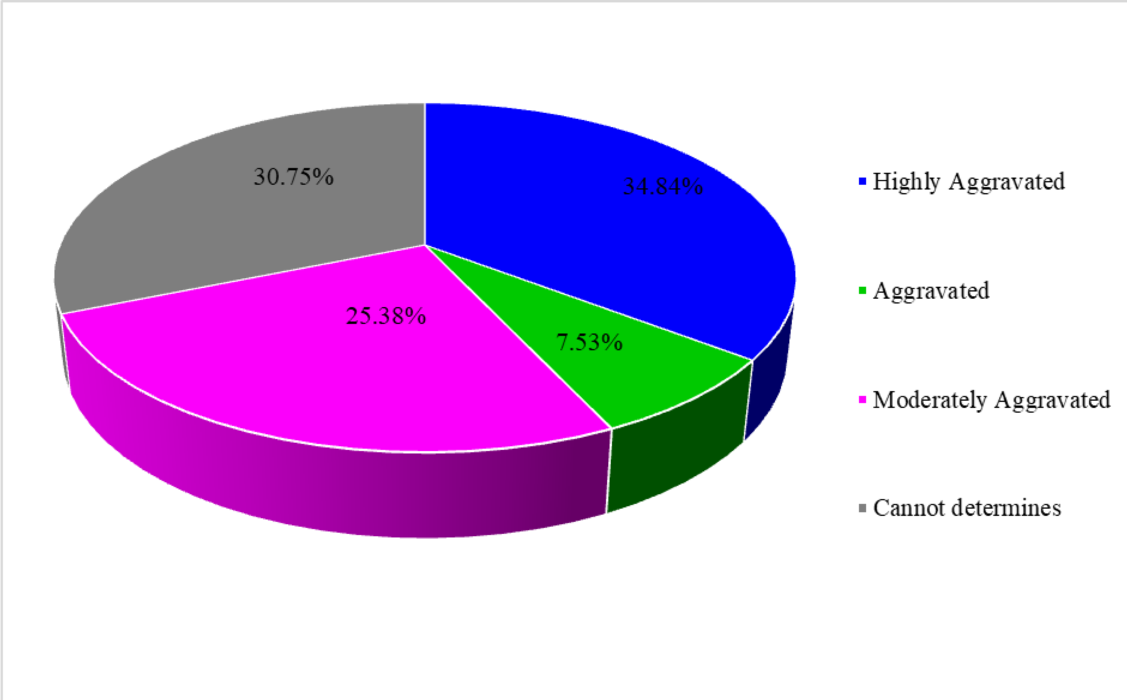

Figure 4:34 The effects of poor collaboration on the spatially non-resilience of the city.
Source: Computed by the author (2020)

According to Figure 4:34, nearly 70% of these respondents believe that the city's low level of institutional collaboration has exacerbated the recurrence of urban uncertainties such as flooding, poor waste management, and encroachment into fragile ecologies. However, the remaining 30% admit that they cannot predict the negative consequences of communicative planning to improve their city's resilience.

The pre-, during-, and post-disaster communication systems demonstrate the five institutions' level of collaboration. The following discussion demonstrates the thesis's findings in this regard.

4.3.4. The disaster communication system deployed in Kombolcha city

This section discusses the disaster communication systems the sampled households revealed and deployed in Kombolcha. The three phases of disaster communication are examined and presented, along with their parameters based on Table 2:2 of this paper.

As one hazard communication system, all of the households contacted for this study reveal a complete lack of and absence of early warning systems in the city to inform the community about the occurrence of any sort of natural hazard.

However, the respondents show that there are practices of implementing pre-and post-disaster communication, such as hazard mapping and community-based approaches (Figure 4:35).

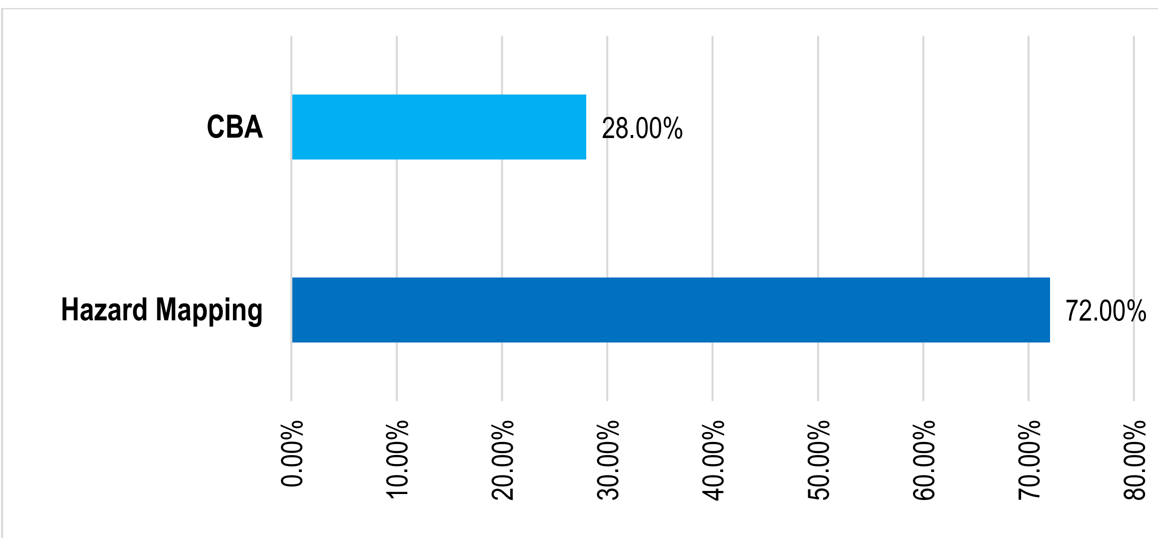

Figure 4:35: Pre and post-disaster communication systems deployed in the city
Source: Computed by the author (2020)

Figure 4:35 shows pre and post-disaster communication systems deployed in the city as revealed by the household respondents. Based on the Figure, nearly 72% of the respondents acknowledge that the city, its inhabitants, and its urban properties are vulnerable to a wide range of disasters, including but not limited to earthquakes, flooding, landslides, and rising temperatures. In contrast, 28% believe that the city and its inhabitants are seldom vulnerable to hazards.

The households are also willing to protect themselves and their neighbors from potential threats. Approximately 54% of them disclose their readiness to engage in DRR activities in these situations.

During the pre-disaster period, hazard mapping takes into account identifying disaster-prone areas. In this vein, the city's various development plans, the 2001 development plan/DP/ and the SP, serve as a starting point for identifying and mapping recurring hazards in the city. The DP identifies urban areas vulnerable to potential disasters as development constraints, including steeply slope areas with a gradient of more than 20% and their vulnerability to flooding. It also identifies geologic hazards such as earthquakes and landslides.

In addition, the plan detects land areas serving a special function, such as waterlogging, military camps, swampy areas, and vacant lands within the city limits as potential sites for hazard aversion. Similarly, the SP recognizes and maps the hazards in the same way.

The information obtained from the key informants depicts the mapping of vulnerable areas from the city municipality by showing the interventions indicated in the city's various development plans, including the SP and the 2013 drainage master plan. The latter has demonstrated the phasing of proposed interventions based on the city's flooding susceptibility of various neighborhoods or localities.

The DP illustrates the significance of building shapes to improve building resilience. In this context, the plan advocated constructing rectangular/square-shaped housing units with a demonstrated ability to withstand potential hazards compared to L and U-shaped buildings. However, there is no information on the urban population's and assets' pre-disaster risk status. Furthermore, the sampled households and key informants reveal a complete lack of evacuation and recovery plans at the city and neighborhood levels. The application of Community-Based Approaches(CBA) is the next disaster communication system considered in the result part of this paper (Table 4:14).

Accordingly, the Table shows that about 53% of the approach is dominated by public participation, followed by information sharing, which constitutes about 36%. Community training towards disaster reduction takes about 11% only.

Table 4:14 Components of CBA communication systems

No	Community-based Approaches	Frequency	Percentage
1	Participation	210	52.50%
2	Information Sharing	145	36.25%
3	Training	45	11.25%
	Total Sum	**400**	**100.00%**

Source: Computed by the author (2020)

As per the data obtained during the field survey, the basic element of participation included the involvement of and informing the community members in DRR activities during the pre and post-disaster events. The KII disclosed the total absence of periodic and regular consultation and empowerment of the community to manage the efforts and tasks carried out.

On the other hand, the South Wollo zone agriculture office (SWZAO) claims that local communities' level of participation and commitment to disaster risk reduction is not uniform and convincing.

Based on the data obtained from the office, only 7.8% of the local community engages in the various DRR activities such as watershed management, including rehabilitation of mountainous areas and gully formations and terracing.

The office attributes the main challenge for low community participation to the poor commitment of the local administrations. In this context, a 2019 assessment conducted by SWZAO indicates the level of involvement of the city's administrative units in DRR (Table 4:15).

Table 4:15 Level of participation by Local administrations/Kebeles/in disaster risk reduction in Kombolcha city

No	Number of Kebeles participating in DRR	Percentage	Level of participation in DRR
1	2	16.67%	Between 50% to 60%
2	4	33.33%	Below 50%
3	6	50.00%	0.00%
Sum	12	100%	

Source: SWZAO (2020)

Per Table 4:15, nearly 17% of the local administrations/Kebeles/ in the city engage in DRR, with less than 60% participation. In comparison, about 33% of them perform with a rate of under 50% participation. The rest, 50% of the Kebeles, do not participate in DRR activities.

Figure 4:36 shows the sampled households response to local community participation in disaster reduction and planning processes as high, moderate, low, or no- response.

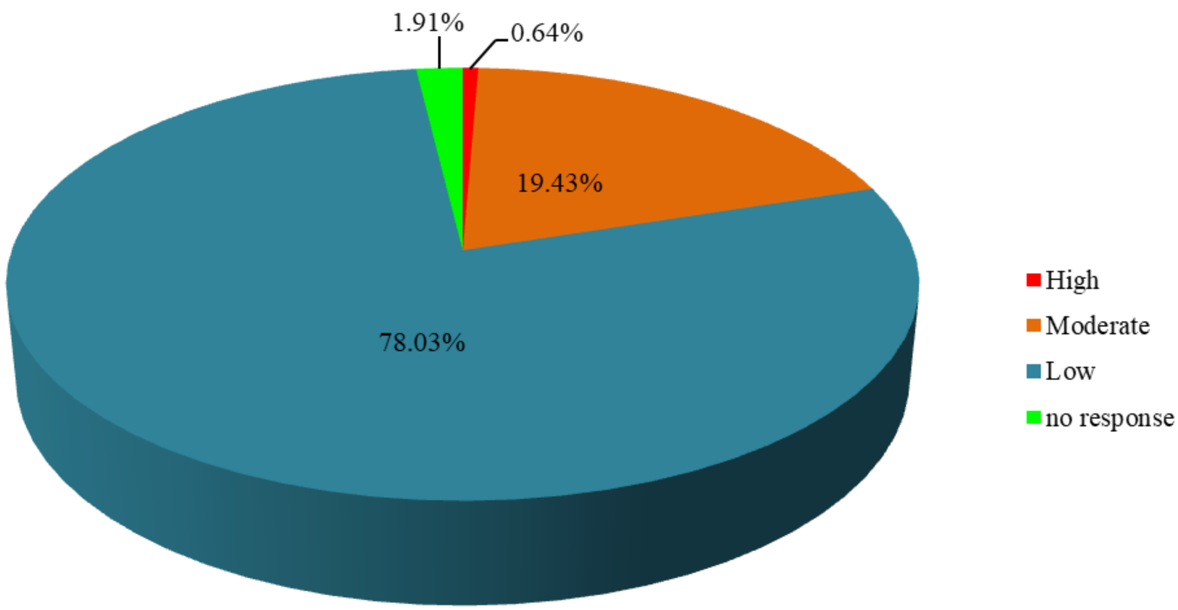

Figure 4:36 Level of participation of local communities towards disaster risk reduction in Kombolcha city
Source: Computed by the author (2020)

Figure 4:36 illustrates that nearly 78% of respondents report low participation, followed by 19.43% who report moderate participation. However, the limited involvement of the local communities did not hamper them from applying disaster information sharing mechanisms found acceptable and relevant to the contexts. Accordingly, the local communities obtain disaster-related information from community leaders, family members, and local administration/Kebeles/ (Figure 4:37).

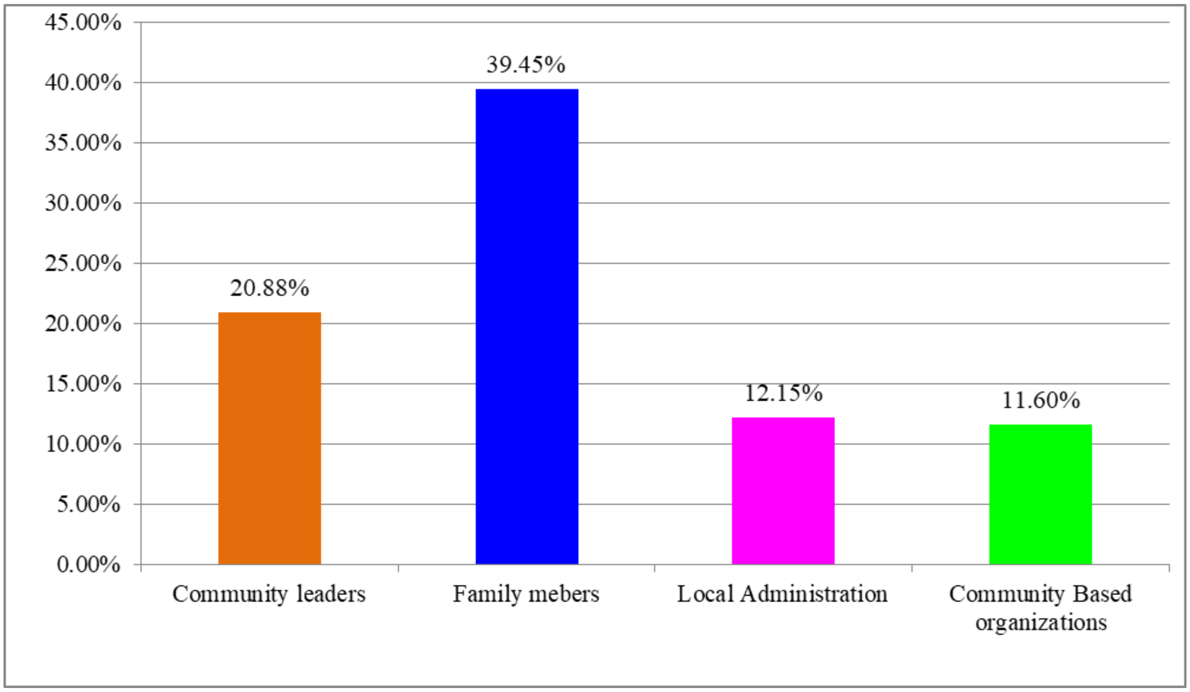

Figure 4:37 Disaster Risk information providers
Source: Computed by the author (2020)

According to Figure 4:37, nearly 40% of the households sampled for this study claim to get disaster risk information from family members, with community leaders coming in second with a close to 21% response. The Figure also depicts the role of local governments and community-based organizations, particularly Idirs, in providing disaster risk information, with 12.15% and 11.60%, respectively. Idirs' role also includes coordinating and engaging the public in disaster risk reduction efforts and providing emergency services.

4.4. Discussions

The inadequate capacities of local governments in secondary cities of SSA to localize international initiatives and develop local resource utilization policies have deteriorated the living conditions of their constituencies (Christiaensen and Kanbur, 2017). Therefore, assessing natural and man-made hazards for these cities is expected to abridge complex experiences of disasters to help make decisions. It also makes people's perceptions more substantial by assisting decision-makers in understanding communities' multiple risks (Dickson et al., 2012; UN-Habitat, 2007).

Popa and Diaconu (2019) disclosed that deforestation, affecting the forest resources, is one factor that potentially triggers flooding and landslides, a combined hazard triggered by seismicity and recurrent surface flooding (Highland and Bobrowsky, 2008). Concurrently, using wood as an energy source and constructing houses in secondary cities of Ethiopia (Githira, Wakibi, Njuguna, Rae, Wandera, Ndirangu, 2020), including Kombolcha city, inevitably made flooding and landslide hazards defining features of the cities.

Flooding in SSA secondary cities is further aggravated by settlements along river banks, booming informal settlements, poor housing, and solid waste dumping in drainage channels (Agbola et al., 2012). In this context, the eastern escarpment or Mountainous areas of Kombolcha city lack adequate drainage facilities that aggravate surface runoff, eroding the topsoil. Subsequently, surface flooding was a concern for settlements found at the foot and plateau/plain lands below the mountains. The drainage lines within the neighborhoods are inadequate to carry the discharges from the overtopping rainwater. Furthermore, the lines within the settlement areas are filled with solid wastes, a global concern attached to environmental degradation (Ferronato and Torretta, 2019), dumped irresponsibly.

The river systems and scant open spaces are spatial locations for solid waste disposal. In this vein, the waste transfer stations in the city are substandard and contribute to making the entire city, particularly the river system, non-resilient in spatial and socio-economic perspectives. According to Ferronato and Torretta (2019), such uncontrolled solid waste disposal causes significant pollution and health risks.

Besides, the lack of a proper waste transportation system in the city exacerbated the problem of solid waste management.

According to Ganin et al. (2017), transportation in general, part of an urban system in secondary cities, is highly susceptible to various shocks and stresses, including traffic accidents and congestion. As a critical concern of traffic management, congestion is attributed to the mismatch between travel demand and road capacity (Aftabuzzaman, 2007).

Accordingly, the recently introduced urban land uses such as the industrial park, the new dry port, and the airport have become a new hub for traffic accidents and congestion in Kombolcha city. Moreover, incompatible existing land uses have also aggravated the problems in the city. The contribution of informal settlements in this regard is immense. The newly added urban functions were added to the existing road networks without proper improvement or upgrading on their right of way width and the quality of pavement materials. The problem is aggravated by poor and inadequate infrastructure, such as narrow and unpaved roads overburdened by the new economically significant urban functions.

Traffic congestion is inevitable due to the daily high volume of freight transport vehicles originating and departing from the dry port and various industrial establishments and warehouses in the city. On-street parking of heavy items and trucks also aggravated urban risks associated with traffic congestion (IPE Global, 2017).

In addition to transportation systems, urban green infrastructures are indispensable in creating resilient and sustainable cities (Reinwald et al., 2019). Concurrently, the city residents acknowledge this concept and reiterated that a lack of green areas and public parks might introduce the social dimension of a non-resilient city like drug addiction due to the absence of leisure spaces.

Urban resilience provides a robust vision for building a resilient city through an innovative approach to spatial planning (Poku-Boansi and Cobbinah, 2018). Yosef (2013) said such planning has a greater impact on shaping the urban forms, including physical structures, security, environmental and socio-spatial policies, and the city's resilience. According to Gunder and Hillier (2009), urban spatial planning 'is the provision. . . of future' certainty' in a complex, unsteady, dynamic and fundamentally uncertain world.'

Fleischhaur (2008) explained that urban spatial planning takes three forms: national, regional, and local. The local urban spatial planning promotes resilience thinking in various parts, including the vision statements depicting the creation of livable and resilient cities (Yamagata and Sharifi, 2018). Fleischhaur's (2008) contribution also noted that the creation of resilient cities lies in integrating redundancy, diversity, robustness, integration/collaboration principles, and sub-dimensions in the local urban spatial plans and implementation.

The induction of resilience thinking into the spatial planning discourse has two inherently important benefits: appraising existing plans, programs, and planning measures on the one hand and making prior identification of critical risks and major planning-related interventions on the other hand, which precedes the setting of priorities and constraints (Eraydin and Taşan-Kok, 2013).

Pinho et al. (2013) asserted that planning evaluation may consider the content of the policy document or investigates the results of the document throughout the planning process, or it could consider both at a time, measured against resilience attributes.

Poku-Boansi and Cobbinah (2018) depicted that the principles can be used to measure experts' understanding to measure the extent to which the local spatial planning documents: legal frameworks, and spatial plans embrace the concept of resilience. The same sources indicated the practices in Ghanaian cities, applied adaptive capacity, inclusiveness, spatial planning, and social equity resilience principles confirmed that urban planners could not translate the concept consistently due to a limited understanding of resilience thinking.

However, the situation in Ethiopia is quite different. The experts representing differing professional qualifications are very much aware of the resilience concept and its integration into spatial planning legal documents, measured against the four principles of spatial resilience. The interviewee also noticed the huge gap wreaked due to the life span of policy documents, which were endorsed more than a decade ago, since 2005. The planning documents have poor implications for contextualizing urban spatial resilience discourses, even though an attempt to measure urban resilience in the scientific world in the 2010s (ICLEI, 2019).

Policy-specific review of this study showed the complementarity of the findings with that of Poku-Boansi and Cobbinah (2018), which attested that the resilience principles were not consistently mainstreamed across the policy documents evaluated. Nevertheless, the experts interviewed revealed that the guiding principles, procedure manuals, and vision statements were the entry points for resilience thinking in Ethiopia's local urban spatial planning exercises. According to Holden et al. (2016); Ilmola (2016), these components of the local spatial planning documents guide all the planning activities towards resilience.

The allocation and distribution of urban services and systems reveal that the disruption of one specific locality does not cause damage to others (Meijers and Romein, 2003). The SPM and UPPIS have also shown the percentage of respective land uses in this context. However, the UPPIS, as later promoted in the GTP II document, provided the 30:30:40% land allocation for green and shared public spaces, roads and infrastructures, and buildings. Thus, such land allocation has made these local urban planning documents aware of redundancy, diversity, and robustness principles. The documents presented the approaches to anticipate and assess potential failures in urban systems due to disruptions.

Within this framework, the 2001 DP and 2011 SP of Kombolcha city allotted land to reserve areas and protected forests, essential components of the redundancy principle. The SPM showed that these areas are mandatory provisions that enable any urban center to withstand future development pressures and potential uncertainties/hazards.

Furthermore, the redundancy principle leads to diversity (Kharrazi et al., 2016). Diversity is defined in land-use types that entail the provisions of main urban elements (Brunetta, G., Caldarice, O., Tollin, N. et al., 2018). In this vein, diversified road types, sizes, hierarchies, land use functions, and location are the concerns of this principle (Figueiredo et al., 2018; Taşan-Kok et al., 2013; Wardekker, 2018). Consequently, the two local urban spatial plans of Kombolcha city, based on the SPM, designated various land use functions and road hierarchies. As a result, the DP and SP endeavored to anticipate potential system collapse and make provisions to ensure that the failure is safe, predictable, and can withstand hazards.

Concerning the practical implementation of spatial plans and their vision related to resilience principles, research by Oliveira et al. (2013), which evaluated four urban policies against resilience's recovery and social capital characteristics, showed mild success. With such a showcase to success and failure, the practical implementation of the provisions of the legal frameworks in Ethiopia was ineffective, as exemplified by the different spatial plans of Kombolcha city.

According to the cross-examination of the DP and SP of Kombolcha city with actual physical developments (ELU), the lands designated as reserve areas and protected forests were transformed into other land-use functions, especially informal settlements and industries have been established. As a result, the existing urban functions of the city are dominated by the redundancy of residential and manufacturing land uses at the expense of realizing the resilience principle.

The SP proposed green spaces and protected forests along river banks, degraded lands, and mountainous city areas currently occupied by informal settlements. As per Yamagata and Sharifi (2018), encroachment by informal settlements into these environmentally sensitive areas disrupts natural and built environments' capacity to withstand disasters.

Urban areas are dynamic and complex systems with social phenomena and a physical transformation of urban form that manifests human connection to the environment (Alberti et al., 2003; Wilkinson, 2012). Besides the urban land use functions, the presence and installation of highly networked and hierarchically developed road infrastructures are inevitably necessary to mobilize goods and services to and from an urban center (Woldeyes and Bishop, 2015).

Within the spatial resilience perspective, Gharai et al. (2018); Ilmola (2016); Lu et al. (2021) contended that urban structures, particularly road and their network make cities robust/strong towards potential disruptions.

The comparisons made concerning the proposals of the two plans against the structural components: roads, and their hierarchy show diverging achievements that do not support robustness or connectivity attributes of resilience. The majority of existing roads further do not satisfy the minimum national standards set on UPPIS and SPM (KCA, 2011).

The urban block is the urban system component with high significance to spatial resilience and is influenced by road networks (Gharai et al., 2018). Tigabu and Semu (2008) attested that urban form remains one of Ethiopia's greatest urban spatial resilience challenges. The fine-grained/subtle urban blocks enhance resilience, while the coarse-grained/crude hamper the capacity of cities to withstand hazards (Gharai et al., 2018). In this context, the urban block arrangement of Kombolha city is characterized as crude with haphazard spacing, pattern, and shape accompanied by the poor quality of the physical structures.

Barthel et al. (2013); Suárez et al. (2016) further alluded that the spatial resilience of cities could be affected by institutional skill, structure, and collaboration. MoUDH and ECSU (2015) discussed that the interventions by key decision-makers impact the effectiveness of hazard planning in all cities of Ethiopia, including Kombolcha. Furthermore, the implementation of urban plans is generally sluggish due to the limited technical capacity of city administrations to prepare detailed plans and their inability to flexibly implement city plans considering the dynamics of cities (MoUDH, 2012).

Accordingly, the poor political commitment, institutional collaboration, stakeholder engagement, and technical capability of municipalities were among the factors that affected the actual implementation of the proposals of the DP and SP towards avoiding urban disturbances and enhancing the urban spatial resilience of Kombolcha city.

Urbanization presents both challenges and opportunities to urban development. The high concentration of people, diversity of population affected by hazards, committed civil societies, and complex governance and service delivery are among the factors that significantly call for strong stakeholder collaboration during planning processes, disaster risk reduction, and resilience-building (Basedow et al., 2017).

UNISDR (2012) discussed that the 2005 Hyogo framework is the guiding instrument for disaster risk reduction and resilience building at international, national, regional, and local levels. According to United Nations Office for Disaster Risk Reduction (2012), disasters are viewed through reducing the risk of and building resilience to disasters, rather than simply responding to a single disaster event.

On the other hand, the resilience principles aim to improve the quality and effectiveness of spatial, environmental, social, and economic sustainability strategies and actions by focusing on all phases of the planning process, including preparation, implementation, and evaluation. Nevertheless, the spatial planning context is significant in implementing sustainable development goals, Goal 11 in particular (Magoni, 2017).

Planning involves a series of collective actions undertaken to ensure the safety and security of citizens by producing changes to public policies, programs, services, and infrastructure against hazards (Berke et al., 1989). The process envisages collaboration amongst planners and other stakeholders to progress planning programs (Bryson, 1989, as cited in Berke et al., 1989).

Accordingly, resilience thinking, expressed through DRR or coping mechanisms, is intentionally integrated into Ethiopia's local urban spatial Plan-making processes. The concept was mainstreamed during the three essential phases of the plan-making process: preparation, planning, implementation, and evaluation.

According to the revised SPM, the preparation phase is the entry point for the resilience concept in the spatial planning perspectives. The phase involves seeking answers to the why, for whom, where, how, and what aspects of resilience. Stakeholder consultation, hazard identification, and preliminary coping strategies development are thoroughly conducted. The second phase, planning, dwells on the findings of the preparation stage.

The stage involves data collection and analysis of a city's spatial, environmental, economic, and social dimensions of structure plan-making. It also includes data on the governance systems of critical urban systems, and producing the land-use plan is its final output leading to the third stage. The implementation stage is highly attributed to translating and interpreting the outputs of the second phase. The monitoring and evaluation phase, on the other hand, is aimed at ensuring sectoral and infrastructure development plans are integrated with components of the structure plan; and all recommendations are enforced per provisions of the same.

The revised SPM disclosed that stakeholders' active and concerted efforts are at the heart of the plan-making processes. However, institutions operating critical physical infrastructures and urban planning implementation and follow-up offices are critical (Magoni, 2017).

According to Alizadeh and Sharifi (2020), the infrastructures are severely affected by urban shocks and stresses. The 2008 Urban planning proclamation ushered that local administrations, in this context the urban plan implementation office, are the lead institution in the plan-making processes with rarely supported and collaboration from water, road, and drainage, green and utility running institutions.

The institutions started to disclose the achievements of sector-specific and non-aligned objectives together during meetings conducted quarterly, bi-annually, and annually with local community representatives. Thus, the thesis's findings show that the overall collaboration during the urban planning process is bad, which is reflected through very low engagement in shared planning and shared alignment of tasks among the operators of the critical urban systems.

It is also noted in the SPM that the various local urban plan-making processes guarantee the appropriate and proper integration of urban uncertainties (Dube, 2014; FDRE, 2008). On the other hand, French and Isaacson (2007) argued that disaster management, including communication systems, is just as important in urban planning as market forces, infrastructure requirements, and other environmental constraints.

The preparation and planning phases are the urban planning processes that show areas vulnerable to hazards by designating potential areas as 'development constraints.' According to Fleischhauer (2008), such demarcation of susceptibility will eventually allow planners to make the site free from any developments. The DP prepared in 2001 also recommended that rectangular-shaped buildings be constructed in hazard-prone areas. The 2012 SPM also ensured that hazard mapping and CBA, elements of disaster communication, are the concerns of the planning processes in Ethiopian urban planning practices.

Sendai Framework for Disaster Risk Reduction adopts a CBA, encouraging local knowledge to prevent, mitigate, and recover from disasters before, during, and after events. In this context, the elements of CBA included Participation, Information sharing, and Training (United Nations Office for Disaster Risk Reduction, 2015).

In addition, Islam et al. (2013); Izumi and Shaw (2012) claimed that collaboration among government, non-government organizations/NGOs/, and community-based organizations are needed to enhance urban resilience. Shome (2019) alluded that collaboration could extend to DRR through communications systems such as pre, during, and post-disaster.

The resilient-oriented spatial planning process puts information sharing and the stakeholders, particularly local institutions, central to DRR (Goldstein, 2009; Walker et al., 2004). On the other hand, Shaw and Okazaki (2004) claimed that the role of local governments is to assist communities' efforts toward disaster management sustainably is significant. Furthermore, CBAs enable people to respond more quickly, efficiently, and fairly to emergencies, which means limited community resources are used efficiently (Twigg, 1999).

Shaw (2012) argued that these organizations are deeply embedded in the society and culture of a given area and facilitate the expression of real needs and priorities, providing the essential information needed to define problems and design and implement solutions. In this context, the thesis investigated the DRR communication systems in Kombolcha city.

In the 2019 report of the South Wollo Zone Agriculture Office, the rural communities or Kebeles/smallest administrative units/ are engaged in DRR activities compared to their urban counterparts. In contrast, the role of community-based organizations, particularly Idirs, seems very low. They are not actively coordinating and engaging the public in DRR efforts; their role lies only in providing emergency services when needed. Concerning disaster information sharing, family members are the crucial sources.

4.5. Spatial planning implications of the study

This research plays a vital role in global, regional, and local urban resilience discourses by providing empirical evidence to create resilient and sustainable secondary cities in a spatial planning context. Furthermore, it will serve as a milestone to work on factors affecting the spatial resilience of cities, addressing the physical and environmental urban problems relevant to spatial resilience.

It would open arguments during urban local spatial planning, policy, strategy, and plan formulation and revision. In addition, the output of this paper would fill some gaps in the existing scholarly contributions and indicate the need for an integrated spatial planning approach to identify, adapt and mitigate urban hazards proactively.

The study has implications for other secondary cities in developing countries and the formulation, review of urban spatial policies, and implementation of the plans. The first is the inevitability of periodic and regular revisions and amendments to spatial planning legal documents and spatial plans to incorporate the evolving and contemporary urban development agenda, particularly resilience discourses.

Second, emphasis should be placed on the actual and practical implementation of site-specific spatial development strategies, backed up by local development and integrated sectoral plans that account for local hazards and their means of adaptation or mitigation.

The third implication is to deploy intensive and comprehensive urban governance capacity-building interventions for cities, institutions, and communities. Strengthening the vertical and horizontal collaboration among stakeholders should center the spatial resilience and planning endeavors.

4.6. Summary

The focus of this chapter was on presenting the empirical investigation and discussing the study's findings in line with the study‘s research questions and objectives. The results section of the thesis indicated the unban resilience issues occurring in secondary cities of Ethiopia. Thus, it has deliberated on the occurrence of seventeen urban challenges with a direct effect on the spatial resilience of these cities. The thesis listed nine urban problems with social, economic, and political dimensions. This paper's objective again found another nineteen urban uncertainties categorized as social, political, and economic factors affecting the resilience of the cities.

The study applied the seventeen urban problems, physical and urban environmental, with profound direct impacts on the spatial resilience of the secondary cities in Ethiopia to constitute the proceeded analysis for Kombolcha city.

However, the household survey conducted in the city found that deforestation, surface flooding, landslides, poor solid waste management, and inadequate drainage facilities were perceived as the top priority urban challenges in Kombolcha city.

The spatial resilience of this city is further challenged by the least re-occurring urban uncertainties, including water scarcity and wind-related shocks. Further, unsustainable material and resource consumption, a lack of infrastructure, poor transportation system conditions, and poor implementation of response measures exacerbated the problems. The responses from the households contacted for this further alluded that the spatial resilience of the city is severely affected by physical and environmental factors.

The result and discussion part of the thesis has also presented the findings on the ex-ante policy reviews conducted on six documents relevant to the country's urban local spatial planning exercises. The reviewed policy documents encompass UDP, UPP, UPPIS, and the GTPs (I and II). The emphasis of the review was to investigate integrating the four characteristics of spatial resilience: redundancy, diversity, robustness, and integration into the policy documents. Therefore, the result indicated that the resilience principles are mainstreamed into the policy documents. Consequently, integration is a core resilience principle among the principles in the policy documents.

On the other hand, policy-specific findings revealed that the more recent National Development Plans implemented for a decade from 2010 to 2020, GTP one and two, have adequately mainstreamed the principles. The GTP documents are reflections of the sustainable development goals. However, integrating the principles of spatial resilience in the two development plans of Kombolcha city is very interesting. They were the direct reflection of the provisions of the policy documents. The vision statement of the SP is an example in this context that came up with the notion of creating a liveable city by mainstreaming the concepts of redundancy, diversity, and robustness through the various land use and road network proposals.

However, implementing the proposals of the SP is challenged by high intervention and lack of commitment by all tiers of government, poor institutional collaboration, stakeholder engagement, and technical capacity of the municipality.

The study also examined the level of collaboration among government institutions and the communication system deployed toward disaster risk reduction. The finding showed that institutions operating urban plan implementation, water service, infrastructure (road and bridge), green protection, and utilities rarely collaborate.

Disaster risk reduction efforts in the city are constrained by a complete lack of early warning systems, indicating the potential occurrence of disasters in Kombolcha city. The effort is further affected by poor disaster mapping, public participation, and information sharing. However, the city residents rely on family members to get disaster information.

Eventually, the discussion part of this chapter compared the above findings with previous national and international studies. In this context, the thesis came out with diverging conclusions regarding the views of urban development and planning practitioners in Ghana, West Africa.

CHAPTER FIVE : RESILIENCE-BASED SPATIAL PLANNING STRATEGIES

5.1. Introduction

This chapter addresses research objective four of the study, which is to provide the strategies that allow the integration of the principles of spatial resilience into the city-wide structure plan of Kombolcha city.

According to Simonsen (2015), strategies for maintaining or enhancing diversity include maintaining structural complexity in landscapes, establishing buffers around sensitive areas, creating corridors for connectivity, and controlling the development of informal settlements. In this vein, the thesis has set the spatial resilience frameworks, proposed resilient-oriented spatial planning, and governance systems of spatial planning strategies

5.2. Spatial Resilience Framework for the city

According to Masik and Grabkowska (2020), the urban resilience strategy encompasses resilience's various dimensions and attributes (Figure 5:1).

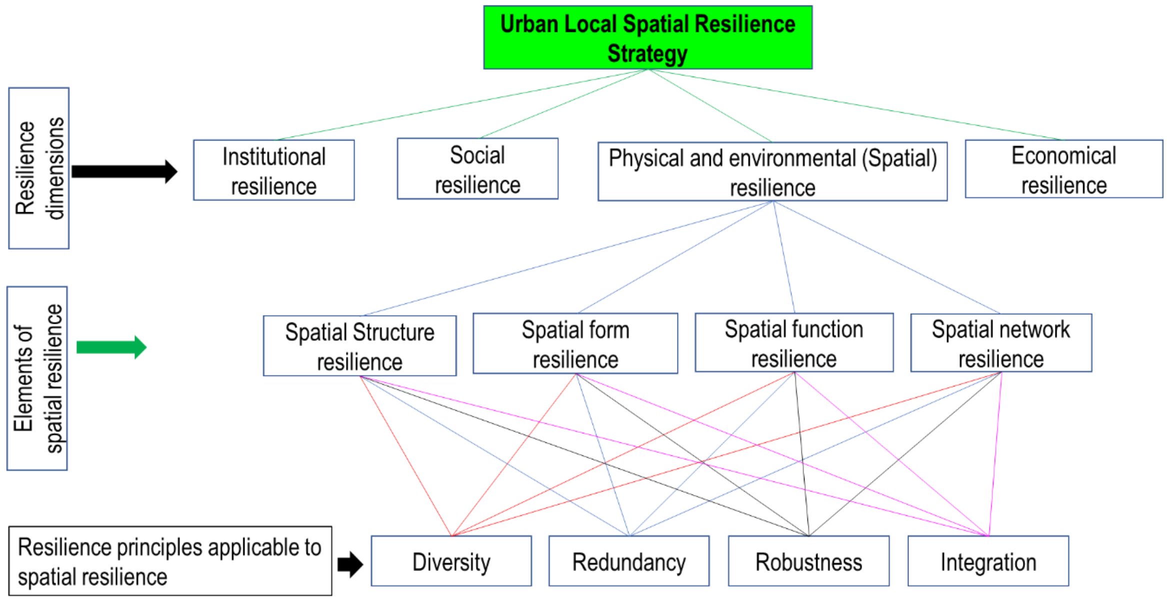

Figure 5:1 Urban resilience strategy: an emphasis on spatial resilience
Source: adapted from Masik and Grabkowska (2020)

The core strategies that could foster the city's resilience in the spatial contexts included preparedness, disaster risk reduction, collaboration, and integration.

Preparedness: this strategy is attached to preparing the city residents for a wide array of uncertainties and disruptions through encouraging community preparedness, creating a culture of risk awareness, and personalizing resilience.

Disaster risk reduction: Capitalize on the collective problem-solving and creativity of the local community by leveraging advances in data, research, and observations to address emerging resilience challenges.

Collaboration/Integration: Embed resilience into city operations and systems by transforming the approach to community resilience.

5.3. Strategies to enhance spatial resilience of cities

The starting point for making cities spatially resilient is to develop a resilience vision based on a shared understanding of urban hazards by community members, who anticipate where they want to see their city's resilience in five years (LDP) and ten years (SPs). The vision statement should serve as a foundation for risk identification, assessment and mitigation measures. It is also a point to integrate the resilience principles into action or implementation through resilient-oriented spatial plans. Therefore, the following are the strategies set forward in this context.

Strategy one: enhance redundancy and diversity principles.

The preparation and implementation of city-wide structure pans should conserve and value redundancy. The main concern is to value the most significant urban functions or services with low redundancy. In this context, preparing the structure plan should promote the creation of green spaces and urban reserve areas per the UPPIS provisions and increase the redundancy of protected areas.

Apart from the functional attributes of resilience, the networks of systems need to be redundant. The preparation of a resilient spatial plan should establish redundant urban networks and connectivity by providing multiple bridges and hierarchical roads that link the city with its hinterlands.

Maintaining the functional diversity of urban spaces is another strategic direction that enhances building a resilient Kombolcha. Diversity in land use functions and road hierarchies or structural complexity is defined through road networks and connectivity through bridges.

Furthermore, the creation of diversified green systems shall also be accompanied by establishing green vegetated buffers and corridors along environmentally sensitive areas such as riverbanks and areas susceptible to natural hazards: earthquakes and landslides.

Strategy two: Increase the robustness of the urban systems

Diversity implies robustness. Thus, the robustness principles should be accompanied by complex structures with appropriate international and national standards. It is important to mark evacuation routes and deploy early warning systems with the active involvement of the communities. This principle should also indicate that the plans and projects for site-specific spatial development complement LDPs, integrated infrastructure, and sectoral plans.

Strategy three: Broaden stakeholder participation:

Involving diverse stakeholders in managing cities and their urban affairs can help build resilience by increasing legitimacy, broadening the breadth and depth of knowledge, and auxiliary in detecting and interpreting disturbances (Biggs et al., 2015). Therefore, the overlapping tools that can broaden the active and effective engagement and participation of stakeholders include:

- Make clear the goals and expectations of the stakeholder participation procedures and processes.
- Identify and involve the stakeholders based on their interest and influence in building the resilience of Kombolcha city.
- Identify people who can motivate the group and inspire them
- Provide capacity building for those who need it.
- Handle power issues and potential conflicts effectively and efficiently.

- Ensure the availability of adequate resources to enable participants to participate effectively.

5.4. Strategies to adapt or mitigate the resilience issues (physical and environmental factors)

The first core strategy for the smart integration of the physical and environmental factors affecting spatial resilience is preparing and implementing a resilient-oriented spatial plan. Therefore, the following sub-strategies help incorporate the resilience issues into the plan.

- **Make urban hazard identification part of future SP and LDP of cities.**

Identifying and addressing urban hazards should be part of the situational assessment study and new SP and LDP proposals for cities. Furthermore, it should be integrated into a resilient-oriented spatial plan.

- **Provide a separate hazard mitigation section and address hazards** throughout the resilient-oriented spatial plan. This part of the thesis targets reducing hazards and building the resilience of cities. The measures constituting the measures include structural: reinforcing, bracing, or strengthening hazard-prone areas and non-structural mitigation measures, including greening the areas.
- **Associate** the resilient-oriented spatial plan and local hazard mitigation plan.

The plan needs to be interlinked and show the frequency and magnitude of the urban hazards in both SPs and LDPs.

- **Cross-examine other urban hazard plans with the resilience plan**

This strategy allows for the holistic consideration of hazards affecting the city's resilience. The intervention further addresses that nothing standing alone as one hazard could bring or introducing another dealing with the whole set of hazards may be required.

5.5. Strategies to enhance the governance systems of spatial planning

When the right people are contacted at the right time, changes and disturbances can be handled quickly by well-connected governance structures, i.e., polycentric governance. The governance structure enables broader stakeholder engagement and empowerment, improves connectivity, improves the potential for response diversity, and builds redundancy to minimize and correct governance errors. Therefore, collaboration among local, regional and national institutions and scales improves the connectivity principles of resilience. The polycentric model also allows tapping traditional and local knowledge into development discourses.

Concerning the enabling environment, the thesis set that the existing local urban spatial planning policies and strategies must be developed regularly through periodic reviews. It is also imperative to strengthen the implementation capabilities of cities and their professionals.

Establishing a resilient-Kombolcha office to address the city's overall urban risks is critical and timely. The office should be able to create a policy/directive or mutually agreed-upon collaboration plan and ensure its consistency and timely implementation. The plan's goal should be to define roles, responsibilities, and timelines for collaboration to effectively and appropriately deal with the city's overall development endeavors, including urban uncertainties.

CHAPTER SIX : CONCLUSIONS AND RECOMMENDATIONS

6.1. Conclusions

Every discipline, development goal, and measurement endeavor has adopted the concept of resilience. It is a promising approach to understanding how communities identify and respond to urban hazards. It has social, political, economic, political and environmental, and physical (spatial) explicit and implicit implications for the spatial resilience of cities with positive and negative effects.

Accordingly, these dimensions set the premises to identify, determine, and categorize the urban resilience issues for secondary cities of Ethiopia. However, this analysis was followed by a detailed presentation on the spatial resilience of Kombolcha city. This dimension of resilience is affected by the type of hazards, institutional setting, severity of disasters, and response pathway, which potentially affect the spatial resilience of cities.

Concerning the urban spatial context, this research looked at the factors that influence the spatial resilience of secondary Ethiopian cities to urban challenges, using empirical data of household perception from Kombolcha city. Consequently, it deliberated on seventeen physical and environmental urban problems affecting the country's spatial resilience of second-tier cities, all of which the case study area is vulnerable to and severely affected by urban problems. The problems are further exacerbated by a lack of appropriate planning and the unsustainability of deployed biophysical measures.

Besides these, local urban planning legal frameworks play a major role in making cities resilient and liveable. In this context, land use, road hierarchies, networks, and existing facilities' capacity to withstand risk are the concerns of resilient spatial planning. As a result, urban resilience discourses have introduced spatial resilience qualities that incorporate redundancy, diversity, robustness, and integration.

The thesis attempted to investigate how these principles are mainstreamed into Ethiopia's local urban spatial planning legal frameworks and plans. Furthermore, it viewed the practice of implementing the provisions of the planning documents in the various spatial plans: DP, SP, and ELU of Kombolcha city.

The UDP is the first spatial planning document to bring the urban agenda into Ethiopian development discourses concerning the policy review. The UPPIS and GTP II document's motto was 'making Ethiopian cities livable, resilient, and sustainable,' which was expected to be achieved through the adoption of 30:30:40 land allocation. The GTPs, on the other hand, linked Ethiopia's economic and spatial strategies to promote the long-term development of urban centers.

In terms of spatial resilience, the SPM and UPPIS emphasized the importance of assessing and anticipating hazards during the development of local urban spatial plans and demonstrating how hazards could be adapted or mitigated. In this context, Kombolcha city's DP and SP proposals illustrate the procedure manuals and associated standards set on the SPM.

The proposals considered various urban hazards and proposed land use and road network changes to mitigate or adapt. However, the findings presented a different story, with bold negative comments on the practical implementation of the policy documents' provisions into urban plans.

The ELU revealed passive implementation and total disengagement with the plans developed and the legal frameworks governing local spatial planning. According to this research, preparing an SP does not imply creating a resilient and sustainable city.

The thesis also analyzed the extent of collaboration and communication systems toward disaster risk reduction. Institutions running urban plan implementation are considered the prime sector in this context, which serves as the foundation for the functioning and operation of the other urban functions. As a result, such government actions can be viewed as a first step toward implementing communicative planning to address man-made and natural disasters.

Communicative planning ensures that participating institutions understand that their agreements will make a city resilient and that coming together and collaborating is required to plan for resilience. According to Yamagata and Sharifi (2018), collaboration is one of the opportunities provided by the resilience-oriented planning process and activities.

The thesis identified five inherently significant local institutions contributing to Kombolcha's spatial resilience in light of this broad concept. The land administration authority, green and environmental protection, road and drainage facilities, and water and sewerage utilities are critical urban systems.

However, communication between these institutions is indecisive throughout the planning processes, integrating resilience thinking and making the city resilient. The institutions rarely collaborate on issues affecting the well-being of city residents.

Nonetheless, few efforts to plan jointly were observed, which should be aggressively and decisively enhanced to the other principles of communicative planning: work alignment and public disclosure of common targets, goals, and achievements.

The planning process is a starting point for communicating disaster risk reduction during the pre-, during, and post-disaster phases. The mapping of hazards is an inherent concern of the planning process, and CBAs are the most important aspect of Kombolcha city's disaster risk reduction efforts.

However, low community participation, a lack of a disaster information sharing platform, and limited training all contribute to the negative effects of hazards.

The thesis filled the gap in identifying and determining the physical and environmental issues affecting the spatial resilience of Kombolcha. In this vein, Kombolcha city's households' perception of the was at the center of the methodological contribution of the thesis through principal component analysis. The analysis was validated through secondary data sources on various resilience issues of secondary cities and other sub-themes considered in Kombolcha city.

Furthermore, the study converges with applying the resilience principles with a study conducted in Ghana in 2018 by Poku-Boansi and Cobbinah and Oporto, Portugal, in 2013 by Oliveira and colleagues.

Concerning the understanding of key informants toward the resilience principles and thinking related to urban local spatial planning, the findings of this study differ from those of the Ghanaian study. The difference was that the key informants or experts engaged in this paper have a better cognizance of the application and mainstreaming of the concept into the policy document reviewed. However, the theme considered is still not fully explored and studied, and it needs further investigation in various dimensions and aspects of resilience mentioned below.

6.2. Recommendations

The thesis suggested that future research should focus on developing strategies, instruments, and plans that mainstream spatial resilience's essential characteristics into resilient-spatial planning practices at a national, regional, and local level. The thesis recommends introducing hazard insurance for the city inhabitants, particularly those settled in and around areas susceptible to the hazards, should buy disaster insurance premiums, which could provide emergency assistance, evacuation compensations, and resettlement efforts during and post-disaster events.

Secondary cities in the global south are deficient in dealing with the neighborhood-level application of the principles, which are the discourses left for future research. The investment requirement of resilience efforts geared towards the urban spaces and potential funding sources to make cities more resilient is left for further research. Besides, the research could also be conducted to identify and determine the distribution of spatially relevant multiple hazards at an urban or neighborhood level.

References

Aburas, M. M., Abullah, S. H., Ramli, M. F. and Ash'aari, Z. H. (2015) 'A review of land suitability analysis for urban growth by using the GIS-based analytic hierarchy process', *Asian Journal of Applied Sciences*, vol. 3, no. 6.

Adger, W. N. (2006) 'Vulnerability', *Global Environmental Change*, vol. 16, no. 3, pp. 268–281.

Adger, W. N., Hughes, T. P., Folke, C., Carpenter, S. R. and Rockström, J. (2005) 'Social-ecological resilience to coastal disasters', *Science (New York, N.Y.)*, vol. 309, no. 5737, pp. 1036–1039.

Aftabuzzaman, M. (ed) (2007) *Measuring traffic congestion: A critical review.* [Online], Melbourne, Victoria, Australia. Available at https://www.researchgate.net/publication/282780229_Measuring_traffic_congestion-_A_critical_review.%20Accessed%20on%20May%2006,%202021.

Agbola, B. S., Ajayi, O., Taiwo, O. J. and Wahab, B. W. (2012) 'The August 2011 flood in Ibadan, Nigeria: Anthropogenic causes and consequences', *International Journal of Disaster Risk Science*, vol. 3, no. 4, pp. 207–217.

Ahern, J. (2011) 'From fail-safe to safe-to-fail: Sustainability and resilience in the new urban world', *Landscape and Urban Planning*, vol. 100, no. 4, pp. 341–343.

Alberti, M., Marzluff, M. M., Shulenberger, E., Bradley, G., Ryan, C. and Zumbrunnen, C. (2003) 'Integrating Humans into Ecology: Opportunities and Challenges for Studying Urban Ecosystems', *BioScience*, vol. 53, no. 12, p. 1169.

Al-Bqour, N. (2020) *Integrating the Resilience Perspective in Urban Planning* [Online], Hashemite University. Available at https://www.researchgate.net/publication/338630949_Integrating_the_Resilience_Perspective_in_Urban_Planning/citations (Accessed 9 December 2021).

Alizadeh, H. and Sharifi, A. (2020) 'Assessing Resilience of Urban Critical Infrastructure Networks: A Case Study of Ahvaz, Iran', *Sustainability*, vol. 12, no. 9, p. 3691.

Allan, P. and Bryant, M. (2011) 'Resilience as a framework for urbanism and recovery', *Journal of Landscape Architecture*, vol. 6, no. 2, pp. 34–45.

Allan, P., Bryant, M., Wirsching, C., Garcia, D. and Teresa Rodriguez, M. (2013) 'The Influence of Urban Morphology on the Resilience of Cities Following an Earthquake', *Journal of Urban Design*, vol. 18, no. 2, pp. 242–262.

Allen, C. R., Angeler, D. G., Cumming, G. S., Folke, C., Twidwell, D., Uden, D. R. and Bennett, J. (2016) 'Quantifying spatial resilience', *Journal of Applied Ecology*, vol. 53, no. 3, pp. 625–635.

Allen, C. R., Cumming, G. S., Garmestani, A. S., Taylor, P. D. and Walker, B. H. (2011) 'Managing for resilience', *Wildlife Biology*, vol. 17, no. 4, pp. 337–349.

Alliance, C. (2007) *Cities Alliance: Cities without Slums. Annual Report 2007.* [Online], Washington, DC, Cities Alliance. Available at https://www.citiesalliance.org/resources/publications/annual-reports/annual-report-2007 (Accessed 20 March 2019).

Alsaqqaf, Z. and Zhang, H. (eds) (2011) *Towards a sustainable system:: application of temporal analysis on flood risk management* (Sustainable Development and Planning V), Ashurst, Southampton, United Kingdom.

Anderies, J. M. (2014) 'Embedding built environments in social–ecological systems: Resilience-based design principles', *Building Research & Information*, vol. 42, no. 2, pp. 130–142.

Angelidou, M., Balla, C., Manousaridou, A., Marmeloudis, S. and Nalmpantis, D. (2018) 'Spatial Planning For Urban Resilience: Assessing Current Prospects Through A Multilevel Approach And A Use Case In Northern Greece.', *Regional Science Inquiry*, vol. 10, no. 3, pp. 33–45.

Arup (2014) *City resilience framework* [Online], The Rockefeller Foundation and ARUP. Available at https://www.100resilientcities.org/resources/.%20Accessed%20December%2024,%202019 (Accessed 24 December 2019).

Asadzadeh, A., Kötter, T. and Zebardast, E. (2015) 'An augmented approach for measurement of disaster resilience using connective factor analysis and analytic network process (F'ANP) model', *International Journal of Disaster Risk Reduction*, vol. 14, no. 15, pp. 504–518.

Asian Development Bank (2013) *Moving from risk to resilience: Sustainable urban development in the Pacific* [Online], Mandaluyong, Philippines, Asian Development Bank. Available at https://think-asia.org/bitstream/handle/11540/801/moving-risk-resilience-sustainable-urban-development-pacific.pdf?sequence=1 (Accessed March 2021).

Asian Disaster Preparedness Center (2015) 'Resilient Cities Framework: Learning from 20 years of experience in over 50 cities across 13 countries in Asia, Bangkok, Thailand'.

Assumma, V., Bottero, M., Angelis, E. de, Lourenço, J. M., Monaco, R. and Soares, A. J. (2021) 'A decision support system for territorial resilience assessment and planning: An application to the Douro Valley (Portugal)', *The Science of the total environment*, vol. 756, p. 143806.

Awumbila, M. (ed) (2017) *Drivers of Migration and Urbanization in Africa: Key Trends and Issues*, Legon, Ghana, UN.

Baas, S., Ramamasy, S., Dey Pryck, J. de and Battista, F. (2008) *Disaster risk management systems analysis: A guide book,* FAO.

Bahadur, A., Tanner, T. and Pichon, F. (2016) *Enhancing Urban climate change resilience: Seven entry points for action*, Philippines, Asian Development Bank.

Barthel, S., Colding, S., Grahn, H., Erixon, H., Ernstson, C., Kärsten, L. and . . . Torsvall (2013) 'Principles of Social-Ecological Urbanism: Case Study: Albano Campus, Stockholm', *KTH, Stockholm: TRITA-ARK.*

Basedow, J., Westrope, C. and Meaux, A. (2017) *Urban stakeholder engagement and coordination.: Guidance note for humanitarian practitioners* [Online], IIED, London.

Bengtsson, J., Angelstam, P., Elmqvist, T., Emanuelsson, U., Folke, C., Ihse, M., Moberg, F. and Nyström, M. (2003) 'Reserves, resilience and dynamic landscapes', *Ambio*, vol. 32, no. 6, pp. 389–396.

Benini, A. (2016) *Severity Measures in Humanitarian Needs Assessments: Purpose, Measurements, and Integration (Technical Note)* [Online]. Available at file://D:/Documents/Categorized%20References_March%202021/Urban%20Resilience/Severity%20Measures%20in%20Humanitarian%20Needs%20Assessments.pdf (Accessed 20 September 2021).

Benson, M. H. and Garmestani, A. S. (2011) 'Embracing panarchy, building resilience and integrating adaptive management through a rebirth of the National Environmental Policy Act', *Journal of environmental management*, vol. 92, no. 5, pp. 1420–1427.

Berke, P., Beatley, T. and Wilhite, S. (1989) 'Influences on local adoption of planning measures for earthquake hazard mitigation', *International Journal of Mass Emergencies and Disasters*, vol. 7, no. 1, pp. 33–56.

Berke, P. R., Song, Y. and Stevens, M. (2009) 'Integrating Hazard Mitigation into New Urban and Conventional Developments', *Journal of Planning Education and Research*, vol. 28, no. 4, pp. 441–455.

Berkes, F. (2007) 'Understanding uncertainty and reducing vulnerability: Lessons from resilience thinking', *Natural Hazards*, vol. 41, no. 2, pp. 283–295.

Berkes, F. (ed) (2008) *Navigating social-ecological systems: Building resilience for complexity and change*, Cambridge, Cambridge Univ. Press.

Berkes, F. and Ross, H. (2013) 'Community Resilience: Toward an Integrated Approach', *Society & Natural Resources*, vol. 26, no. 1, pp. 5–20.

Berkowitz, J. (1998) *Sampling and Sample Size* [Online]. Available at https://www.google.com/search?client=firefox-b-d&q=the+sample+size+for+descriptive+research+shall+be+based+on+the+required+precision+of+the+prevalence+estimate+and+it+should+be+computed+with+attention+to+dropout+rates (Accessed 11 February 2018).

Bevilacqua, C., Calabrò, F. and Della Spina, L. (eds) (2019) *New Metropolitan Perspectives: Local Knowledge and Innovation Dynamics Towards Territory Attractiveness Through the Implementation of Horizon/E2020/Agenda2030 –Volume 2* [Online], Switzerland, Springer International Publishing. Available at https://link.springer.com/content/pdf//10.1007/978-3-319-92102-0.pdf.%20Accessed%20December%2021,%202019 (Accessed 21 December 2019).

Biggs, R., Schlüter, M. and Schoon, M. L. (eds) (2015) *Principles for building resilience: Sustaining ecosystem services in social-ecological systems*, Cambridge, Cambridge University Press.

Billi, P., Alemu, Y. T. and Ciampalini, R. (2015) 'Increased frequency of flash floods in Dire Dawa, Ethiopia: Change in rainfall intensity or human impact?', *Natural Hazards*, vol. 76, no. 2, pp. 1373–1394.

Boadi, K., Kuitunen, M. and Raheem, K. (2005) ‘Urbanisation Without Development: Environmental and Health Implications in African Cities’, *Environment, Development and Sustainability*, vol. 7, no. 4, pp. 465–500.

Brand, F. S. and Jax, K. (2007) ‘Focusing the Meaning(s) of Resilience: Resilience as a Descriptive Concept and a Boundary Object’, *Ecology and Society*, vol. 12, no. 1.

Brown, A., Dayal, A. and Rumbaitis Del Rio, C. (2012) ‘From practice to theory: Emerging lessons from Asia for building urban climate change resilience’, *Environment and Urbanization*, vol. 24, no. 2, pp. 531–556.

Brunetta, G. and Caldarice, O. (2019) ‘New Metropolitan Perspectives: Local Knowledge and Innovation Dynamics Towards Territory Attractiveness Through the Implementation of Horizon/E2020/Agenda2030 - Volume 2’, vol. 101.

Brunetta, G. and Caldarice, O. (2020) *Spatial Resilience in Planning: Meanings, Challenges, and Perspectives for Urban Transition. In: Leal Filho W., Marisa Azul A., Brandli L., Gökçin Özuyar P., Wall T. (eds): Sustainable Cities and Communities, Encyclopedia of the UN Sustainable Development Goals*, Springer, Cham.

Brunetta, G., Faggian, A. and Caldarice, O. (2021) ‘Bridging the Gap: The Measure of Urban Resilience’, *Sustainability*, vol. 13, no. 3, p. 1113.

Brunetta, G., Caldarice, O., Tollin, N., Rosas-Casals, M. and Morató, J. (eds) (2018) *Urban Resilience For Risk And Adaptation: Theory and practice* [Online], Springer. Available at https://link.springer.com/content/pdf/10.1007/978-3-319-76944-8.pdf (Accessed Decemeber 28, 2019).

Cain, A., Daly, M. and Robson, P. (2002) *Basic service provision for the urban poor: The experience of development workshop in Angola (Vol. 8)*, 8th edn, lied.

Carmin, J., Nikhil, N. and Christopher, R. (2012) *Progress and Challenges in Urban climate Adaptation Planning: Results of a Global Survey*.

Carpenter, S., Walker, B., Anderies, J. M. and Abel, N. (2001) ‘From Metaphor to Measurement: Resilience of What to What?’, *Ecosystems*, vol. 4, no. 8, pp. 765–781.

Carrilho, M. (2015) *The use of analytical hierarchy process in spatial decision support system for land use management: A case study of the Zambezi River valley in Mozambique*, Lisbon, Portugal., Universidade Nova de Lisboa.

Carter, J. (1994) ‘Book Reviews: Evaluation Thesaurus (4th ed.), by Michael Scriven. Newbury Park: Sage Publications, 1991, 391 pp’, *American Journal of Evaluation*, vol. 15, no. 1, pp. 109–110.

Cerny, B. A. and Kaiser, H. F. (1977) ‘A Study Of A Measure Of Sampling Adequacy For Factor-Analytic Correlation Matrices’, *Multivariate behavioral research*, vol. 12, no. 1, pp. 43–47.

Chabay, I. (2011) *Assessing the role of vertical and horizontal communication in disaster risk reduction learning and planning: The case of the Spanish Tous dam-break, 1982*.

Chakraborty, A., Chesher, B., Dibis, F. and Issa, N. (2019) ‘Urban resilience: A look into global climate change impacts and possible design mitigation.’.

Chang, S. E. and Shinozuka, M. (2004) ‘Measuring improvements in the disaster resilience of communities’, *Earthquake spectra*, vol. 20, no. 3, pp. 739–755.

Christiaensen, L. and Kanbur, R. (2017) ‘Secondary towns and poverty reduction: Refocusing the urbanization agenda’, *Policy Research Working Paper 7895*, vol. 9, pp. 405–419.

Climate Development Knowledge Network /CDKN/ (2017) ‘Green climate compatible urban industrial development in Ethiopia: Strategy and projects for the Kombolcha-Mek’ele Industrial Corridor’.

Coaffee, J. (2013) ‘Towards Next-Generation Urban Resilience in Planning Practice: From Securitization to Integrated Place Making’, *Planning Practice and Research*, vol. 28, no. 3, pp. 323–339.

Coaffee, J. and Lee, P. (2016) *Urban resilience: Planning for risk, crisis and uncertainty*, London, Palgrave.

Cohen, B., CO2 IMPACT and Capitalism, C. (2011) *TRIPLE PUNDIT: Global Ranking of Top 10 Resilient Cities* [Online]. Available at https://www.google.com/search?client=firefox-b-d&q=example+of+resilient+cities (Accessed 13 February 2019).

Colucci, A. (2014) *Resilient Cities Approaches and practices: Resilience injection into an urban agenda*.

Congalton, R. G. (1991) ‘A review of assessing the accuracy of classifications of remotely sensed data.’, *Remote sensing of environment*, vol. 37, no. 1, pp. 35–46.

Cote, M. E. and King, R. (2017a) *Urban Resilience Planning for Secondary African Cities: A Case Study of Mozambique,* SOUP Project Team ECODIT LLC [Online]. Available at http://urban-links.org /urban-resilience-planning-secondary-african-cities-case-study-mozambique/ .%20Accessed%20on%20August%2003,%202021.

Cote, M. E. and King, R. (2017b) *Urban Resilience Planning for Secondary African Cities: A Case Study of Mozambique, SOUP Project Team ECODIT LLC* [Online]. Available at https://www.alnap.org /system/files/content/resource/files/main/urban-resilience-planning-for-secondary-african-cities-a-case-study-of-mozambique-final.pdf (Accessed 2 August 2021).

Crompton, P. (1996) ‘Evaluation: A practical guide to methods’, *Learning Technology Dissemination Initiative*, vol. 66.

Crown (2011) *Defining Disaster Resilience: A DFID Approach Paper,* DFID [Online]. Available at https://www.gov.uk/government/publications/defining-disaster-resilience-a-dfid-approach-paper.%20Accessed%20on%20February%2010,%202021.

Cruz, S. S., Costa, J.P.T., Sousa, S.Á. de and Pinho, P. (2013) *Urban resilience and spatial dynamics*, Springer International Publishing.

CSA (2013) *Population Projections for Ethiopia: 2007-2037* [Online]. Available at https://www.statsethiopia.gov.et/wp-content/uploads/2019/05/ICPS-Population-Projection-2007-2037-produced-in-2012.pdf.%20Accessed%20January%2020,%202021 (Accessed 20 January 2021).

Cumming, G. S. (2011) *Spatial resilience in social-ecological systems.*, Springer Science & Business Media.

Cutter, S. L., Barnes, L., Berry, M., Burton, C., Evans, E., Tate, E. and Webb, J. (2008) 'A place-based model for understanding community resilience to natural disasters', *Global Environmental Change*, vol. 18, no. 4, pp. 598–606.

Cutter, S. L., Burton, C. G. and Emrich, C. T. (2010) 'Disaster Resilience Indicators for Benchmarking Baseline Conditions', *Journal of Homeland Security and Emergency Management*, vol. 7, no. 1.

Damtew, A. A., Ketema, A. A. and Behailu, B. M. (eds) (2019) *Assessment of Industrial Effluent Pollution on Borkena River, Kombolcha, Ethiopia. In: Habtu N., Ayele D., Fanta S., Admasu B., Bitew M. (eds) Advances of Science and Technology. ICAST 2019. Lecture Notes of the Institute for Computer Sciences, Social Informatics and Telecommunications Engineering, vol 308 (pp. 325-333)*, Springer, Cham. https://doi.org/10.1007/978-3-030-43690-2_22.

Darkwah, R.M. (2016) *An analysis of urban resilience in selected communities in Kumasi and its environs*, MSc, Ghana,, Kwame Nkrumah University of Science and Technology.

Derissen, S., Quaas, M. and Baumgärtner, S. (2009) 'The relationship between resilience and sustainable development of ecological-economic systems', *University of Lüneburg Working Paper Series in Economics*, no. 46.

Dicicco-Bloom, B. and Crabtree, B. F. (2006) 'The qualitative research interview', *Medical education*, vol. 40, no. 4, pp. 314–321.

Dickson, E., Baker, J. L., Hoornweg, D. and Asmita, T. (2012) *Urban Risk Assessments: Understanding Disaster and Climate Risk in Cities,* World Bank.

Dieleman, H. (2013) 'Organizational learning for resilient cities, through realizing eco-cultural innovations', *Journal of Cleaner Production*, vol. 50, no. 2, pp. 171–180.

Dong, X., Shi, T., Zhang, W. and Zhou, Q. (2020) 'Temporal and Spatial Differences in the Resilience of Smart Cities and Their Influencing Factors: Evidence from Non-Provincial Cities in China', *Sustainability*, vol. 12, no. 4, p. 1321.

dos Santos, F. T. and Partidário, M. R. (2011) 'SPARK: Strategic Planning Approach for Resilience Keeping', *European Planning Studies*, vol. 19, no. 8, pp. 1517–1536.

Dube, E. E. (2014) 'Urban planning and land management challenges in emerging towns of Ethiopia: The case of Arba Minch', *Journal of Urban and Environmental Engineering*, pp. 340–348.

Eraydin, A. (ed) (2013) *"Resilience Thinking" for Planning: In: Eraydin A., Taşan-Kok T. (eds) Resilience thinking in urban planning*, Springer, Dordrecht., Springer,

Eraydin, A. and Taşan-Kok, T. (2013) *The Evaluation of Findings and Future of Resilience Thinking in Planning*, Springer International Publishing.

Ernstson, H., van der Leeuw, S. E., Redman, C. L., Meffert, D. J., Davis, G., Alfsen, C. and Elmqvist, T. (2010) ‘Urban transitions: On urban resilience and human-dominated ecosystems’, *Ambio*, vol. 39, no. 8, pp. 531–545.

Evans, J. P. (2011) ‘Resilience, ecology and adaptation in the experimental city’, *Transactions of the Institute of British Geographers*, vol. 36, no. 2, pp. 223–237.

Fana Broadcasting Corporation (December 2021) *Looting and vandalizing urban propeties in Kombolcha city by TPLF*, Kombolcha city, Fana Broadcasting Corporation.

FDRE (2008) *Urban Planning Proclamation: Proclamation No. 574/2008* [Online]. Available at https://chilot.files.wordpress.com/2011/01/proc-574-urbban-planning.pdf.%20Accessed%20November%2014,%202018 (Accessed on).

FDRE (2013) *National Policy and Strategy on Disaster Risk Reduction* [Online]. Available at https://www.refworld.org/pdfid/5a2689ea4.pdf.%20Accessed%20November%2029,%202019 (Accessed 29 November 2019).

FDRE (2021) *Ten Years Perspective Development Plan,* Plan and development Commission.

FDRE Ministry of Mines (2010) *Geology geochemistry and gravity survey of the Dessie area: Memoir 28,* Geological survey of Ethiopia.

Feliciotti, A., Romice, O. and Porta, S. (2017) ‘Urban regeneration, masterplans and resilience: The case of Gorbals, Glasgow’, *Urban Morphology*, vol. 21, no. 1, pp. 61–79.

Feng, C. C. and Chan, E. H. W. (2004) ‘Application of AHP in Decision-Making on Urban Land Use: A Case Study of Chao-Hu City Development in China’, *International Journal of Construction Management*, vol. 4, no. 1, pp. 103–110.

Feng, X., Lei, J., Xiu, C., Li, J., Bai, L. and Zhong, Y. (2020) 'Analysis of Spatial Scale Effect on Urban Resilience: A Case Study of Shenyang, China', *Chinese Geographical Science*, vol. 30, no. 6, pp. 1005–1021.

Ferronato, N. and Torretta, V. (2019) 'Waste Mismanagement in Developing Countries: A Review of Global Issues', *International journal of environmental research and public health*, vol. 16, no. 6.

Figueiredo, L., Honiden, T. and Schumann, A. (2018) *Indicators for Resilient Cities,* OECD Regional Development Working Papers [Online]. Available at https://www.oecd-ilibrary.org/docserver/6f1f6065-en.pdf?expires=1622814985&id=id&accname=guest&checksum=DC4F798339A3E6FEF5820F22429BA180 (Accessed 20 September 2019).

Fleischhauer, M. (2008) 'The-role-of-spatial-planning-in-strengthening-urban-resilience', *In Resilience of Cities to Terrorist and other Threats, Springer, Dordrecht.*, pp. 273–298.

Fleischhaur (2008) 'The role of spatial planning in strengthening urban resilience.', *Cities to Terrorist and other Threats.*, 273–298. Springer, Dordrecht.

Folke, C. (2006) 'Resilience: The emergence of a perspective for social–ecological systems analyses.', *Global Environmental Change*, vol. 16, no. 3, pp. 253–267 [Online]. Available at doi://%2010.1016/j.gloenvcha.2006.04.002.

Folke, C., Berkes, F. and Colding, J. (eds) (2003) *Navigating social-ecological systems: Building resilience for complexity and change* [Online], Cambridge, New York, Cambridge University Press. Available at http://search.ebscohost.com/login.aspx?direct=true&scope=site&db=nlebk&db=nlabk&AN=120253.

Folke, C., Carpenter, S., Elmqvist, T., Gunderson, L., Holling, C. S. and & Walker, B. (2002) 'Resilience and Sustainable Development: Building Adaptive Capacity in a World of Transformations', *A Journal of the Human Environment*, vol. 31, no. 5, pp. 437–440.

Forster, T., Santini, G., Edwards, D., Flanagan, K. and Taguchi, M. (2015) *Strengthening urban rural linkages through city region food systems: Regional Development Dialogue*.

Franklin, J. F. and Forman, R. T. (1987) 'Creating landscape patterns by forest cutting:: Ecological consequences and principles', *Landscape ecology*, vol. 1, no. 1, pp. 5–18.

Fratini, C. F., Geldof, G. D., Kluck, J. and Mikkelsen, P. S. (2012) 'Three Points Approach (3PA) for urban flood risk management: A tool to support climate change adaptation through transdisciplinarity and multifunctionality', *Urban Water Journal*, vol. 9, no. 5, pp. 317–331.

Frazier, T. G., Thompson, C. M. and Dezzani, R. J. (2014) 'A framework for the development of the SERV model: A Spatially Explicit Resilience-Vulnerability model', *Applied Geography*, vol. 51, pp. 158–172.

French, S. P. and Isaacson, M. S. (2007) 'Applying Earthquake Risk Analysis Techniques to Land Use Planning', *Journal of the American Planning Association*, vol. 50, no. 4, pp. 509–522.

G/Egziabher, T. (2010) *Cities and climate change:: The case of Addis Ababa, Ethiopia*.

Galantini, Z.D.Y. and Tezer, A. (2018) 'Resilient urban planning process in question: Istanbul case', *International Journal of Disaster Resilience in the Built Environment*, vol. 13, no. 1, p. 0 [Online]. DOI: 10.1108/IJDRBE-10-2016-0038.

Ganin, A. A., Kitsak, M., Marchese, D., Keisler, J. M., Seager, T. and Linkov, I. (2017) 'Resilience and efficiency in transportation networks: .', *Science advances*, vol. 3, no. 12, p.e1701079.

Garschagen, M. and Romero-Lankao, P. (2015) 'Exploring the relationships between urbanization trends and climate change vulnerability', *Climatic Change*, vol. 133, no. 1, pp. 37–52.

Gharai, F., Masnavi, M. R. and Hajibandeh, M. (2018) ‘Urban Local-Spatial Resilience: Developing the Key Indicators and Measures, a Brief Review of Literature’, *Bagh-e Nazar.*, vol. 14, no. 57, pp. 19–32.

Githira, D., Wakibi, S., Njuguna, I. K., Rae, G., Wandera, S. and Ndirangu, J. (2020) *Analysis of multiple deprivations in secondary cities in sub-Saharan Africa: Analysis Report* [Online], Marylebone: UN-Habitat and UNICEF. Available at https://unhabitat.org/sites/default/files/2021/04/analysis_of_multiple_deprivations_in_secondary_cities_-_analysis_report.pdf (Accessed 20 September 2021).

Githira, D., Wakibi, S., Njuguna, I. K., Rae, G., Wandera, S. and Ndirangu, J.,. (2020) ‘Analysis of multiple deprivations in secondary cities in sub-Saharan Africa: Analysis Report’, *Marylebone: UN-Habitat and UNICEF*.

Godschalk, D. R. (2003) ‘Urban Hazard Mitigation: Creating Resilient Cities’, *Natural hazards review,*, vol. 4, no. 3, pp. 136–143.

Goldstein, B. E. (2009) ‘Resilience to Surprises through Communicative Planning’, *Ecology and Society*, vol. 14, no. 2 [Online]. Available at http://www.ecologyandsociety.org/vol14/iss2/art33/ (Accessed 10 August 2020).

Golini, A. (2001) ‘Urbanization and Urban Population’.

Google earth pro (2021) ‘Informal residential buildings built in reserve areas and protected lands’.

Grazia, B. and Stefano, S. (2019) ‘Mapping Urban Resilience for Spatial Planning: A First A,ttempt to Measure the Vulnerability of the System’, *Sustainabilty*, vol. 11, no. 2331.

Guarte, J. M. and Barrios, E. B. (2007) ‘Estimation Under Purposive Sampling’, *Communications in Statistics - Simulation and Computation*, vol. 35, no. 2, pp. 277–284.

Gunder, M. and Hillier, J. (2009) *Planning in Ten Words or Less: A Lacanian Entanglement with Spatial Planning*, Ashgate Publishing, Ltd.

Guwahat, S. (2013) 'Chapter 2: Determination of appropriate Sample Size', *Bull. Gauhati Univ. Math. Assoc. Int. J.Appl. Math. Stat. Sci*, vol. 12, p. 28.

Habitat, U. N. (2015) *Habitat III Issue Paper 15_Urban Resilience: Habitat III issue papers. .[Online] Available:* [Online], New York:, UN Habitat. Available at http://unhabitat. org.[Accessed: 1/3/2016]. (Accessed 3 November 2021).

Hardin, G. (2009) 'The Tragedy of the Commons', *Journal of Natural Resources Policy Research*, vol. 1, no. 3, pp. 243–253.

Highland, L. and Bobrowsky, P.T.' (2008) *The landslide handbook: A guide to understanding landslides,* US Geological Survey. [Online]. Available at https://pubs.usgs.gov/circ/1325/pdf/Sections/Section1.pdf.%20Accessed%20on%20July%2013,%202021.

Holden, M., Robinson, J. and Sheppard, S. (2016) 'From resilience to transformation via a regenerative sustainability development path.', *Urban Resilience (pp. 295-319)*, Springer, Cham.

Holling, C. S. (1973) 'Resilience and Stability of Ecological Systems', *Annual review of ecology and systematics*, vol. 4, no. 1, pp. 1–23.

Horst, A. (2006) 'Rehabilitation of urban forests in Addis Ababa.', *Journal of the Drylands*, vol. 1, no. 2, 108-117.

Hudson, R. (2010) 'Resilient regions in an uncertain world: Wishful thinking or a practical reality?', *Cambridge Journal of Regions, Economy and Society*, vol. 3, no. 1, pp. 11–25.

Hui, J. and Lim, S. (2018) 'An Analytic Hierarchy Process (AHP) Approach for Sustainable Assessment of Economy-Based and Community-Based Urban Regeneration: The Case of South Korea', *Sustainability*, vol. 10, no. 12, p. 4456.

Hynes, W., Trump, B., Love, P. and Linkov, I. (2020) 'Bouncing forward: A resilience approach to dealing with COVID-19 and future systemic shocks', *Environment systems & decisions*, pp. 1–11.

ICLEI (2019) *Resilient-Cities-Thriving: The evolution of urban resilience.*

IGI Global (2022) *What is Methodological Framework?* [Online], IGI publishers. Available at https://www.igi-global.com/dictionary/methodological-framework/18485 (Accessed 28 June 2022).

Iglesias, A. and Buono, F. (2009) 'Towards sustainability of water policies in Mediterranean countries: Evaluation approaches in the SWAP project', *Current Opinion in Environmental Sustainability*, vol. 1, no. 2, pp. 133–140.

Ilmola, L. (2016) 'Approaches to Measurement of Urban Resilience', *In Urban resilience (pp. 207-237).*, Springer, Cham.

International Strategy for Disaster Reduction (2009) *2009 UNISDR Terminology* [Online]. Available at https://www.unisdr.org/files/7817_UNISDRTerminologyEnglish.pdf (Accessed 15 February 2021).

IPE Global (2017) *Climate compatible urban industrial project development and investment plan in Ethiopia: Kombolcha Baseline report and opportunities assessment*.

Islam, A., Mallick, F. and Shaw, R. (eds) (2013) *Disaster Risk Reduction Approaches in Bangladesh*, Tokyo, Springer Japan; Imprint: Springer.

Islam, M. and Quek, A. (eds) (2014) *Climate Change and Urban Resilience: The Singapore Story*, Singapore, Hackensack, N.J, World Scientific Pub. Co.

Island Press and The Kresge Foundation (2013) *Bounce Forward: Urban Resilience in the Era of Climate Change* [Online].

Iturriza, M., Hernantes, J., Abdelgawad, A. A. and Labaka, L. (2020) 'Are Cities Aware Enough?: A Framework for Developing City Awareness to Climate Change', *Sustainability*, vol. 12, no. 6, p. 2168.

Iverson, L. R. (1988) 'Land-use changes in Illinois, USA: The influence of landscape attributes on current and historic land use', *Landscape ecology*, vol. 2, pp. 45–62.

Izumi, T. and Shaw, R. (2012) 'Chapter 3 Role of NGOS in Community-Based Disaster Risk Reduction: In Community-Based Disaster Risk Reduction. Emerald Group Publishing Limited'.

Jamshed, A., Birkmann, J., Feldmeyer, D. and Rana, I. A. (2020) 'A Conceptual Framework to Understand the Dynamics of Rural–Urban Linkages for Rural Flood Vulnerability', vol. 12, no. 2894.

Jones, L. (2018) 'Resilience isn't the same for all: Comparing subjective and objective approaches to resilience measurement', *Wiley Interdisciplinary Reviews: Climate Change*, vol. 10, no. 1, e552.

Jones, L. (2019) *A how-to guide for subjective evaluations of resilience,* BRACED.

Jones, L. and Tanner, T. (2017) 'Subjective resilience': Using perceptions to quantify household resilience to climate extremes and disasters', *Regional Environmental Change*, vol. 17, no. 1, pp. 229–243.

Kärrholm, M., Nylund, K. and La Prieto de Fuente, P. (2014) 'Spatial resilience and urban planning: Addressing the interdependence of urban retail areas', *Cities*, vol. 36, no. 3, pp. 121–130.

KCA (2001) *Development Pan of Kombolcha city,* Kombolcha City Administration.

KCA (2011) *The 2011 Kombolcha City Structure Plan Report,* Kombolcha City Administration /KCA/.

KCA (2020) *Kombolcha City Asset Management Plan*.

Keen, M., Brown, V. A. and Dyball, R. (2005) *Social learning in environmental management: Towards a sustainable future*, London, Sterling VA, Earthscan.

Keeney, R. L. and McDaniels, T. L. (2001) 'A Framework to Guide Thinking and Analysis Regarding Climate Change Policies', *Risk Analysis*, vol. 21, no. 6, pp. 989–1000.

Kharrazi, A., Fath, B. and Katzmair, H. (2016) 'Advancing Empirical Approaches to the Concept of Resilience: A Critical Examination of Panarchy, Ecological Information, and Statistical Evidence', *Sustainability*, vol. 8, no. 9, p. 935.

Laframboise, N. and Loko, B. (2012) *Natural disasters: Mitigating impact, managing risks.* 12/245 [Online]. Available at https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2169784.%20Accessed%20on%20November%2021,%202019 (Accessed 21 November 2019).

Lasheen, E. (2014) *Proactive Urban Resilience: Prospects of a comprehensive evaluation metric*, Cambridge, Massachusetts, Harvard University [Online]. Available at https://www.academia.edu/8876368/Proactive_Urban_Resilience_Prospects_of_an_evaluation_metric?auto=download&email_work_card=download-paper (Accessed 14 February 2022).

Lee, A. D., Green, B. N., Johnson, C. D. and Nyquist, J. (2010) 'How to Write a Scholarly Book Review for Publication in a Peer-Reviewed Journal: A review of the literature', *Journal of Chiropractic Education*, vol. 24, no. 1, pp. 57-69.

Lorenzo, C. and Marta, O. (eds) (2012) *Multidisciplinary perspectives on urban resilience: A Workshop Report (1st edition)*, Spain, BC3, Basque Centre for Climate Change.

Lu, P. and Stead, D. (2013) 'Understanding the notion of resilience in spatial planning: A case study of Rotterdam, The Netherlands', *Cities*, vol. 35, pp. 200–212.

Lu, Y., Zhai, G., Zhou, S. and Shi, Y. (2021) 'Risk reduction through urban spatial resilience: A theoretical framework', *Human and Ecological Risk Assessment: An International Journal*, vol. 27, no. 4, pp. 921–937.

Mägdefrau, N. (2016) *Building urban resilience through spatial planning following disasters: The Great East Japan Earthquake and Tsunami*.

Magoni, M. (2017) 'Resilience thinking and urban metabolism in spatial planning: Which possible integrations', *City, Territory and Architecture*, vol. 4, no. 1, p. 95.

Martin-Breen, P. and Anderies, J. M. (2011) *Resilience: A literature review*, Bellagio Initiative [Online]. Available at https://opendocs.ids.ac.uk/opendocs/handle/20.500.12413/3692.%20Accessed%20January%208,%202019.

Masik, G. and Grabkowska, M. (2020) 'Practical dimension of urban and regional resilience concepts: A proposal of resilience strategy model', *Miscellanea Geographica*, vol. 24, no. 1, pp. 30–34.

McGill, R. (2020) 'Urban resilience – An urban management perspective', *Journal of Urban Management*, vol. 9, no. 3, pp. 372–381.

McGranahan, G., Marcotullio, P., Bai, X., Balk, D., Braga, T., Douglas, I., Elmqvist, T., Rees, W., Satterthwaite, D., Songsore, J. and Zlotnik, H. (2005) 'Urban systems: Ecosystems and human well-being', *Current state and trends*, vol. 1, pp. 795–825.

Meerow, S. and Newell, J. P. (2018) 'Urban resilience for whom, what, when, where, and why?', *Urban Geography*, vol. 40, no. 3, pp. 309–329.

Meerow, S., Newell, J. P. and Stults, M. (2016) 'Defining urban resilience: A review', *Landscape and Urban Planning*, vol. 147, pp. 38–49.

Meerow, S. and Stults, M. (2016) 'Comparing Conceptualizations of Urban Climate Resilience in Theory and Practice', *Sustainability*, vol. 8, no. 7, p. 701.

Meijers, E. and Romein, A. (2003) ‘Realizing Potential: Building regional organizing capacity in polycentric urban regions.’, *European Urban and Regional Studies*, vol. 10, no. 2, pp. 173–186.

Meriläinen, E. (2019) ‘The dual discourse of urban resilience: Robust city and self-organized neighborhoods’, *Disasters*, vol. 44, no. 1, pp. 125–151.

Mertens, B. and Lambin, E. F. (2000) ‘Land-Cover-Change Trajectories in Southern Cameroon’, *Annals of the Association of American Geographers*, vol. 90, no. 3, pp. 467–494.

Miles, S. B. (2014) ‘Foundations of community disaster resilience: Well-being, identity, services, and capitals’, *Environmental Hazards*, vol. 14, no. 2, pp. 103–121.

Mitchell, T. and Harris, K. (2012) ‘Resilience: A risk management approach’, *ODI Background Notes - Discussion papers*, pp. 1–7.

MoFA (2005) *Urban Development Policy,* Ministry of Urban Development and Housing.

Monette, D. R., Sullivan, T. J., DeJong, C. R. and Hilton, T. (2014) *Applied social research: A tool for the human services*, Belmont CA, Brooks/Cole Cengage Learning.

Morgado, S. and Dias, L. F. (eds) (2013) *Systems, Cultures and Styles: Spatial Planning in Portugal, Turkey, Sweden and the Netherlands*.

Moser, G. (ed) (2004) *Urban Environments and Human Behavior.* [Online]. Available at https://doi.org/10.1016/B0-12-657410-3/00953-3.

MoUDH (2016b) *Draft Urban Planning Proclamation,* Ministry of Urban Development and Housing.

MoUDH (2015a) *National Urban Development Spatial Plan: Ethiopia’s Urban Development Scenarios FINAL Report,* Ministry of Urban Development and Housing.

MoUDH (2015b) *National Urban Development Spatial Plan: Existing Situation and Diagnostic Final Report,* Ministry of Urban Development and Housing.

MoUDH (2015c) *Structure Plan Spatial Framework Implementation Guidelines and Standards: Land use and City Structure,* Ministry of Urban Development and Housing.

MoUDH (2015d) *The Second Growth and Transformational Plan: (Ethiopian Cities Sustainable Prosperity Initiative) (2015- 2020)*, GTP II 2.

MoUDH (2016a) 'Urban Plan Preparation and Implementation'.

MoUDH (2012) *Structure Plan Manual: Revised Version,* Ministryof Urban Development and Housing.

MoUDH (2014) *National Report on Housing & Sustainable Urban Development,* Ministry of Urban Development and Housing [Online]. Available at https://uploads.habitat3.org/hb3/National-Report-Africa-Ethiopia-Final-in-English.pdf (Accessed 21 March 2019).

MoUDH (2017) *Draft Climate Resilience Strategy: Urban Development and Housing,* Ministry of Urban Development and Housing.

MoUDH and Ethiopian Civil Service University /ECSU/ (2015) 'State of Ethiopian Cities Report'.

Müller, B. (ed) (2011) *German Annual of Spatial Research and Policy 2010: Urban Regional Resilience: How Do Cities and Regions Deal with Change?* [Online], Berlin, Heidelberg, Springer-Verlag Berlin Heidelberg. Available at http://dx.doi.org/10.1007/978-3-642-12785-4.

Nelson, D. R., Adger, W. N. and Brown, K. (2007) 'Adaptation to Environmental Change: Contributions of a Resilience Framework', *Annual Review of Environment and Resources*, vol. 32, no. 1, pp. 395–419.

Nepstad, D., Carvalho, G., Barros, A. C., Alencar, A., Capobianco, J. P., Bishop, J., Moutinho, P., Lefebvre, P., Silva Jr, U. L. and Prins, E. (2001) 'Road paving, fire regime feedbacks, and the future of Amazon forests.', *Forest ecology and management*, vol. 154, no. 3, pp. 395–407.

Njoh, A. J. (2003) 'Urbanization and development in sub-Saharan Africa', *Cities*, vol. 20, no. 3, pp. 167–174.

Nyström, M. and Folke, C. (2001) 'Spatial Resilience of Coral Reefs', *Ecosystems*, vol. 4, no. 5, pp. 406–417.

Nyström, M., Folke, C. and Moberg, F. (2000) 'Coral reef disturbance and resilience in a human-dominated environment.', *Trends in Ecology & Evolution*, vol. 15, no. 10, pp. 413–417.

Obrist, B., Pfeiffer, C. and Henley, R. (2010) 'Multi-layered social resilience', *Progress in Development Studies*, vol. 10, no. 4, pp. 283–293.

OCHA (2022) *Ethiopian Population statistics* [Online], United nations Office for the Coordination of Human Affairs. Available at https://www.google.com/search?q=OCHA+2017+population+data+of+ethiopia&oq=OCHA+2017+population+data+of+ethiopia&aqs=chrome.69i57j0i546l2.14406j0j7&sourceid=chrome&ie=UTF-8 (Accessed 9 July 2022).

OECD (2013) *Guidelines on Measuring Subjective Well-being,* OECD Publishing.

Olazabal, M. and Pascual, U. (2012) 'Postulates of urban resilient sustainability transitions: A cross-disciplinary approach. In Paper submitted to ISEE 2012 Conference-Ecological Economics and Rio', vol. 20.

Olds, A. D., Pitt, K. A., Maxwell, P. S., Connolly, R. M. and Frid, C. (2012) 'Synergistic effects of reserves and connectivity on ecological resilience', *Journal of Applied Ecology*, vol. 49, no. 6, pp. 1195–1203.

Oliveira, V., Martins, A. and Cruz, S. S. (2013) ‘Evaluating Urban Policies from a resilience perspectives: The Case of Oporto.’, *Resilience Thinking in Urban Planning (pp. 161-177). Springer, Dordrecht*.

Ostadtaghizadeh, A., Ardalan, A., Paton, D., Jabbari, H. and Khankeh, H. R. (2015) ‘Community disaster resilience: A systematic review on assessment models and tools’, *PLoS currents*, vol. 7.

Paton, D. and Johnston, D. (2001) ‘Disasters and communities: Vulnerability, resilience, and preparedness’, *Disaster prevention and Management*, vol. 10, no. 4, pp. 270–277.

Perry, G., Laituri, M. and Cline, L. (2020) *Why Secondary Cities Deserve More Attention?* [Online]. Available at https://www.newsecuritybeat.org/2020/10/secondary-cities-deserve-attention/.%20Accessed%20on%20August%2007,%202021.

Pimm, S. L. (1984) ‘The complexity and stability of ecosystems’, *Nature,*, vol. 307, no. 5949, pp. 321–326.

Pinho, Paulo, Vítor, O. and Ana, M. (2013) ‘Evaluating resilience in planning: In Resilience Thinking in Urban Planning’, *Springer, Dordrecht.*, pp. 131–144.

Pinho, P., Oliveira, V. and Martins, A. (2013) ‘Chapter 8: Evaluating Resilience in Planning’, *in Resilience Thinking in Urban Planning, Springer, Dordrecht.*, pp. 131–144.

Plata, J.A.R. and México, L. de (2019) ‘Urban Planning, Urban Design, and the Creation of Public Goods’.

Plodinec, M. J. (2009) *Definition of community resilience: An analysis* [Online], Oak Ridge: Community and Regional Resilience Institute. Available at https://s31207.pcdn.co/wp-content/uploads/2019/08/Definitions-of-community-resilience.pdf.

Poku-Boansi, M. and Cobbinah, P. B. (2018) ‘Are we planning for resilient cities in Ghana?: An analysis of policy and planners' perspectives’, *Cities*, vol. 72, pp. 252–260.

Ponserre (ed) (2004) *Ethiopia National Information on Disaster Reduction: Report for the World Conference on Disaster Reduction* [Online], Addis Ababa, Ethiopia. Available at https://www.unisdr.org/2005/mdgs-drr/national-reports/Ethiopia-report.pdf.%20Accessed%20january%2012,%202020.

Popa, M. C. and Diaconu, D.C. (eds) (2019) *Effects of Deforestation on Flooding in the Moldova River Basin*, Casa Cărţii de Ştiinţă.

Powrie, E. (2012) *Law and Regulation for the Reduction of Risk from Natural Disasters in Ethiopia: A National Law Desk Survey,* International Federation of Red Cross and Red Crescent Societies [Online]. Available at https://disasterlaw.ifrc.org/sites/default/files/media/disaster_law/2021-02/Ethiopia-Desk-Survey.pdf.%20Accessed%20May%2025,%202021.

Quinlan, A. E., Berbés-Blázquez, M., Haider, L. J., Peterson, G. D. and Allen, C. (2016) ‘Measuring and assessing resilience: Broadening understanding through multiple disciplinary perspectives’, *Journal of Applied Ecology*, vol. 53, no. 3, pp. 677–687.

Rahman, H. A. (2018) ‘Community-based approach towards disaster management in Malaysia’, *Asian Journal of Environment, History and Heritage*, vol. 2, no. 2.

Rahman, M.M., Chowdhury, M.R.H.K., Islam, M.A., Tohfa, M. U., Kader, M.A.L., Ahmed, A.A.A. and Donepudi, P. K. (2020) ‘Relationship between Socio-Demographic Characteristics and Job Satisfaction: Evidence from Private Bank Employees’, *American Journal of Trade and Policy*, vol. 7, no. 2, pp. 65–72.

Randolph, J. (2004) *Environmental Land Use Planning and Management: 2004. Environmental land use planning and management.*

Razafindrabe, G. A., Parvin, A., Surjan, Y. and Takeuchi, R. S. (2009) ‘Climate disaster resilience: focus on coastal urban cities in Asia’, *Asian Journal of environment and disaster Management*, vol. 1, no. 1, pp. 101–116 [Online]. Available at https://www.alnap.org/system/files/content/resource/files/main/12505-climatedisasterresilienceen.pdf.%20Accessed%20on%20August%2010,%202021.

Redman, C. L. (2014) ‘Should Sustainability and Resilience Be Combined or Remain Distinct Pursuits?’, *Ecology and Society*, vol. 19, no. 2.

Rega, C. and Bonifazi, A. (2020) ‘The Rise of Resilience in Spatial Planning: A Journey through Disciplinary Boundaries and Contested Practices’, *Sustainability*, vol. 12, no. 18, p. 7277.

Reinwald, F., Ring, Z., Kraus, F., Kainz, A., Tötzer, T. and Damyanovic, D. (2019) ‘Green Resilient City - A framework to integrate the Green and Open Space Factor and climate simulations into everyday planning to support a green and climate-sensitive landscape and urban development’, *IOP Conference Series: Earth and Environmental Science*, vol. 323, p. 12082.

Ribeiro, P.J.G. and Gonçalves, L.A.P.J. (2019) ‘Urban resilience: A conceptual framework’, *Sustainable Cities and Society*, vol. 50, no. 4, p. 101625.

RIMA (2016) *AnalyzIng Resilience for better targeting and action: Resilience Analysis in Jordan*, Rome, Resilience Index Measurement and Analysis.

Roberts, B.H. and Hohmann, R. P. (2014) *The Systems of Secondary Cities: The neglected drivers of urbanizing economies.,* The World Bank Group., CIVIS Sharing Knowledge and Learning from Cities No. 89861, pp. 1-12. [Online]. Available at https://documents.worldbank.org/en/publication/documents-reports/documentdetail/400881468181444474/the-systems-of-secondary-cities-the-neglected-drivers-of-urbanising-economies.%20Accessed%20on%20August%2003,%202021.

Roberts, P. (2006) 'Evaluating regional sustainable development: Approaches, methods and the politics of analysis', *Journal of Environmental Planning and Management*, vol. 49, no. 4, pp. 515–532.

Rogov, M. and Rozenblat, C. (2018) 'Urban Resilience Discourse Analysis: Towards a Multi-Level Approach to Cities', *Sustainability*, vol. 10, no. 12, p. 4431.

Romero-Lankao, P., Gnatz, D., Wilhelmi, O. and Hayden, M. (2016) 'Urban Sustainability and Resilience: From Theory to Practice', *Sustainability*, vol. 8, no. 12, p. 1224.

Romice, O., Feliciotti, A. and Porta, S. (2017) 'The road to masterplanning for change and the design of resilient places', *Architectural Research in Finland*, vol. 1, no. 1.

Rwanga, S. S. and Ndambuki, J. M. (2017) 'Accuracy Assessment of Land Use/Land Cover Classification Using Remote Sensing and GIS', *International Journal of Geosciences*, vol. 08, no. 04, pp. 611–622.

Saaty, T. L. (1988) 'What is the analytic hierarchy process?', *In Mathematical models for decision support*, pp. 109–121.

Saaty, T. L. (2008) 'Decision making with the analytic hierarchy process', *International journal of services sciences,*, vol. 1, no. 1, pp. 83–98.

Sadowy, K. (2016) 'Sustainable city – flexible or durable? Socio-economics aspects of urban patterns', in Urbanek, P. (ed) *Economy Today. An Interdisciplinary Approach to Contemporary Economic Challenges,* Wydawnictwo Uniwersytetu Łódzkiego.

Saghir, J. and Santoro, J. (2018) 'Urbanization in Sub-Saharan Africa: Meeting Challenges by Bridging Stakeholders' [Online]. Available at https://csis-prod.s3.amazonaws.com/s3fs-public/publication/180411_Saghir_UrbanizationAfrica_Web.pdf.

Sakakibara, H., Kajitani, Y. and Okada, N. (2004) 'Road Network Robustness for Avoiding Functional Isolation in Disasters', *Journal of transportation Engineering*, vol. 130, no. 5, pp. 560–567.

Salehi, E., Aghababaei, M. T., Sarmadi, H. and Farzad, B. M. (2011) 'Considering the environment resiliency by use of cause model', *Journal of Environmental Studies*, vol. 37, no. 59, pp. 99–112.

Salmons, J. and Wilson, L. (2009) *Handbook of research on electronic collaboration and organizational synergy*, Hershey, Information Science Reference.

Satterthwaite, D. (2017) 'The impact of urban development on risk in sub-Saharan Africa's cities with a focus on small and intermediate urban centres', *International Journal of Disaster Risk Reduction*, vol. 26, pp. 16–23.

Schouten, M. A., van der Heide, C. M., Heijman, W.J. and Opdam, P. F. (2012) 'A resilience-based policy evaluation framework: Application to European rural development policies', *Ecological Economics*, vol. 81, pp. 165–175.

Sharifi, A. (2016) 'A critical review of selected tools for assessing community resilience', *Ecological Indicators*, vol. 69, pp. 629–647.

Sharifi, A., Chelleri, L., Fox-Lent, C., Grafakos, S., Pathak, M., Olazabal, M., Moloney, S., Yumagulova, L. and Yamagata, Y. (2017) 'Conceptualizing Dimensions and Characteristics of Urban Resilience: Insights from a Co-Design Process', *Sustainability*, vol. 9, no. 6, p. 1032.

Sharifi, A. and Yamagata, Y. (eds) (2014) *Major principles and criteria for development of an urban resilience assessment index: International Conference and Utility Exhibition*.

Sharifi, A. and Yamagata, Y. (2016) *Urban Resilience Assessment: Multiple Dimensions, Criteria, and Indicators. In: Yamagata Y., Maruyama H. (eds) Urban Resilience. Advanced Sciences and Technologies for Security Applications. Springer, Cham. https://doi.org/10.1007/978-3-319-39812-9_13*.

Shaw, D., Nadin, V. and Westlake, T. (1995) ‘The compendium of European spatial planning systems’, *European Planning Studies*, vol. 3, no. 3, pp. 390–395.

Shaw, R. (ed) (2012) *Chapter 1 Overview of Community-Based Disaster Risk Reduction. In: Community-Based Disaster Risk Reduction (Community, Environment and Disaster Risk Management, Vol. 10)*, Emerald Group Publishing Limited, Bingley, pp. 3-17.https://doi.org/10.1108/S2040-7262(2012)0000010007.

Shaw, R. and Okazaki, K. (2004) *Sustainable community based disaster management (CBDM), practices in Asia: A user's Guide,* Disaster Management Planning Hyogo Office, UNCRD.

Sherbinin, A. de, Castro, M., Gemenne, F., Cernea, M. M., Adamo, S., Fearnside, P. M., Krieger, G., Lahmani, S., Oliver-Smith, A., Pankhurst, A., Scudder, T., Singer, B., Tan, Y., Wannier, G., Boncour, P., Ehrhart, C., Hugo, G., Pandey, B. and Shi, G. (2011) ‘Climate change. Preparing for resettlement associated with climate change’, *Science (New York, N.Y.)*, vol. 334, no. 6055, pp. 456–457.

Shome, P. (2019) ‘Disaster Risk Communication System in Urban Areas: Current Practices, Prospects and Comparison with Other Countries’, HURP Publication, *Journal of Environmental Engineering and its Scope*, vol. 2, no. 3 [Online]. Available at https://zenodo.org/record/3591332/files/Disaster%20Risk%20Communication%20System%20in%20Urban%20Areas%20-HBRP%20Publication.pdf?download=1 (Accessed 4 September 2021).

Shores, A., Johnson, H., Fugate, D. and Laituri, M. (2019) ‘Networks of need: A geospatial analysis of secondary cities’, *Applied Network Science*, vol. 4, no. 1, p. 103.

Shove, E. (2010) ‘Beyond the ABC: Climate Change Policy and Theories of Social Change’, *Environment and Planning A*, vol. 42, no. 6, pp. 1273–1285.

Silva, M., Oliveira, V. and Leal, V. (2017) ‘Urban Form and Energy Demand’, *Journal of Planning Literature*, vol. 32, no. 4, pp. 346–365.

Smith, A. M. (2012) ‘Research Methodology: A Step-by-step Guide for Beginners’, *Nurse Education in Practice*, vol. 12, no. 3, e25.

Smith, B. E. (1997) ‘A Review of Monocentric Urban Density Analysis’, *Journal of Planning Literature*, vol. 12, no. 2.

Sobian, A. (2016) ‘An Overview of the Participation of Community and Faith-Based Organisations (FBO) in Disaster Preparedness in Malaysia’, *TAFHIM: IKIM Journal of Islam and the Contemporary World*, vol. 9.

Sommerkorn, M., Cornell, S., Nilsson, A. E., Wilkinson, C., Robards, M., Vlasova, T. and Quinlan, A. (2016) ‘A resilience approach to social ecological systems: Central concepts and concerns.’.

Song, L. (2013) *Secondary Cities in Southeast Asia: Frontiers of Opportunity and Challenge, as Explained by their Mayors* [Online], Community Innovators Lab (CoLab). Available at http:// colabradio.mit.edu/secondary-cities-in-southeast-asia/ .%20Accessed%20on%20August%2011,%202021.

Stead, D. and Nadin, V. (2008) *Spatial planning: Key instrument for development and effective governance with special reference to countries in transition.,* United Nations Economic Commission for Europe.

Suárez, M., Gómez-Baggethun, E., Benayas, J. and Tilbury, D. (2016) ‘Towards an Urban Resilience Index: A Case Study in 50 Spanish Cities’, *Sustainability*, vol. 8, no. 8, p. 774.

Sutanta, H., Bishop, I.D.B. and Rajabifard, A. R. (2010) ‘Integrating spatial planning and disaster risk reduction at the local level in the context of spatially enabled government.’.

SWZCO (December 2021) *Looting by TPLF*, Kombolcha, Ethiopia, SWZCO.

Tabibian, M. and Rezapour, M. (2016) 'Assessment of Urban Resilience: A case study of Region 8 of Tehran City, Iran', vol. 23, no. 4, pp. 1599–1707 [Online]. Available at https://pdfs.semanticscholar.org/f28a/82ba590f2bf1f25261fdf6bf3e557a0a4e6c.pdf.%20Accessed%20January%2025,%202018.

Taşan-Kok, T., Stead, D. and Lu, P. (2013) *Conceptual Overview of Resilience: History and Context*, Springer, Dordrecht.

Tegenu, T. (2010) 'Urbanization in Ethiopia: Study on Growth, Patterns, Functions and Alternative Policy Strategy', *Stockholm University, Department of Human Geography*.

Tesfaunegn, E. (2017) *Urban and peri-urban development dynamics in Ethiopia,* Swiss Agency for Development and Cooperation [Online]. Available at https://www.shareweb.ch/site/Agriculture-and-Food-Security/focusareas/Documents/urban_country_study_ethiopia.pdf.Accessed%20November%2022,%202018.

The Copernicus Emergency Management Service (2013) *RISK & RECOVERY MAPPING product portfolio: Emergency Management Service* [Online], Copernicus. Available at https://emergency.copernicus.eu/mapping/sites/default/files/files/CopernicusEMS-Service_Portfolio-Risk_and_Recovery_Mapping.pdf (Accessed 19 September 2021).

Thompson, W. D. and Walter, S. D. (1988) 'A reappraisal of the kappa coefficient. Journal of clinical epidemiology, 41(10), pp.949-958.', vol. 41, no. 10, pp. 949–958.

Tigabu, T. and Semu, G. (2008) *Ethiopia urban profile: 2008*, Nairobi, UN-HABITAT Regional and Technical Cooperation Division.

Twigg, J. (1999) 'The Age of Accountability?: Future Community Involvement in Disaster Reduction: Future community involvement in disaster reduction', *Australian Journal of Emergency Management*, vol. 14, no. 4, pp. 51–58.

Twigg, J. (2009) *Characteristics of resileinet communities: A guidance note*.

U.S. Department of Homeland Security (2014) *Landslide Mitigation Strategies: prepared for Department for Natiral Resource /Minnesota DNR* [Online]. Available at https:// www.google.com/search?client=firefox-b-d&q=DNR%2C+Minnesota%3A+Landslide+Mitigation+Strategies. (Accessed 12 February 2019).

UN (2014) 'World Urbanization Prospects:: The 2014 Revision-Highlights. UN'.

UN (2018) 'World Urbanization prospects: The 2018 Revision' [Online]. Available at https:// population.un.org/wup/Publications/Files/WUP2018-KeyFacts.pdf.

UN DESA (2014) 'World urbanization prospects', *United Nations Department of Economics and Social Affairs, Population Division*, New York, NY, USA, 41.

UN Habitat (2017) *Trends_in_Urban_Resilience_2017*, Nairobi Kenya, nited Nations Human Settlements Programme (UN-Habitat).

UNDP (2010) *Disaster Risk Reduction and Recovery,* Bureau for Crisis Prevention and Recovery-UNDP [Online]. Available at https://www.undp.org/content/dam/undp/library/ crisis%20prevention/disaster/1Disaster%20Risk%20Reduction%20and%20Recovery%20-%20Introduction.pdf.%20Accessed%20on%20On%20March%208,%202021.

UN-Habitat (1996) *Management of Secondary Cities in Southeast Asia*.

UN-Habitat (2007) *Enhancing Urban Safety and Security:: Global Report on Human Settlements 2007 (Full report)* [Online]. Available at Earthscan in the UK and US. Available at www.earthscan.co.uk (Accessed ebruary 20, 2021).

UN-Habitat III (ed) (2016) *Habitat III New Urban Agenda:: Quito Declaration on sustainable cities and human settlements for all*.

UNISDR (2013) *Making Cities Resilient: Summary for Policymakers. A global snapshot of how local governments reduce disaster risk – April 2013,* UNISDR [Online]. Available at https:// www.preventionweb.net/files/33059_33059finalprinterversionexecutivesu.pdf (Accessed 20 October 2018).

UNISDR, W. (2012) *Disaster risk and resilience.: Thematic Think Piece, UN System Task Force on the Post-2015 UN Development Agenda.* [Online]. Available at https://www.un.org/ millenniumgoals/pdf/Think%20Pieces/3_disaster_risk_resilience.pdf (Accessed 29 September 2021).

United Nations Department of Economic and Social Affairs (2016) *The world's cities in 2016* [Online]. Available at https://www.un-ilibrary.org/ (Accessed 13 August 2021).

United Nations Office for Disaster Risk Reduction (2012) *Disaster Risk and Resilience: Thematic Think Piece* [Online]. Available at https://www.un.org/en/development/desa/policy/untaskteam_undf/ thinkpieces/3_disaster_risk_resilience.pdf (Accessed 29 September 2021).

United Nations Office for Disaster Risk Reduction (2015) *Sendai Framework for Disaster Risk Reduction 2015 - 2030,* UN.

Viverita, V., Kusumastuti, R. D., Husodo, Z. A., Suardi, L. and Danarsari, D. N. (2014) 'Households perceptions on factors affecting resilience towards natural disasters in Indonesia', *The South East Asian Journal of Management*.

Walker, B., Holling, C. S., Carpenter, S. and Kinzig, A. (2004) 'Resilience, Adaptability and Transformability in Social– ecological Systems', *Ecology and Society*, vol. 9, no. 2 [Online]. Available at http://www.ecologyandsociety.org/vol9/iss2/art5 (Accessed 13 November 2019).

Walker, B. and Salt, D. (2006) *Resilience Thinking: Sustaining Ecosystems and People in a Changing World*, Island press.

Walta Information Center (December 2021) *Mass grave found in Kombolcha city*, Kombolcha, Ethiopia, Walta Information Center.

Wamsler, C., Brink, E. and Rivera, C. (2013) 'Planning for climate change in urban areas: From theory to practice', *Journal of Cleaner Production*, vol. 50, no. 2, pp. 68–81.

Wardekker (2018) 'Resilience Principles as a Tool for Exploring Options for Urban Resilience', *Solutions*, vol. 9, no. 1.

Water and Land Resource Center/WLRC/, Ethiopia (2018) *National and City Location map of Ethiopia* [Online], Addis Ababa, Ethiopia, WLRC. Available at https://www.ethiogis-mapserver.org/dataDownload.php (Accessed 10 December 2020).

Webber, M. e.M. (2016) 'Explorations Into Urban Structure', *University of Pennsylvania Press.*

Wilkinson, C. (2012) 'Social-ecological resilience: Insights and issues for planning theory', *Planning Theory*, vol. 11, no. 2, pp. 148–169.

Woldeyes, F. and Bishop, R. (2015a) *Unlocking the Power of Ethiopia's Cities* [Online]. Available at http://newclimateeconomy.report/2014/wp-content/uploads/sites/2/2015/03/Unlocking-the-Power-of-Cities-in-Ethiopia.pdf.%20Accessed%20on%20October%2020,%202019.

Woldeyes, F. and Bishop, R. (2015b) *Unlocking the Power of Ethiopia's Cities: A report by Ethiopia's New Climate Economy Partnership* [Online]. Available at https://newclimateeconomy.report/workingpapers/wp-content/uploads/sites/5/2016/04/Unlocking-the-Power-of-Cities-in-Ethiopia.pdf.%20Accessed%20September%2023,%202019 (Accessed 23 September 2019).

World Bank (2018) 'An urban institutional and infrastructure development program for Federal democratic republic of Ethiopia', *Social, Urban, Rural, and Resilience Global Practice Africa*.

Yamagata, Y. and Sharifi, A. (eds) (2018) *Resilience-Oriented Urban Planning: Theoretical and Empirical Insights* [Online], Cham, Springer. Available at https://link.springer.com/content/pdf/10.1007/978-3-319-75798-8.pdf.%20Accessed%20February%2002,%202020.

Yimer, S. and Sahu, O. P. (2014) 'Assessment and Management of Municipal Solid wastes for Kombolcha City:, 1(1), pp.1-20.', *World Journal of Soil, Water and Air Pollution*, vol. 1, no. 1, pp. 1–20.

Yodmani, S. (2001) *Disaster Risk Management and Vulnerability Reduction: Protecting the Poor,* Asian Development Bank [Online]. Available at http://lib.riskreductionafrica.org/bitstream/handle/123456789/495/2023.Disaster%20Risk%20Management%20and%20Vulnerability%20Reduction.pdf?sequence=1 (Accessed 20 September 2021).

Yosef, J. (2013) 'Planning the resilient city: Concepts and strategies for coping with climate change and environmental risk', *Cities*, vol. 31, no. 3, pp. 220–229.

Zhang, Y. (2010) 'Residential Housing Choice in a Multihazard Environment: Implications for Natural Hazards Mitigation and Community Environmental Justice', *Journal of Planning Education and Research*, vol. 30, no. 2, pp. 117–131.

Zhongming, Z., Linong, L., Xiaona, Y., Wangqiang, Z. and Wei, L. (2012) *How to make cities more resilient: a handbook for local government leaders*.

Zumbo, B. D., Gadermann, A. M. and Zeisser, C. (2007) 'Ordinal Versions of Coefficients Alpha and Theta for Likert Rating Scales', *Journal of Modern Applied Statistical Methods*, vol. 6, no. 1, pp. 21–29.

Annexes

Annex 1: LULC change detection

LULC Class	Class Change (2010 - 2020)	Area change (Ha)	Percentage change per class
Bare Land	Bare Land - Bare Land	819.4403	27.17%
	Bare Land - Built-Up	607.82	**20.15%**
	Bare Land - Cultivation Land	1511.772	50.12%
	Bare Land - Forest	67.24297	2.23%
	Bare Land - Waterbody	10.16761	0.34%
	Total area	**3016.442**	100.00%
Built-Up	Built-Up - Bare Land	43.11516	8.75%
	Built-Up - Built-Up	417.9039	84.81%
	Built-Up - Cultivation Land	31.20395	6.33%
	Built-Up - Waterbody	0.533779	0.11%
	Total area	**492.7568**	100.00%
Cultivation Land	Cultivation Land - Bare Land	753.3823	10.23%
	Cultivation Land - Built-Up	866.8495	**11.77%**
	Cultivation Land - Cultivation Land	5638.809	76.58%
	Cultivation Land - Forest	96.57537	1.31%
	Cultivation Land - Waterbody	7.207995	0.10%
	Total area	**7362.824**	100.00%
Forest	Forest - Bare Land	6.956788	0.48%

	Forest - Built-Up	**30.82284**	**2.13%**
	Forest - Cultivation Land	284.1385	19.67%
	Forest - Forest	1121.808	77.67%
	Forest - Waterbody	0.523259	0.04%
	Total area	**1444.249**	100.00%
Waterbody	Waterbody - Bare Land	1.976053	1.47%
	Waterbody - Built-Up	2.88197	2.15%
	Waterbody - Cultivation Land	14.23319	10.60%
	Waterbody - Forest	0.004166	0.00%
	Waterbody - Waterbody	115.2104	85.78%
	Total area	**134.3058**	100.00%

Annex 2: Accuracy assessment and Kappa coefficients

Accuracy assessment table for LULC 2010

	Bare Land	**Built-Up**	**Cultivation Land**	**Forest**	**Water body**	**Total (User)**
Bare Land	9	0	2	0	0	11
Built-Up	1	5	0	1	0	7
Cultivation Land	0	0	14	0	0	14
Forest	0	0	1	10	0	11
Water body	0	0	0	0	7	7
Total (Producer)	10	5	17	11	7	50

Overall accuracy = $\frac{Total\ number\ of\ correctly\ classified\ pixels\ (Diagonal)}{Total\ number\ of\ reference\ pixels}\ x\ 100 =$

Overall accuracy = $\frac{45}{50}\ x\ 100 =$ **90% Accurate**

Kappa coefficient (k) = $\frac{((\boldsymbol{TS*TCS})-\sum(\boldsymbol{Column\ total*Raw\ total}\ )}{\mathbf{TS*TS}-\sum(\boldsymbol{Column\ total-Raw\ total})}$

$$= \frac{(50*45)-\sum[(10*11)+(5*7)+(17*14)+(11*11)+(7*7)]}{50*50)-\sum[(10*11)+(5*7)+(17*14)+(11*11)+(7*7)]}$$

$$= \frac{(2250)-\sum[111+35+98+121+49]}{(2500)-\sum[111+35+98+121+49]} = \frac{2250-414}{2500-414}$$

Kappa coefficient (k) = 0.88

Accuracy assessment table for LULC 2020

	Bare Land	Built-Up	Cultivation Land	Forest	Water body	Total (User)
Bare Land	8	0	0	1	0	9
Built-Up	2	11	0	2	0	15
Cultivation Land	1	0	8	1	0	10
Forest	0	0	0	10	0	10
Water body	0	0	0	0	6	6
Total (Producer)	11	11	8	14	6	50

Overall accuracy = $\frac{Total\ number\ of\ correctly\ classified\ pixels\ (Diagonal)}{Total\ number\ of\ reference\ pixels}\ x\ 100 =$

Overall accuracy = $\frac{43}{50}\ x\ 100 =$ **86% Accurate**

Kappa coefficient (k) = $\frac{((\boldsymbol{TS*TCS})-\sum(\boldsymbol{Column\ total*Raw\ total}\,)}{\mathbf{TS*TS}-\sum(\boldsymbol{Column\ total-Raw\ total})}$

$$\frac{(50*43)-\sum ((11*9)+(11*15)+(10*8)+(14*10)+(6*6))}{(50*50)-\sum ((11*9)+(11*15)+(10*8)+(14*10)+(6*6))}$$

$$\frac{(2150)-(99+165+80+140+36))}{(2500)-(99+165+80+140+36))} = \frac{2150-520}{2500-520}$$

Kappa coefficient (k) = 0.823

Annex 3: Published articles