Riverside Regeneration in Addis Ababa: A case Study of the little Akaki River

Anwar Abrar Mohammed

A Thesis Submitted to the Department of Architecture

School of Civil Engineering and Architecture

Presented in Partial Fulfilment of the Requirement for the Degree of Master's in Urban Planning and Design

Office of Post Graduate Studies

Adama Science and Technology University

June 2024

Adama, Ethiopia

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Advisor: Yared Girma (PhD)

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Declaration

I declare that this thesis proposal entitled "Riverside Regeneration in Addis Ababa: A case study of the little Akaki River" is my own work and has not been submitted to any university for similar purpose. The references used in this proposal are duly recognized by proper citations.

Anwar Abrar	_____	_____
Name of student	Signature	Date

Recommendation of Advisors

I, the major advisor/supervisor of this research proposal, hereby certify that I have closely advised/supervised the student while developing this proposal and read the draft thesis/dissertation proposal entitled *"Riverside Regeneration in Addis Ababa: A case study of the little Akaki River"* prepared under my guidance by Anwar Abrar. Therefore, I recommend the submission of the proposal to the department for further review and evaluation.

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Major Advisor/Supervisor	Signature	Date
_____	_____	_____
Co-advisor/Co-supervisor	Signature	Date

Approval Page of M.Sc. Thesis

I/we the advisors of the thesis entitled *"Riverside Regeneration in Addis Ababa: A case study of the little Akaki River"* and developed by Anwar Abrar, hereby certify that the recommendation and suggestions made by the board of examiners are appropriately incorporated into the final version of the thesis.

Major Advisor	Signature	Date
Co-advisor	Signature	Date

We, the undersigned, members of the Board of Examiners of the thesis by Anwar Abrar have read and evaluated the thesis entitled *"Riverside Regeneration in Addis Ababa: A case study of the little Akaki River"* and examined the candidate during open defense. This is, therefore, to certify that the thesis is accepted for partial fulfillment of the requirement of the degree of Master of Science in Urban Planning and Design.

Chairperson	Signature	Date
Internal Examiner	Signature	Date
External Examiner	Signature	Date

Finally, approval and acceptance of the thesis is contingent upon submission of its final copy to the Office of Postgraduate Studies (OPGS) through the Department Graduate Council (DGC) and School Graduate Committee (SGC).

Department Head	Signature	Date
School Dean	Signature	Date
Office of Postgraduate Studies, Dean	Signature	Date

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List of Acronym

ADBG - African Development Bank Group

BDP - Building Design Partnership

BOD - Biological Oxygen Demand

CBO – Community Based Organisation

CSA - Central Statistical Agency of Ethiopia

ECA - Economic Commission for Africa

FAO - Food and Agricultural Organization

GDP - Gross Domestic Products

KML - Keyhole Markup Language

NGO – Non Governmental Organizations

SPSS - Statistical Package for the Social Sciences

ULI - Urban Land Institute

Abstract

Over the past half-century, Addis Ababa's burgeoning economy and urban expansion have led to significant changes in its central area. Industrial spaces have been relocated and abandoned, giving rise to a host of urban challenges. Concurrently, the city's land structure has prompted a call for rational transformation, particularly along the riverside areas. The study area focuses on the Little Akaki River, assessing the causes of pollution and proposing strategies to mitigate adverse impacts, thereby transitioning the polluted downstream region into a habitable riverside environment. To achieve the study objectives, both qualitative and quantitative data were gathered from various sources and analyzed. Statistical analysis was conducted using the SPSS tool, while the existing features of the study area were mapped using Google Earth Pro and Spatial Manager for AutoCAD tool. Spatial data encompassing site features, land use patterns, road networks, grain patterns, environmental concerns, and topography were assessed. The analysis revealed several key characteristics, problems, and potential of the area along the Little Akaki River. Existing developments along the riverbank were found to consist largely of informal and improper settlements, with a dispersed grain pattern and limited green infrastructure. Infrastructure and stormwater management systems were found to be inadequate. On the positive side, the area boasts a moderate topographic altitude (ranging from 2115.04m to 2160.15m above mean sea level), active community engagement and participation. The study identifies various interconnected factors contributing to pollution in the downstream sections of the Little Akaki River. These include industrial discharge containing heavy metals and hazardous substances, inadequate wastewater management, agricultural runoff carrying fertilizers and pesticides, and urbanization leading to improper sanitation and solid waste disposal. The cumulative impact of these pollutants results in degraded water quality, posing risks to human health and aquatic life. In response to these findings, a riverside urban regeneration plan is proposed, aimed at transforming the polluted and underutilized riverside space into a vibrant and sustainable urban area. This plan involves comprehensive strategies to address pollution, upgrade infrastructure, enhance green spaces, and promote community participation. By leveraging the area's potential and addressing its challenges, the proposed plan seeks to create a more livable and environmentally friendly riverside environment in Addis Ababa.

Key Words: Urban Regeneration, Riverside development, Akaki River, Design strategies, Urban design concept.

CHAPTER ONE

1. INTRODUCTION

1.1 Background of the Study

Riverside is the unique places where land and water meet. Such places are a finite resource embodying the special history and character of each community (K. Bassett., 2002). Urban Riverside planning examines the different ways of experiencing and using the edges of rivers and understanding their qualities for the community (Sairinen, 2006). In many cases it has been seen that urban Riverside regeneration is driven by economic transition, concerns of social community environment, physical obsolescence and new recreational land and property requirements, environmental quality and sustainable development (Brown, 2008).

Riverside development presents a holistic solution to urban challenges, offering numerous benefits. It reduces cooling demands in buildings, thereby lowering energy consumption (Gaffen & Köhler, 2012), while restoring natural habitats enhances ecology and biodiversity (Bingham et al., 2014), and improves air and water quality (Nowak et al., 2013; Vymazal, 2010). Additionally, it serves as a natural sound barrier, mitigating noise pollution (van den Bosch & de Jong, 2017). Properly designed riverside areas can also mitigate floods by utilizing natural retention and infrastructure (Ahern, 2011), and adapt to climate change by sequestering carbon and enhancing flood resilience (Palmer et al., 2014; Wolff et al., 2013). Ultimately, riverside development contributes to sustainable and livable cities by enhancing biodiversity, improving environmental quality, reducing noise pollution, and facilitating climate change adaptation and mitigation, making it an invaluable tool for urban planning.

With burgeoning urbanization, the pollution of rivers has reached an alarming level. Especially in developing countries, where institutions are weak, rivers are being polluted and are becoming non-usable, and sometimes toxic to living things (Cresswell, 2015). In developing countries, people prefer to live far from rivers because most rivers are polluted and repulsive. Those people who live near rivers are the poor and are those who could not access land through the formal channels. That is why we see informal developments surrounding rivers in developing countries like Ethiopia, especially in cities like Addis Ababa.

Little Akakai river, a river that drains through the city of Addis Ababa is one of the most polluted rivers in the city. It is very polluted because it receives untreated household, business and industrial wastes that originate from portion of the city (Gebre & Van Rooijen, 2009). In

addition, there is uncontrolled riverside agricultural activity that uses unknown amount of agrochemicals for vegetable production along its banks.

In addition, as any person can witness, settlements along the river are very informal and unsustainable, as people are living in a very poorly planned and poorly serviced conditions (Gebre & Van Rooijen, 2009). This makes them vulnerable to various hazards such as flooding, disease outbreak, exposure to toxic substances and etc. This poorly planned settlement system along the river is considered to be the major cause of pollution of the river. This research, therefore, sets out to study the main causes of pollution of Little Akaki River, especially on its lower courses (in Akaki Kality Sub-City), and what needs to be done to improve the settlement and the river conditions through spatially investigating what is happening around this river.

1.2 Statement of the Problem

Riverside areas play a crucial role in urban environments, offering various ecological, social, and economic benefits. However, in many cities, riversides have been neglected and subjected to degradation due to urbanization, industrialization, and pollution. In the context of Addis Ababa, Ethiopia, the Little Akaki River presents a significant case study for examining the challenges and opportunities associated with riverside regeneration. The Little Akaki River, like many urban water bodies, faces severe pollution and degradation. Industrial discharge, inadequate wastewater management, agricultural runoff, and improper solid waste disposal contribute to the contamination of the river, affecting water quality and biodiversity. The degradation of the river's ecosystem poses risks to human health and undermines its ecological functions.

As Addis Ababa experiences rapid urbanization, pressure on land and resources intensifies. Informal settlements and unregulated construction activities encroach upon the riverbanks, leading to habitat destruction, increased pollution, and reduced access to green spaces. The urbanization of riverside areas exacerbates environmental degradation and compromises the well-being of residents.

The absence of comprehensive planning and regulatory frameworks further exacerbates the degradation of the Little Akaki River. Inadequate enforcement of environmental regulations, limited coordination among government agencies, and insufficient investment in infrastructure contribute to the deterioration of riverside areas. The lack of proactive measures to address

pollution and urban encroachment hinders efforts to revitalize the river and promote sustainable development.

In light of these pressing issues, there is an urgent need to examine strategies for riverside regeneration in Addis Ababa, with a specific focus on the Little Akaki River. Addressing environmental degradation, urbanization pressure, planning deficiencies, socio-economic impacts, and climate change vulnerabilities is essential for promoting sustainable development and enhancing the resilience of riverside communities. This research aims to assess causes of pollution to the little Akaki River and dentify effective interventions and policy recommendations to revitalize the Little Akaki River and promote inclusive, environmentally sustainable urban development in Addis Ababa.

1.3. Research Objectives

1.3.1 General objective

The general objective of the research is to assess causes of pollution to the little Akaki River and providing strategies of mitigating the adverse impacts to change the study area from the pollutant downstream to livable riverside.

1.3.2 Specific objective

This research will specifically

1. Assess the existing condition of riverside in the study area.
2. Analyze the major cause of pollution to the downstream of the little Akaki River and neighborhood along it.
3. Identify ways of mitigating the adverse impacts due to pollution around little Akaki River.
4. Come up with possible spatial regeneration plan along the little Akaki river that helps to regenerate the little Akaki River and along its banks to promote sustainable life.

1.4 Research Questions

This research aims to answer the following key research questions. These are:

1. What is the existing condition around the lower courses (downstream) of little Akaki river?
2. What are the major causes of pollution to the little Akaki River and the spatial configuration along the riversides?
3. What mitigation strategies can help to improve the pollution conditions around the lower courses of the little Akaki river?

4. What design option can be applied to regenerate the little Akaki riverside that can promote sustainable life along its banks?

1.5 Significance of the Study

This research is an academic attempt to understand what causes pollution to Little Akaki river from spatial configuration perspective. Hence, it is an original work that links pollution with urban planning. The researcher attempted to investigate the link between the pollution of little Akaki River with the way the space is configured around it and how the two are linked to one another. Hence it gives a new perspective into new causes of pollution. Although there are many researches done in the area, none of them linked the pollution of the river to space configuration or urban planning.

The research help the city change the haphazard settlement patterns that is significantly affecting the environment. The research is also important to the surrounding community because it finally aims to develop a new plan that will change the image of the riverside, at least in some portion of the lower course of the river. Furthermore, this research is also significant for Addis Ababa city administration specially for Addis Ababa City Master Plan Project Office, Addis Ababa city beautification office environmental protection office through raising awareness about the area.

This research has potential significance on area of Urban Development and Planning in contributing valuable insights into urban development and planning strategies, helping to create sustainable and well-designed urban spaces. Riverside areas are ecologically sensitive, and their regeneration can have implications for biodiversity, water quality, and overall environmental health. The research have also potential significance in Community Engagement and Livability hence, regeneration projects often impact local communities. Understanding how the regeneration of riverside areas affects residents, businesses, and overall community well-being can be crucial for fostering positive change and ensuring that development aligns with the needs and aspirations of the people. Riverside areas often have the potential to become vibrant cultural and economic hubs. The study could assess the economic impact of regeneration on local businesses, employment, and tourism, contributing to the city's overall economic growth.

Regeneration projects typically involve improvements in Infrastructure and Accessibility or transportation. Studying how these changes affect accessibility, mobility, and connectivity in Addis Ababa around the study area; this study provided valuable information for urban planners

and policymakers. Given the proximity to rivers, the study could explore how regeneration efforts address water management and flood control issues. This is crucial for creating resilient and sustainable urban environments, especially in the face of climate change.

In summary, the significance of the research study lies in its potential to inform and guide urban development policies, contribute to environmental sustainability, enhance community well-being, and foster economic growth in Addis Ababa, mainly along the little Akaki River. Additionally, this thesis paper contributes to the field of urban planning and design by showing the relationship between macro and micro scales. Starting from the regional context, master planning the entire riverside showing different phases of development and then narrowing down to a structure in the form of a connecting link between the city and its riverside design in urban regeneration.

1.6. Limitations

My research and development were focused on making effective connections from the downtown area to the Riverside of little akaki river. In existing scenario, people living adjacent of the little Akaki river have not recognized the strength of the city's natural assets. My study and design recommendations gave emphasis on how to attract people towards waterfront, while making the area safe, sustainable, and enjoyable. It also included the study of what type of a suitable development for existing situations of the city.

In urban detail design, an author emphasized on innovative design of a connecting link through the built structure, which will create an easy and safe access for people to reach riverside. The design explorations addresses innovative ideas of mitigating infrastructural barriers present on the site. In addition, it was focuses on the study of existing movements and potential access.

This thesis research did not involve the study of financial conditions or funding situations. It did not include the market and real estate conditions or the potential changes expected in the field of marketing due to my design recommendations. The design proposal includes some fundamental infrastructural changes, but it did not address the cost analysis for the same.

The proposed urban village was a mixed land-use development project. Hence includes public and private spaces. However, I did not focus on what type and how this public private partnership will work. Findings restricted to the design and planning aspect; it did not provide any statistical information about any kind of estimated analysis due to the development.

1.7 Scope of the Study

Thematic and Spatial Scope: the study area selected because of tangible and serious problem the area-characterized in. for instance the study area known by its informal settlements, improper street layout, temporary housing development, polluted and felt smell arises. Such issues need profound solution through research. This study is limited to the causes Pollution of Little Akaki river by focusing on its downstream areas in Addis Ababa which lie in Nifas silk lafto and Akaki kality sub city. The area approximately covers 150-200 hectare right and left side of rivers including buffer spaces. The thematic scope covers collection of the relevant socio-economic, spatial, environmental and institutional information from all relevant sources.

Temporal Scope- this research depend on primary data that have collected in the year 2023/24 from the space defined in the previous paragraph. However, the researcher may also collect secondary data of previous years from available secondary sources to understand the nature and causes of pollution of Little Akaki River. In addition, the spatial analysis may use satellite images taken during previous years to analyze the growth of settlements and its impact on the river (possibly, to show how settlements grew in the past 20 years).

1.8 Operational definitions

Operational definitions clarify the specific meaning of a concept in the context of a research study, outlining how it measured or observed. The term urban regeneration refers to the process of helping an area, develop and grow strong again or recover from decline, to return from a state of decline to a revitalized state through interventions such as planning (socio-economic and spatial) and infrastructure provision. As noted in(Peter & hugh,2000).Comprehensive and integrated vision and action which leads to the resolution of urban problems and which seeks to bring about a lasting improvement in the economic, physical , social and environmental condition of an area that has been subject to change.

Buffer zone: buffer zone in this context refers to the space left unused to separate rivers from other developments such as residence, commerce, businesses and other intensive human uses.

Waterfront: means the urban area in direct contact with water. In the case of "riverside regeneration," the following operational definitions get considerations:

Physical Infrastructure Improvement: Riverside regeneration is operationally defined as the physical enhancement of infrastructure along the riverbanks, encompassing the creation of

pedestrian walkways, cycling paths, green spaces, and recreational facilities (Smith & Jones, 2018).

Environmental Restoration: Riverside regeneration is operationally defined as the systematic restoration and improvement of the natural environment along the river, involving actions such as planting native vegetation, preserving biodiversity, and implementing measures to enhance water quality and ecological sustainability (Brown et al., 2020).

Community Engagement and Participation: Riverside regeneration is operationally defined as the inclusive and participatory involvement of local communities in the planning, decision-making, and implementation processes of the regeneration project. This encompasses community consultations, workshops, and feedback mechanisms to ensure that residents' perspectives are considered (Johnson & Smith, 2017).

Social and Economic Development: Riverside regeneration is operationally defined as the intentional promotion of social and economic development in the surrounding areas, involving the creation of job opportunities, provision of affordable housing, and encouragement of local businesses and cultural activities (Garcia & Martinez, 2019).

Aesthetic and Cultural Enhancement: Riverside regeneration is operationally defined as the systematic effort to enhance the aesthetic appeal of the riverfront and preserve or promote cultural elements. This includes the installation of public art, historical preservation, and the incorporation of cultural themes in the design and architecture of the regenerated space (Turner & White, 2015).

Accessibility and Connectivity: Riverside regeneration is operationally defined as the purposeful improvement of accessibility and connectivity in and around the riverfront area. This includes the development of transportation infrastructure, pedestrian-friendly pathways, and connections to other parts of the city (Manning et al., 2021).

CHAPTER TWO

2. REVIEW OF LITERATURE

2.1 Theoretical literature

2.1.1. Historical background of development along a riverside

a) Early Civilizations and River Valleys

Rivers have played a crucial role in the development of human civilizations. The earliest known civilizations, such as those in Mesopotamia, the Indus Valley, Egypt, and China, all developed along rivers. These river valleys provided fertile land for agriculture, a reliable water source, and a means of transport and trade.

In Mesopotamia, the Tigris and Euphrates rivers supported the growth of cities like Uruk and Babylon, where irrigation techniques were first developed (Postgate, 1992). Along Indus Valley, the Indus River enabled the rise of cities like Harappa and Mohenjo-Daro, known for their advanced urban planning and water management systems (Kenoyer, 1998). In Egypt, the Nile River was central to the Egyptian civilization, providing resources for farming, fishing, and transportation (Butzer, 1976). In China, the Yellow River supported the development of early Chinese states and agricultural practices (Needham, 1954).

b) Medieval and Renaissance Periods

During the medieval period, European cities often grew around rivers, which served as critical arteries for commerce and communication. The Renaissance further spurred riverside development as trade and exploration expanded.

In Medieval Europe, Cities like Paris (Seine River), London (Thames River), and Cologne (Rhine River) thrived as centers of commerce due to their riverine locations (Nicholas, 1997) and during Renaissance era, the increase in trade and exploration during this period saw significant developments in river ports and infrastructure, facilitating the exchange of goods and ideas across Europe (Braudel, 1972).

c) Industrial Revolution

The Industrial Revolution in the 18th and 19th centuries marked a significant shift in riverside development. Rivers became vital for powering mills, factories, and for the transportation of raw materials and finished products.

Mainly in England Industrial revolution, the River Thames in London and the River Clyde in Glasgow became hubs of industrial activity, with factories and warehouses lining their banks (Freeman, 1999). Also in United States Industrial revolution, Rivers like the Mississippi and Ohio became crucial for the transport of goods and raw materials, aiding the industrial growth of cities like New Orleans and Cincinnati (Hunter, 2006).

d) Modern Development

In the 20th and 21st centuries, riverside development has focused on urban renewal and environmental sustainability. Many cities have undertaken projects to revitalize their waterfronts, turning former industrial areas into spaces for residential, commercial, and recreational use for Urban Renewal developments (Smith & Ferrari, 2012). Also for Environmental Sustainability, Modern riverside developments often incorporate green spaces, flood management systems, and efforts to restore natural habitats (Bunce & Desfor, 2007).

2.1.2. The Relationship of River and Urban Built Environment

The relationship between rivers and the urban built environment is a critical aspect of urban planning and design. Research indicates that the integration of rivers and urban areas can significantly impact urban vitality and resilience.

Factors such as compactness, functional mixing, building density, and pedestrian-friendly elements influence urban vitality and the overall quality of urban spaces. The loss of urban vitality in central urban areas can be addressed by understanding how the built environment affects urban life and well-being (Lu S. et al., 2019).

Moreover, the built environment has a direct impact on public health and behavior. The physical environment, including access to parks, green spaces, and walk-able neighborhoods, can influence people's activity levels and eating behaviors. For instance, creating walk-able neighborhoods and promoting physical activity through urban design along river side can contribute to healthier lifestyles and reduce chronic health issues associated with sedentary behavior (Clay, R. A. 2007).

2.1.3. Challenges facing on the development of riversides

Urban riverside development is a complex endeavor that involves balancing economic growth, environmental sustainability, and social equity. Some of key challenges associated with

developing urban riversides are Environmental Degradation, Flood Risk Management, Socio-Economic Equity, Regulatory Barriers and Financial Constraints.

a) Environmental Degradation

One of the primary challenges in urban riverside development is addressing the environmental degradation such as pollution and habitat destruction that often accompanies urbanization and industrial activities.

Pollution such as industrial discharges, sewage, and runoff from urban areas can severely pollute rivers, affecting water quality and aquatic ecosystems (Adler, 1995). Development along riversides can lead to the destruction of natural habitats, disrupting local biodiversity. Efforts to restore and protect these habitats are crucial but can be challenging due to competing land-use demands (Bunce & Desfor, 2007).

b) Flood Risk Management

Riverside development must contend with the risk of flooding, which can be exacerbated by climate change and urbanization. Implementing effective flood control measures, such as levees, floodwalls, and green infrastructure, is essential to protect urban areas from flooding (Brown et al., 2011). To adapt Climate Change, Rising sea levels and increased frequency of extreme weather events pose additional challenges for riverside development (IPCC, 2014).

c) Social and Economic Equity

Ensuring that riverside development benefits all segments of the urban population is another significant challenge. Through gentrification, where rising property values and living costs displace long-time residents, can create social tensions and exacerbate inequality (Smith & Ferrari, 2012). In addition, Inclusive Planning that provides affordable housing and accessible public spaces for diverse communities can achieved through participatory planning processes that involve local residents and stakeholders (Lehmann, 2016).

d) Regulatory and Institutional Barriers

Different levels of government (local, regional, national) may have overlapping jurisdictions and regulations affecting riverside development. Coordinating these regulations can be challenging and time-consuming (Freeman, 1999).

Successful development requires collaboration between various public and private entities, including government agencies, developers, and community organizations. Building such,

partnerships can be difficult but is essential for integrated planning and implementation (Healey, 2006).

e) Financial Constraints

Funding riverside development projects is a significant challenge, particularly in times of economic uncertainty. The costs associated with environmental remediation, infrastructure development, and flood protection can be substantial. Securing funding from public and private sources is often a major hurdle (Smith & Ferrari, 2012).

Ensuring that riverside development projects are economically viable while meeting social and environmental goals requires careful planning and often-innovative financing mechanisms, such as public-private partnerships (Lehmann, 2016).

2.1.4. Principles for successful riverside redevelopment

Riverside redevelopment can significantly enhance urban environments by transforming polluted, neglected or underused areas into vibrant, sustainable, and inclusive spaces. successful riverside redevelopment have to incorporate basic principles such as Sustainability, Economic Viability, Inclusiveness, Cultural and Historical Sensitivity, Connectivity and Accessibility.

a) Sustainable Development

Sustainable development is fundamental to riverside redevelopment, ensuring long-term environmental health and resilience. Prioritizing the restoration and preservation of natural habitats and ecosystems along the river. This includes creating green buffers, wetlands, and riparian zones that enhance biodiversity and water quality (Bunce & Desfor, 2007). Design infrastructure and public spaces that are adaptable to climate change impacts, such as rising water levels and increased flooding. Implementing green infrastructure, such as permeable surfaces and rain gardens, can help manage stormwater and reduce flood risks (Brown et al., 2011).

b) Inclusive and Participatory Planning

Ensuring that riverside redevelopment benefits the entire community requires inclusive and participatory planning processes. Actively involve local residents, businesses, and stakeholders in the planning and decision-making process. This helps ensure that the redevelopment meets the needs and desires of the community and fosters a sense of ownership and pride (Lehmann, 2016). Develop affordable housing and accessible public amenities to prevent displacement and

ensure that all community members benefit from the redevelopment. Addressing social equity can help mitigate gentrification and foster a more inclusive urban environment (Smith & Ferrari, 2012).

c) Economic Viability

Successful riverside redevelopment must be economically viable, balancing financial sustainability with community and environmental goals. Promote a mix of residential, commercial, and recreational uses to create a dynamic and economically diverse area. This can attract a variety of users and ensure the area remains active throughout the day and year-round (Tiesdell & Adams, 2011). Leverage public-private partnerships to secure funding and expertise for redevelopment projects. These collaborations can help share risks and benefits, ensuring that projects are financially feasible and well-executed (Healey, 2006).

d) Cultural and Historical Sensitivity

Riverside redevelopment should respect and integrate the cultural and historical context of the area. Identify and preserve historical landmarks, buildings, and cultural sites along the river. Integrating these elements into the redevelopment can enhance the area's identity and appeal (Freeman, 1999). Incorporate spaces for cultural activities, such as public art installations, performance areas, and community events. This can help celebrate the area's heritage and foster a vibrant cultural scene (Desfor & Laidley, 2011).

e) Connectivity and Accessibility

Improving connectivity and accessibility is crucial for integrating riverside areas into the broader urban fabric. Develop efficient and sustainable transport links, including pedestrian and cycling paths, public transit, and water-based transport options. Enhancing connectivity can increase access to the riverside and reduce reliance on cars (Gehl, 2010). Ensure that the waterfront is accessible to all residents, with ample public spaces, parks, and promenades. Designing inclusive public spaces can enhance the quality of life and encourage active use of the riverside (Carmona, 2010).

2.1.5. Benefits of Riverside Redevelopment

Urban riverside redevelopment offers numerous benefits that enhance the social, economic, and environmental aspects of urban areas. These benefits contribute to the overall sustainability and livability of cities.

a) Economic Benefits:

Riverside redevelopment can lead to increased property values and attract investment in the area. The aesthetic appeal and improved amenities associated with redeveloped waterfronts make them desirable locations for residential and commercial real estate.

Redevelopment projects often stimulate local economies by attracting businesses, tourists, and new residents, which boosts local spending and generates tax revenue (Smith & Ferrari, 2012). Construction and development activities create jobs, both during the redevelopment phase and in the long-term through new businesses and services that emerge (Lehmann, 2016).

Riverside areas can become major tourist attractions, offering recreational activities, cultural events, and scenic views. Features such as parks, promenades, and cultural sites draw visitors, which benefits local businesses and promotes economic diversity (Desfor & Laidley, 2011). Enhanced public spaces and amenities provide residents and visitors with recreational opportunities, improving health and well-being (Carmona, 2010).

b) Social Benefits

Redeveloped riverside areas can significantly enhance the quality of life for urban residents by providing accessible green spaces, recreational facilities, and cultural venues. Well-designed public spaces encourage social interaction, community activities, and outdoor recreation, fostering a sense of community and belonging (Gehl, 2010). Access to green spaces and recreational facilities promotes physical activity, reduces stress, and improves mental health (Carmona, 2010).

Inclusive riverside redevelopment can address social equity by providing affordable housing and accessible public amenities for diverse populations. Incorporating affordable housing units within redevelopment projects helps prevent displacement and ensures that all socio-economic groups benefit from the improvements (Smith & Ferrari, 2012).

Community Engagement: Participatory planning processes that involve local residents and stakeholders ensure that the redevelopment meets the needs of the entire community, promoting social inclusion (Lehmann, 2016).

c) Environmental Benefits

Redeveloping urban riversides provides an opportunity to restore and conserve natural habitats, improve water quality, and enhance biodiversity. Projects often include restoring wetlands, riparian zones, and other natural habitats, which support wildlife and improve ecological health (Bunce & Desfor, 2007). Measures to reduce pollution and manage stormwater runoff help improve the water quality of urban rivers, benefiting both ecosystems and human health (Brown et al., 2011).

Riverside redevelopment can enhance a city's resilience to climate change by incorporating sustainable design principles and green infrastructure. Incorporating green infrastructure such as permeable surfaces, green roofs, and floodplains helps manage stormwater and reduce the risk of flooding (IPCC, 2014). Energy-efficient buildings, renewable energy sources, and sustainable materials contribute to the overall sustainability and resilience of the urban environment (Lehmann, 2016).

2.1.6. Theoretical frameworks

Theoretical literature review explores key theoretical frameworks related to urban regeneration and riverfront development, providing a foundation for understanding and analyzing the prospects and challenges of riverside regeneration: Existing theories, concepts, and scholarly discussions related to urban regeneration and riverfront development are examined as follows.

a) Urban Regeneration Theories: offer insights into the motivations, processes, and outcomes of revitalizing urban spaces. Key concepts such as gentrification and place-making (Cresswell, 2015) are central to understanding how urban areas are transformed. Additionally, Harvey's (2008) notion of the "right to the city" is relevant to discussions of equitable development and social justice in the context of regeneration.

b) Riverfront Development Theories: Theories specific to riverfront development provide insights into the unique challenges and opportunities associated with revitalizing waterfront areas. concept of imageability is relevant to understanding the perceptual qualities of riverside

spaces, while Melosi's (2000) work on the "urbanization of nature" sheds light on the dynamic relationship between cities and rivers.

c) Riverside Regeneration in Addis Ababa: Understanding the specific context of Addis Ababa is crucial for effective riverside regeneration. Insights from studies on African urbanism (Pieterse, 2019) and the dynamics of urban development in Ethiopia (Teferra, 2009) provide a foundation for analyzing the unique challenges and opportunities that may arise in Addis Ababa's riverside regeneration efforts.

d) Urban Riverside Redevelopment

Theories specific to riverfront development provide insights into the unique challenges and opportunities associated with revitalizing waterfront areas. concept of imageability is relevant to understanding the perceptual qualities of riverside spaces, while (Melosi's., 2000) work on the "urbanization of nature" sheds light on the dynamic relationship between cities and rivers.

Waterfronts, the unique places where land and water meet, are a finite resource embodying the special history and character of each community. Urban Riversides, like the cities they help define, are dynamic places (Sairinen K., 2006). Urban Riverside planning examines the different ways of experiencing and using the edges of rivers and understanding their qualities for the community. In many cases it has been seen that urban Riverside regeneration is driven by economic transition, concerns of social community environment, physical obsolescence and new recreational land and property requirements, environmental quality and sustainable development (Wang C., 2017). There is no comprehensive theory of Riverside development and research on topic mostly over only few large projects in world cities. In journals and trade magazines they do not specifically address the complex set of issues involved in Riverside development; despite the fact that these projects were started almost half a decade ago. The urban land institute (ULI), a non-profit organization dedicated to creating better places, has also focused on the topic of waterfront development by offering forums, workshops, conferences, panels to educate their members and local leaders (Brown P. H., 2008).

Much of the existing literature views Riverside revitalization as a means to increase the economic vitality of localities, create new public spaces, and increase access to valued cultural and natural amenities. Waterfront revitalization has been seen by many cities as a mechanism to create and promote a more positive image, thus securing growth and capital investment in a competitive global market.

d) Gentrification Related to waterfronts

Historically, industries such as ports, fishing fleets, shipbuilding, warehouses, mills, factories, grain silos, concrete terminals, coal and salt piles, wastewater treatment plants and tank farms dominated urban waterfronts. These industries are often noisy, noxious and built to be functional, rather than attractive. As some industries abandoned the waterfront, cities saw large parcels of inexpensive waterfront land as an opportunity for mixed-use developments. The proposed offices, museums, shops, galleries, marinas, and especially condominiums and hotels can lead to gentrification and are often viewed as incompatible with the normal functioning of industrial businesses that remain.

While gentrification is related to redevelopment on a broader level, the effects are particularly relevant to the topic of industrial waterfronts. The matter of waterfront gentrification is a planning issue. Waterfront ecological restoration, urban livability, and sustainable technologies all appeal to the imagination of urban planners, developers and residents while potentially displacing concerns and questions about how existing waterfront industries fit within these planning schemes. Despite concerns about incompatibility, no studies document industries lost to the forces of gentrification or the effect of mixed-use waterfront redevelopment on adjacent industrial uses.

A mix of productive, cultural, leisure, retail and residential functions often represents the keystone of the success to developing the Riverside. Developments that relied solely on large commercial and entertainment structures or vast residential districts lack complexity and interest, and reveal an embarrassing poverty of intent. Rinio Bruttomesso asserts that including a variety of activities linked to previous and original uses preserves meaningful traces of the identity of places. He advocates retention of productive activities, compatible with the renewed context, capable of offering visual contrasts and economic diversity.

2.2 Empirical literature

As indicated in Mekonnen (2007), the informal settlements along river banks, unlike settlements in open spaces and expansion areas, did not apply proper street layout, plot division, and use of permanent building materials. Houses built with temporary building materials like eucalyptus splint walling adjoined with chika mortar and covered initially by plastic tent and gradually replaced by corrugated iron sheet shade (Zanigaba) roofing. Due to its simplicity, the construction of these houses does not take time like others since it requires simple construction

technique. Except wall erection and roofing large part of construction activities are performed mostly by unskilled immediate neighbors, close friends and relatives of the settlers.

It is clear that human settlement, if not properly planned and managed, carries risks for rivers, streams and other water reservoirs. This is because human activity is associated with waste disposals that lead into chemical contamination of water bodies. And this is what seems to be happening to Akaki River. Contamination of rivers are mostly caused by on-site sanitation and sewerage systems, waste disposal, urban runoff, fuel storage, handling and disposal of chlorinated solvents, and pesticide application for public health and vector control and Spills of many chemicals (including petroleum and fuel oils). This are most of the sources of contamination of both ground waters and surface waters in Addis Ababa (Sisay et al., 2017).

According to African Development Bank Group (2021) Addis Ababa is going through rapid urbanization with unprecedented high rate of road and building constructions, resulting in a sudden increase of impervious surfaces and generation of significant amounts of runoff volumes. This source indicates that the main challenge of the city is the underdevelopment of drainage system. Even those available drainage lines were indeed planned and designed unsystematically through a segmental approach. In addition, the storm water management system of the city poorly collects and conveys storm water from source to rivers. It has no system of retention, infiltration, and harvesting process, which directly injects pollutants to rivers and other water bodies.

And such degradation of water bodies poses serious impact on the environment, society and the economy. The accumulation of heavy metals in Akaki River as noted in Hamere & Eyasu (2017) calls critical attention because there are large urban agriculture activities that grow mainly vegetables around the river. Since, vegetables have a capacity to accumulate heavy metals and directly pass to human body they such contaminations have huge impact on food chain and affect the health of the community. Many researches indicate that the river water should not be used for irrigation, drinking, livestock drinking and washing. In addition, though the economic cost of river pollution in Addis Ababa is not estimated, it obviously puts huge negative impact on the local and national economy.

Generally, the empirical literature review provides a synthesis of existing studies and research findings that have investigated various aspects of specific challenges and opportunities related to the little Akaki riverside regeneration in Addis Ababa.

Urban Regeneration Studies: Several empirical studies have examined different facets of urban regeneration, shedding light on factors influencing success and challenges. Research by while Smith and Brown's (2018) explores the economic impacts of urban regeneration projects and study investigates the social dimensions of regeneration efforts.

Riverfront Development Research: Empirical evidence related to riverfront development is crucial for understanding the dynamics of waterfront areas. A study by Chen and Jim (2008) focuses on the environmental implications of riverfront development projects, providing insights into sustainable practices. Additionally, Zhang et al.'s (2015) research investigates the role of public spaces in enhancing the quality of riverfront developments.

Context-Specific Studies in Addis Ababa: Research specific to the context of Addis Ababa is essential for understanding the unique challenges and opportunities the city faces. A study by Gebre et al. (2017) explores the historical evolution of Addis Ababa and its impact on urban development, providing valuable insights into the city's context. Another study by Lemma et al. (2020) examines the role of community engagement in urban development projects in Addis Ababa.

Contextualizing Riverside Regeneration in Addis Ababa: Understanding the specific context of Addis Ababa is crucial for effective riverside regeneration. Insights from studies on African urbanism (Pieterse, 2019) and the dynamics of urban development in Ethiopia (Teferra, 2009) provide a foundation for analyzing the unique challenges and opportunities that may arise in Addis Ababa's riverside regeneration efforts.

Regeneration is not an easy process. It involves many steps. According to Farrington et al. (n.d) regeneration starts by restoring and healing the biodiversity of the area. This will be followed by the renewal process through evolving and transforming animal and pedestrian movements within the area. The final stage, according to these authors is to effectively revive by thriving and celebrating new ways of living. This shows that the regeneration process involves social, physical and economic matter.

2.3. Case study

These case studies provide a comprehensive understanding of urban riverside regeneration concept, explores the key indicators of successful urban riverside regeneration, explore possible challenges they face, and outcomes of the urban riverside developments. The findings from these case studies can be used to develop strategies and recommendations for the sustainable planning, designing and management of the study areas, considering the unique environmental and social characteristics of each area.

This case study focuses on successful riverside regeneration initiatives from various cities of related projects globally and locally, examining their strategies, outcomes, and lessons learned. Exemplary project Selected from diverse locations, considering factors such as geographical context, environmental challenges, and socio-economic conditions.

BDP (Building Design Partnership) a leading company in all major sectors of building, design and research; including housing, education, urbanism and heritage, and which has won more than 1000 awards for design quality lists the top five successful urban riverside regeneration projects in September 2023 based on the Key design elements the projects incorporates. The design elements used as the indicators of successful urban riverside regeneration by BDP are:

- Integration of native planting and habitat,
- Development of open spaces,
- Improved cooperation between the community and local government,
- Creation of mixed-use developments,
- Enhancement of public access and amenities,
- Implementation of sustainable drainage systems,
- Integration of green infrastructure at multiple scales, and
- Emphasis on creating beautiful new places that are attractive, sustainable, and resilient.

BDP is an international research, build and design company that established in 1961 by Professor Sir George Grenfell Baines and his partners at Bryn Mor Anglesey. By the 1980s, BDP had more than doubled in size as it expanded into new sectors and evolved with the economy. In 2016, BDP combined forces with Japan's leading engineering practice Nippon Koei. These top five successful urban riverside regeneration projects are:

1. Jakarta Riverside Renewal Initiative, Jakarta, Indonesia

2. Cheonggyecheon Restoration, Seoul, South Korea
3. High Line, New York City, USA
4. Thames River Embankment, London, UK
5. Portland Riverfront Park, Portland, Oregon, USA

Accordingly, the projects selected for the case study are:

From local “Beautifying Sheger” Riverside Development Project in Addis Ababa, Ethiopia and from global “Jakarta Riverside Renewal Initiative”, Jakarta, Indonesia chosen and discussed below.

2.3.1. “Beautifying Sheger” Riverside Development Project in Addis Ababa, Ethiopia

Figure1: Addis Ababa “Beautifying Sheger” River Development Project

Soure: coutesy of the African Development Bank Group (2021).

Introduction:

In Addis Ababa, the "Beautifying Sheger" River Development Project is a notable example of a successful riverside regeneration project. This initiative, supported by the African Development Bank, aims to improve the quality of life for residents, address flooding issues, and create green spaces along the Sheger River basin (Increasing the publicness of riversides., 2022). The project includes the development of parks, green spaces, and shared gardens, which

will help to absorb rainfall and improve the environment and quality of life for all residents in the city center and precarious neighborhoods (African Development Bank., 2022).

However, it is important to note that the "Beautifying Sheger" project has also been associated with the displacement of inner-city residents, as part of a broader urban renewal effort that includes the La Gare development and other private investment projects (City Monitor., 2019). This highlights the complexities of urban regeneration, which can lead to both positive and negative outcomes for local communities.

Objectives:

Beautifying Sheger River Development Project done having diverse objectives such as

a) Rehabilitating Environment through restoring and protect the ecological health of the Sheger River and by implementing measures to prevent pollution and promote sustainable water management.
b) Developing Public Spaces and Recreation areas along the riverbanks, including parks, walkways, and open spaces for public use.
c) Improving Economic Development by Attracting investments and businesses to the riverside areas, fostering economic growth, Promoting tourism by showcasing the cultural and historical significance of the Sheger River.
d) Improving Aesthetic through landscaping and beautification measures to enhance the visual appeal of the riverbanks and Incorporating public art and architectural elements to create a unique and attractive urban environment.

Implementation:

The Implementation of Beautifying Sheger River Development Project participates different stakeholders and improves giant developments:

a) Government Leadership: relevant ministries and agencies.
b) Collaboration with Stakeholders: Engage local communities, businesses, and NGOs.
c) Infrastructure Development: pedestrian-friendly walkways, bridges, infrastructure for waste management and environmental conservation.
d) Cultural Integration: Incorporate cultural elements into the project.

Challenges and Solutions:

The Beautifying Sheger River Development Project were has the following threats and come up with equivalent Solutions:

a) For Community Resistance may rise from some residents stake holders implement a comprehensive communication strategy to engage and educate the community about the benefits of the project.
b) To ensure Environmental Conservation: sustainable practices, such as green infrastructure and eco-friendly construction materials are integrated.

Finally, the "Beautifying Sheger" River Development Project reflects the Ethiopian government's commitment to creating a sustainable, aesthetically pleasing, and economically vibrant urban environment. Through collaboration with stakeholders and a focus on environmental conservation, the project aims to improve the quality of life for residents while preserving the cultural and natural heritage of Addis Ababa. Ongoing monitoring and community engagement will be crucial for the project's long-term success.

2.3.2. "Jakarta Riverside Renewal Initiative", Jakarta, Indonesia

Figure2: Jakarta Riverside Development
Source: BDP web gallery[https://www.bdp.com/en/projects/f-l/jakarta-river/]

Introduction:

Project Name: Jakarta Riverside Renewal Initiative

Location: Jakarta, Indonesia

Size: 182.67 hectares

Completion: 2019

Objectives:

Enhancing Livability: The primary goal is to improve the quality of life for Jakarta's residents by revitalizing the riverside area, creating public spaces, and fostering a sense of community.

Economic Development: Stimulating economic growth by attracting businesses, promoting tourism, and creating job opportunities through the development of commercial and recreational spaces.

Ecological Restoration**:** Implementing sustainable practices to restore and enhance the natural environment along the riverbanks, including water quality improvement and biodiversity conservation.

Cultural Preservation: Preserving and showcasing Jakarta's cultural heritage by integrating historical and cultural elements into the redevelopment, potentially preserving existing structures and landmarks.

Key Components:

Public Spaces and Parks: Creating green spaces and parks along the riverbanks for recreational activities, including jogging trails, picnic areas, and public art installations.

Mixed-Use Development: Integrating mixed-use developments such as residential complexes, commercial spaces, and cultural hubs to encourage a vibrant and diverse community.

Waterfront Promenades: Designing pedestrian-friendly waterfront promenades with cafes, shops, and recreational facilities to attract residents and visitors to the riverside.

Infrastructure Improvements: Upgrading essential infrastructure such as bridges, walkways, and lighting to improve accessibility, safety, and overall connectivity.

Flood Resilience Measures: Implementing flood resilience strategies and infrastructure to address Jakarta's vulnerability to flooding, ensuring the sustainability of the riverside developments.

Stakeholder Involvement:

Community Engagement: Engaging with local communities through public consultations, workshops, and feedback sessions to incorporate the needs and preferences of residents.

Government Collaboration: Collaborating with local and national government bodies to ensure regulatory compliance, secure funding, and coordinate infrastructure improvements.

Private Sector Partnerships**:** Collaborating with private developers, businesses, and investors to fund and implement commercial aspects of the project, fostering economic growth.

Challenges:

Resettlement and Displacement: Addressing potential issues related to resettlement and displacement of existing communities, ensuring fair and inclusive development.

Environmental Impact: Mitigating the environmental impact of construction activities and ensuring sustainable practices are implemented to protect the natural ecosystem.

Infrastructure Integration: Coordinating with existing city infrastructure projects and ensuring seamless integration with transportation networks.

Evaluation and Monitoring:

Community Feedback: Regularly collecting feedback from residents and stakeholders to assess the project's impact on the community and address any concerns.

Ecological Monitoring: Conducting ongoing assessments of the ecological health of the riverside area, ensuring that environmental sustainability goals are being met.

Economic Indicators: Monitoring economic indicators such as job creation, business growth, and property values to gauge the project's economic impact.

2.4. Research gap

The study summarized some potential research gaps within the existing literature where there is insufficient coverage or understanding as following.

- Researches on the specific socio-economic impacts of riverside regeneration projects in Addis Ababa, especially focusing on the Little Akaki River area highly limited. Therefore, investigating the effects on local communities, businesses, and property values could provide valuable insights.
- There is lack of studies examining the role of community engagement and participation in riverside regeneration initiatives along the Little Akaki River. Exploring community perceptions, involvement, and empowerment could contribute to effective riverside regeneration strategies.
- Existing literature are inadequately address the integration of environmental sustainability principles and green infrastructure strategies in riverside regeneration projects along the Little Akaki River. Researching innovative approaches to enhance ecological resilience and mitigate environmental risks could fill this gap.
- There are limited research comparing riverside regeneration efforts in Addis Ababa with similar initiatives in other cities globally. Conducting comparative studies and identifying best practices from international experiences could offer valuable lessons for improving riverfront development strategies along the Little Akaki River.
- Empirical evidence related to riverside regeneration are projects on riverfront development those used for understanding the dynamics of waterfront areas.
- There is a need for more in-depth analysis of policy and governance frameworks governing riverside regeneration in Addis Ababa, particularly focusing on the institutional arrangements, regulatory mechanisms, and stakeholder coordination involved in the Little Akaki River area.

CHAPTER THREE

3. Research Methodology

3.1. Description of the Study Area

Addis Ababa city Administration has eleven (11) Sub-cities and about one hundred seventeen (117) woredas. Akaki Kality and nifas silk lafto are of the eleven sub-cities that little akaki river cross through and the study portion serves as boundary for both sub-cities. These sub-cities characterized by a mix of existing industrial, freight areas, low income residential areas and they are accessible to the Bishoftu-Adama road which is currently very congested outskirt.

There are two Akaki rivers that flow through the city of Addis. Little Akaki flows through the western part of the city. It starts from Wechacha Mountain and flows for 40 km before it reaches the reservoir. The Big Akaki river, which starts from (Entoto Kidane Miheret) area and flows into Aba-Samuel reservoir after 53 km. This river finally drains to Awash river (Hamere & Eyasu , 2017). The river has been heavily polluted due to the city's waste disposal practices, posing a risk to the rural population that relies on it for drinking water (Melaku, M., 2005). The river and its tributaries have been found to contain elevated levels of several metals, raising concerns about environmental and public health safety (Taddese, T., 2021).

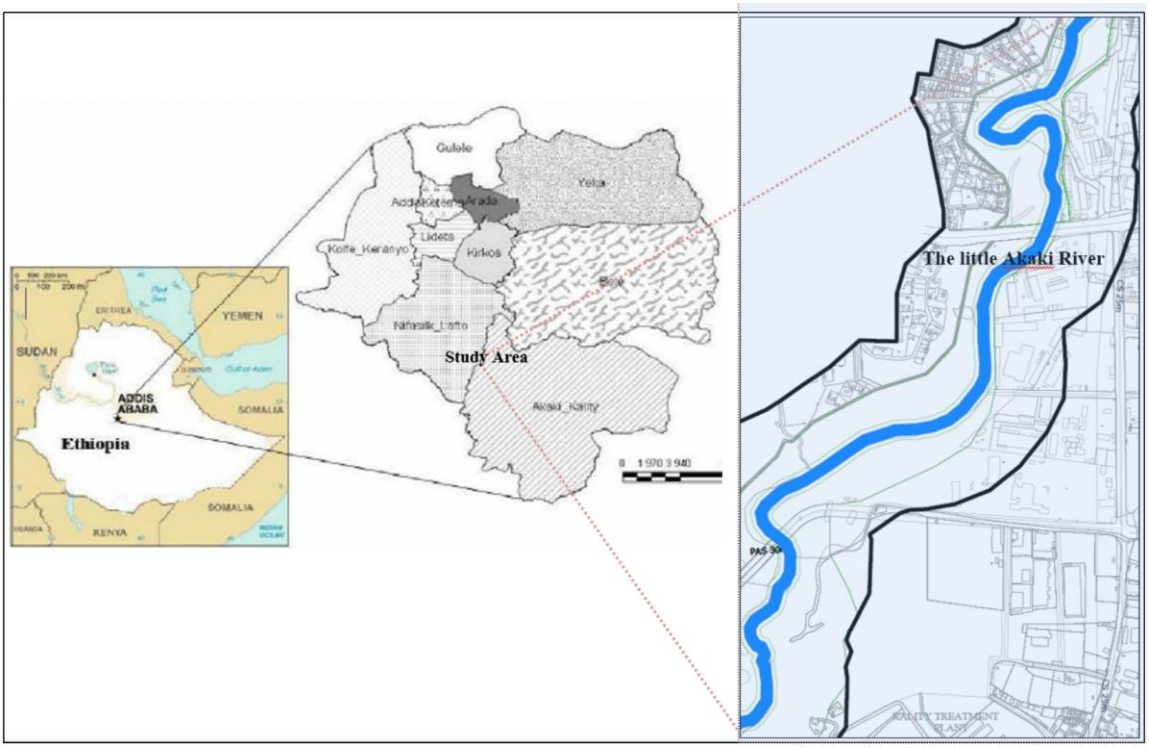


Figure3: location map

3.2. Research Design

The procedures used to conduct a research study starting from collecting data, examining, and interpreting the finding summarized as in the following diagram. This research aims at analyzing the space related causes of pollution of little Akaki River. Hence, it links space usage (planning issues) with pollution of the river. Hence, it primarily first describes the state of pollution and settlement issues around the river. Therefore, the research mainly relies on descriptive methods. Descriptive tools such as maps, tables, and graphs will be widely utilized throughout the paper.

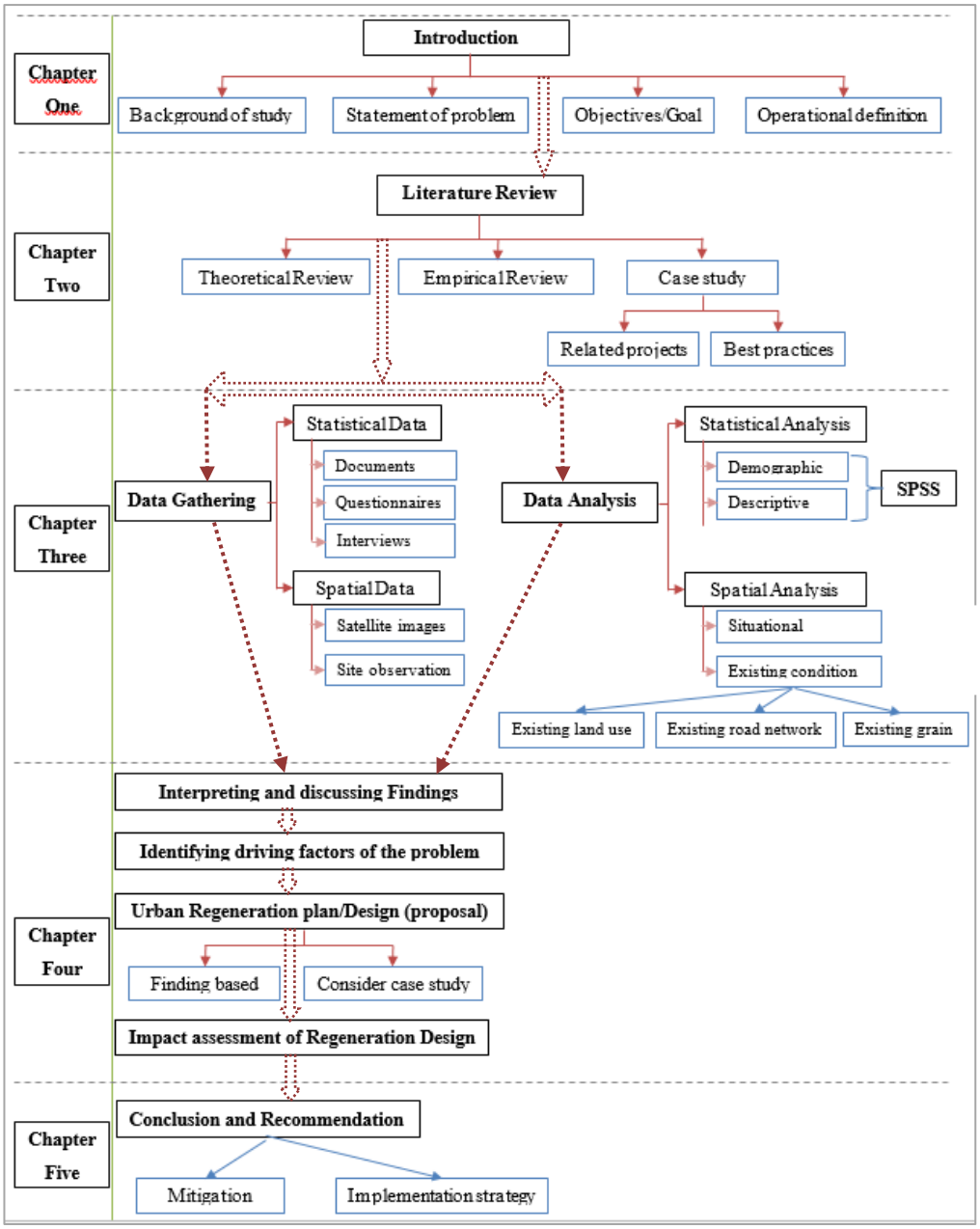


Figure4: Schematic diagram of research design

3.3. Study Approaches

As described above, this research mainly focuses on linking the causes of the pollution with space usage and planning matters on the lower courses of the little Akaki River. It contains planning issues that connect both socio economic and spatial matters. The research rely on both qualitative and quantitative approaches. This means, the researcher collected both qualitative and quantitative data both from relevant sources.

Mixing the two approaches is relevant because the qualitative data gave us more elaboration (flesh) to the issues that described quantitatively. In addition to this, there are some institutional, social and policy related matters that cannot be captured through numbers. In such cases qualitative approach deployed to describe the facts on the ground.

3.4. Sample Design

3.4.1. Study Population

The main study population are residents that live along the Little Akaki River banks (both on the left and right hand side of the river). These residents are sampled and data were mainly collected from these subjects. All residents (household heads) included in the population and sample was drawn from this population. In addition, key informant interviews have been conducted with officials of the bureaus, sub-city and woreda officials to get in-depth information about the subject at hand. This method proved to be valuable, especially in situations where residents were not easily approachable or cooperative for interviews or photography. Direct observation allows for a non-intrusive approach to data collection, as the researcher can simply observe and record what they see without disrupting the natural environment or behavior of the individuals being studied.

The sampling frame to identify respondents was the list of 586 representing all households and each industries in the study area. It provides an opportunity to capture authentic and unfiltered data about people's activities, interactions, and causes of pollution to and by little Akaki River. Using direct observation as a data collection method, the study was able to gain valuable insights into how residents behave and engage with the case areas, which contributes to a more comprehensive understanding of the phenomena under investigation.

3.4.2. Sample Size and Sampling technique

Since a complete list of the population could not be found, the research used the following sample size determination formula to determine the sample size of selected household heads that respond to the questions.

As a result, residents, factory owners/representatives, concerning administration body, business owners within the neighborhoods were the subject of the inquiry were all contacted for these interviews. Additionally, the process of random sampling was used to choose the resident from which an interview and or questionnaire would be conducted.

Systematic random sampling technique based on the following sample size calculation formula. The Study area determined offsetting centerline of the little Akaki River by 100 meter to both side to incorporate average width of neighborhood design at the riverbank. The area occupies 29 manufacturing centers including polutary, and 557 house hold compound that total sum of equals to 586 House Holds. based on the formula of Kothari (2004) the following formula is used to calculate sample size for a finite population and it will be:

$$n = \frac{(Z^2)(\mathrm{p})(\mathrm{q})(\mathrm{N})}{(e^2)(\mathrm{N}-1)+ (Z^2)(\mathrm{p})(\mathrm{q})}$$

Where n= required sample size, N= total population=586, Z= Confidence interval at 95% which is 1.96, e=8%, P= 0.5 and q= 0.5. Accordingly,

$$\mathbf{n}= \frac{((1.962^2)(0.5)(0.5)(586))}{((0.082^2)(586-1)+ (1.962^2)(0.5)(0.5))} ,\mathbf{n}= \frac{562.8}{4.89} ,\mathbf{n}= 115.09 \quad \underline{\mathbf{n}= 115}$$

In case, to conduct this research primary data collected from 115 households from the residents living along the Little Akaki River. In addition, Key informant interviews collected from relevant government officials. Regarding the sampling techniques, the researcher mainly rely on simple random sampling technique to identify and question the 115 research subjects from the total population. Purposive sampling technique used to identify the interviewees from relevant government offices and environmental officer in manufacturing units because those people who have an in-depth knowledge about the subject matter.

3.5. Data Types and Sources

The researcher conducted both primary and secondary data from different sources. Primary data collected through observation and from questionnaire survey conducted to sampled residents, industry owners and companies that live along the little Akaki riverbanks. In addition,

interviews and Key informant interviews have been conducted with selected officials and residents.

Moreover, secondary sources collected from relevant sources such as from the Addis Ababa Planning Commission, Beautifying Sheger Project Office, Addis Ababa Environment Protection Bureau, Addis Ababa Sanitation and Beautification Bureau and other relevant offices. Furthermore, academic articles, reports, and case studies used as the data sources. These sources provide insights into the factors that contribute to the success of the study.

By combining primary and secondary data, the study is able to gain a comprehensive understanding of the research topic, drawing from multiple perspectives and sources of information. This approach enhances the validity and reliability of the study's findings. Questionnaire Surveys, observations, interviews, and the researcher's own photos were used to acquire primary data. Books, academic articles, reports, case studies, official websites such as Google Scholar, Sci-hub, Research gate and Science Direct used as the secondary data sources.

Table1: Data Type and Sources

Data type	**Data source**
Spatial Data	Spatial manager to autocad, City master plans, satellite imagery, google earth pro
Social and Economic data	Census data, socioeconomic surveys
Environmental Data	questionnaire to residents, Interviews with stakeholders
Case Study Data	Detailed reports and documentations
Survey Data	questionnaire to residents, Interviews with stakeholders, businesses
Policy Planning Documents	City master plans, urban development strategies.

Source: Organized by researcher, (2024)

3.6. Data Collection Tools

The research deployed various data collection tools to address the research objectives. These are:

Surveys and Questionnaires

Questionnaires used to gather data from residents and stakeholders about their perceptions, usage patterns, and the socio-economic status of the study area. Accordingly, one person mainly head of household representing randomly selected parcel chosen and gave answers to designed questionnaires. Statistical software, SPSS used for data analysis, allowing researchers to perform complex statistical tests.

Interviews

Conducting structured or semi-structured interviews with key informants, such as environmental experts, government officials, elder and long-lived person in the neighborhood, factory owners or representative, victim of the pollution, and stakeholders, those can provides qualitative insights into the social dimensions of the area and development. Statistical software, SPSS used for data analysis to perform complex statistical tests.

Geospatial Analysis Tools

Software like Spatial Manager to AutoCAD, google earth pro and AutoCAD are used for mapping and spatial data analysis, helping to visualize the existing spatial relationships. Manually drawn line, polyline and polygon on Ariel view of google earth pro saved as in KML file and converted to DWG file processing in spatial manager to AutoCAD. Satellite images are widely used to study the spatial aspects of the research. The researcher used Camera pictures to map and analyze the existing study area.

3.7. Study Variables

In order to meet the aim of the study, assessing causes of pollution to the little Akaki River and providing strategies of mitigation the adverse impacts to change the study area from the pollutant downstream to livable riverside, study variables such as background of respondents, main cases of the pollution and existing condition of the study area were used. Generally, used variables are as shown in the table 2 below.

3.8. Types of Variables and Measuring Techniques

The types of variables were used for this study along with their analysis and measurement techniques are specified and presented in detail as shown in (Table 2).

Table2: Study Variable, its type and Measuring Methods

Variables	Variable type	Measuring methods
gender, age, level of educations, field of expertise, & workplace,	Independent	Descriptive statistics graphs were used.
participation in community	Independent	
ownership	Independent	
Source of potable water	Independent	Using Nominal scales and descriptive statistics were applied to the findings.
Energy source	Independent	
Road type	Independent	
liquid waste disposal	Independent	
Solid waste disposal	Independent	
property distance from little akaki river	Independent	
Causes of pollution to LARiver	Independent	Using Nominal scales and descriptive statistics were applied to the findings.
impacts of the Little Akaki river pollution	Independent	
impacts of the Little Akaki river pollution	Independent	
Awareness to regeneration	Independent	
Willingness	Independent	Using Nominal scales and descriptive statistics were applied to the findings.
housing development	Independent	
urban agriculture	Independent	
recreational centers	Independent	
lodges	Independent	
Riverside aesthetics	Independent	Using Nominal scales and descriptive statistics were applied to the findings.
NH_polution	Dependent	
NH_development	Dependent	
suggestions on successfulness of regeneration	Independent	

Source: Organized by researcher.

3.9. Data Analysis and Interpretation

It is indicated that this research mainly relies on descriptive methods. Hence, tools such as SPSS widely used to enter the data collected from households, company representatives, and governmental officials. This makes the analysis simple and helps to easily interpreted the results. Interpretations based on the quantitative outputs of the SPSS that displayed in tables and graphs. The qualitative results triangulated with secondary sources and qualitative interview results.

3.9.1. Spatial Analyses

To understand potential and characteristics of the little Akaki River along the study area, its patterns, trends, and relationships within a geographic area, existing feature of the area, existing land use, existing road network, and existing grain pattern analyzed primarily in map illustration. This analysis, enable us to understand existing conditions, identify opportunities and challenges, and monitor the impact of regeneration initiatives. Key methods and aspects the

author deployed to analyze spatial data are Spatial Statistical Analysis, Visualization and Participatory mapping.

3.9.2. Statistical Analyses

The demographic characteristics of the respondents summarized by frequency and percentage. The offered information on the reliability of the literary components of riverside regeneration seen. Although descriptive Statistics used to summarize and describe the features of the data set. These statistics provide insights into the central tendency and dispersion of the data. In addition, used to calculate basic descriptive statistics for one or more continuous numeric variables of shown in table 2. It generates uni-variate summary statistics in a single table and compute standardized values. This analysis helps us to understand the distribution and characteristics of the data effectively.

3.9.3. Validity and reliability check

Validity check: Checking the normality of gathered data used to determine whether parametric or non-parametric statistical tests are appropriate for analysis. In case the results of the Kolmogorov-Smirnov and Shapiro-Wilk tests assessed.

Reliability Check: Cronbach's alpha used for measure of internal consistency reliability in consideration to a value above 0.70 as good.

3.10. Ethical Consideration

During the entire investigation all references used had cited, information had shared with permission, and any information gathered about participants would remain confidential. There is no inaccurate or biased reporting in this thesis paper.

CHAPTER FOUR

4. RESULT AND DISCUSSION

This chapter focuses on the analysis and discussion of the data that was gathered in order to meet the study's overall and specific objectives. The discussion of the information gathered on Riverside in the case of the Little Akaki River presented in this part. The data analysis, interpretation, and discussion of the research findings are all included.

4.1. Demographic Characteristics

Underneath demographic information of the respondents, provide us context for the survey responses.

4.1.1. Gender Structure

The gender distribution among 115 respondents reflects the composition of male and female participants within the community. The data reveals that out of the sampled residents, 48 individuals (41.7%identify as male, while 67 individuals (58.3%) identify as female and none of respondent selected not preferred to tell his/her gender type.

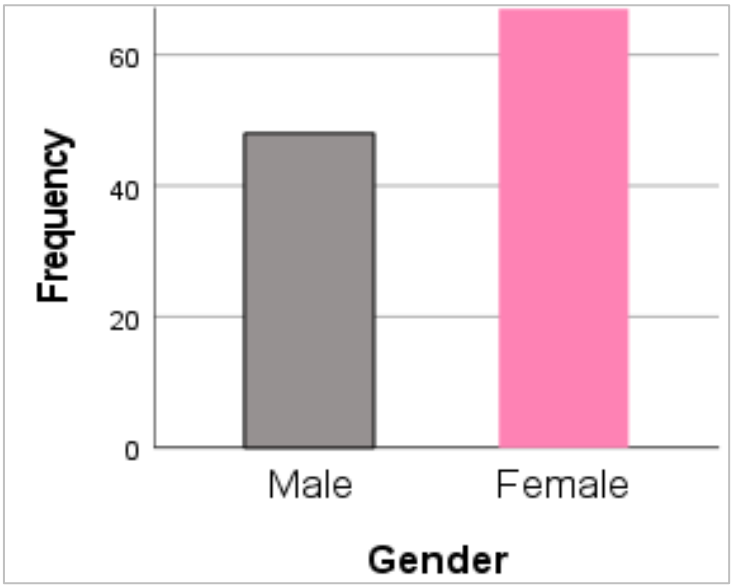


Figure5: Gender Structure

4.1.2. Age Structure

The gathered data unveils significant patterns, providing key insights into the preferences and reliance on the little akaki river regeneration among different age groups. The age group of 18-29 encompasses 37 respondents, representing 32.2% of the total. The highest segment is age

range of 30-39 includes 43 respondents, comprising 37.4% of the total participants and the lowest segment of respondents, constituting 4.3% of the total participants 5, falls within the age range of greater than 65.

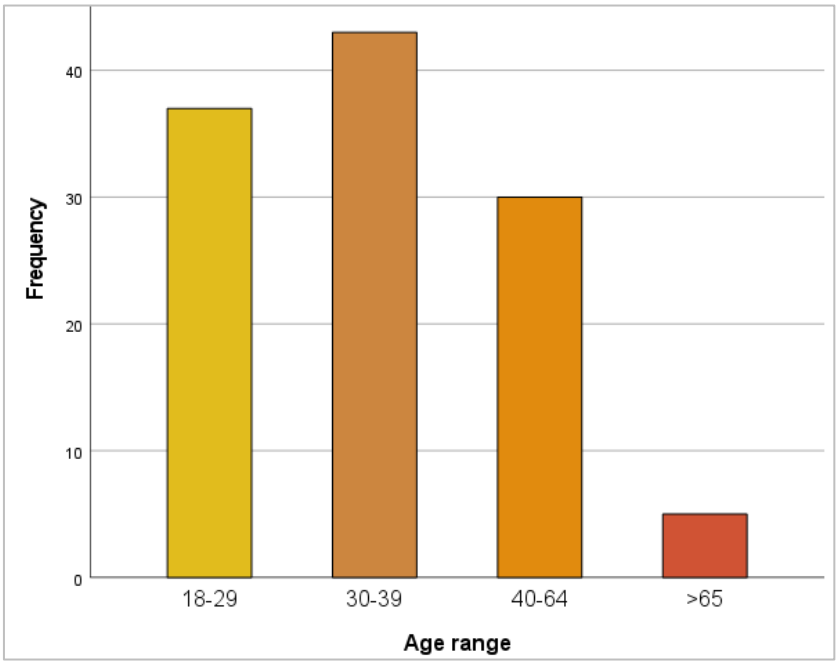


Figure6: Age Structure map.

4.1.3. Education level of the respondents

The diverse educational statuses of the participants and their potential influence on their understanding and engagement with river side regeneration along the little akaki river. Analysis of the data reveals that the largest proportion of respondents do not possessed a first-degree. High school educational status, constituting the majority with 35 individuals 30.4%. Following this, respondents with a vocational education background account for 32 individuals 27.8%. first degree educational backgrounds among respondents are represented by 25 individuals 21.7%, followed by illiterate with 18 individuals 15.7%.

Lastly, respondents with master's degree and above education status comprise 5 individuals 4.3%. These people gave unique perspectives and experiences to the overall understanding on environmental pollution, treatment system and urban riverside regeneration. By considering the educational backgrounds of respondents as depicted in Figure7, it becomes evident that the participants possess a wide range of educational qualifications, providing valuable insights and reliable information regarding the status and benefits of the regeneration study. However, we

can deduct that there is educational dependency or high number of people categorized under low educational qualification.

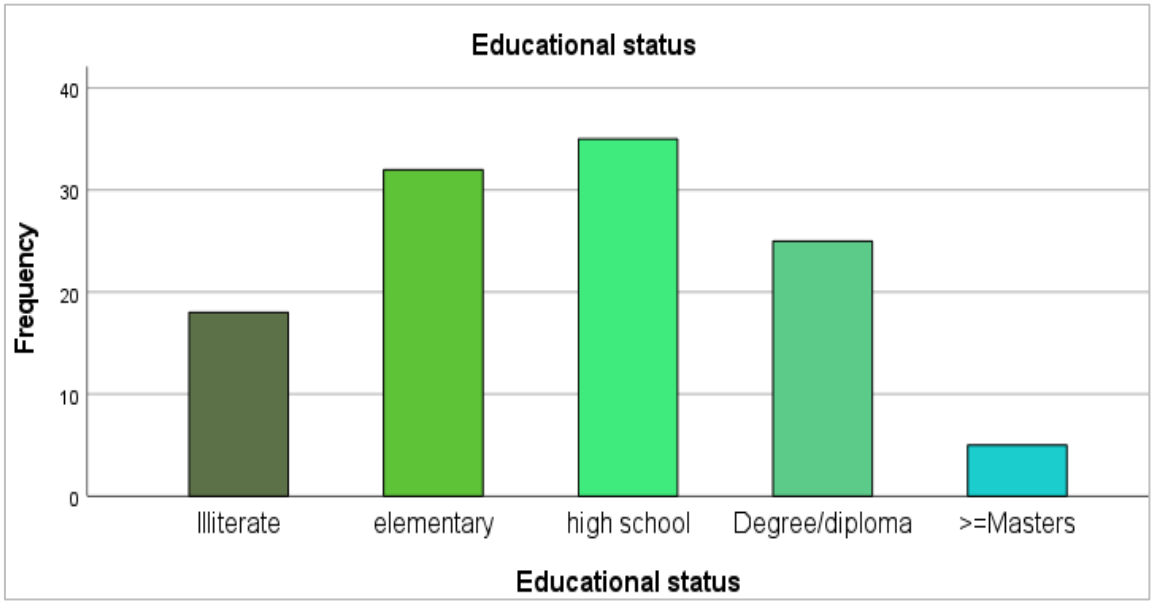
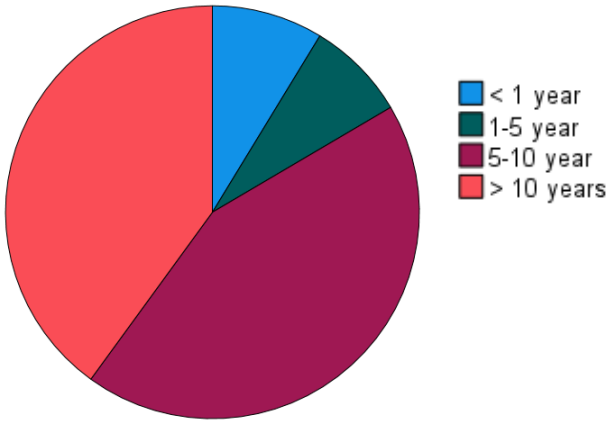


Figure7: Educational status.

4.1.4. Duration character

Analysis of the data reveals that the largest proportion of residents along The little Akaki river lived for five to 10 years in the neighbor, constituting the majority with 50 respondents 43.5%. with little number variance 40% of inhabitants lived for more than ten years and few time lived categories those lived for less than five years constitutes only 16.5% of households population. Generally, the analysis reveals that the development at the area is long aged as information from respondents show most of the lived in the area for more than ten years.

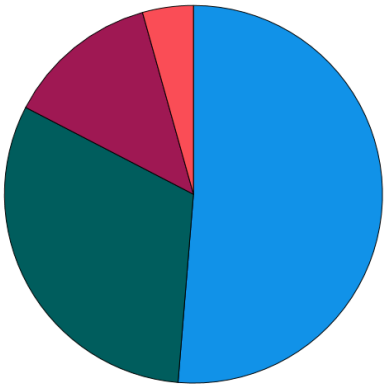


Time lived in the study area		
	N	%
< 1 year	10	8.7%
1-5 year	9	7.8%
5-10 year	50	43.5%
> 10 years	46	40.0%

Figure8: Time lived in the study area

4.1.5. Social integration (CBO)

To predict sustainable social planning the local Social integration of sampled households and company owners/representatives along the little akaki river analyzed relative to indigenous or local community based organizations. In case the data finding reveals that about 51.3% of population included and actively participate in Idir.



participation in community based organizations		
	N	%
Idir	59	51.3%
Mahber/tsiwa	36	31.3%
Senbat	15	13.0%
other	5	4.3%

Figure9: Social integration in CBO

4.1.6. Social problem

Frequency of expectable social problems analyzed to provide valuable insights into the prevalence and patterns of these issues within a community. Accordingly, Drunkard and Theft raised as the main problems for societies living along the little akaki river. As labeled on the table below they constituting 68.3% and 45% Dichotomy group reply consecutively. The result of this analysis can help law enforcement and policymakers understand the scope of these issues and develop targeted strategies to address them effectively.

Table3: Social problem Frequency data

Social problem Frequencies				
		Responses		Percent of Cases
		N	Percent	
Trended_Social_problem[a]	Theft	27	34.2%	45.0%
	Beggary	3	3.8%	5.0%
	Dacoity/Burglary	8	10.1%	13.3%
	Drunkard	41	51.9%	68.3%
Total		79	100.0%	131.7%
a. Dichotomy group tabulated at value 1.				

4.2. Statistical Analyses

This statistical analysis applied to summarize and describe the features of the dataset and to provide insights into the central tendency and dispersion of the data. In addition, used to

calculate basic descriptive statistics for one or more continuous numeric variables. It generates univariate summary statistics in a single table and compute standardized values. This analysis helps us to understand the distribution and characteristics of the data effectively.

4.2.1. Data normality test

Checking the normality of gathered data used to determine whether parametric or non-parametric statistical tests are appropriate for analysis. The Shapiro–Wilk test is more appropriate method for small sample sizes (<50 samples) although it can also be handling on larger sample size while Kolmogorov–Smirnov test is used for n ≥50. For both of the above tests, null hypothesis states that data are taken from normal distributed population. In case the results of the Kolmogorov-Smirnov and Shapiro-Wilk tests, the significance value (p-value) as lebeled in table 4 is less than the chosen alpha level p= 0.05, then the data is considered as normally distributed.

Table4: Tests of Normality

	Kolmogorov-Smirnov[a]		**Shapiro-Wilk**	
	Statistic	Sig.	Statistic	Sig.
Little Akaki river side regeneration	0.001	0.152	0.001	0.891
a. Lilliefors Significance Correction				

In another hand, through histogram examination of dependent variable (Little Akaki river side regeneration success) as shown on figure above, it is bell shaped compared to independent variables labeled in table 2. This ensures the data distribution is normal.

Table5: data distribution Normality test

	N	Skewness	Kurtosis
	Statistic	Statistic	Statistic
SUCCESSFULNESS OF REGENERATION	115	1.916	1.699

Skewness measures the asymmetry of a distribution. A positive skewness indicates that the tail on the right side of the distribution is longer or fatter than the left side, while a negative skewness indicates the opposite. Hence, a skewness value between -1 and +1 is considered excellent, while a value between -2 and +2 is generally acceptable and Values beyond -2 and +2 suggest substantial non-normality in the distribution a skewness value of 1.916 suggests a moderately high positive skewness, meaning that the distribution is skewed to the right.

Kurtosis, on the other hand, measures the heaviness of the tails of a distribution in relation to the normal distribution. A kurtosis value of 1.7 indicates that the distribution is mesokurtic,

meaning it has a similar peak and tails compared to a normal distribution. Mesokurtic distributions have kurtosis values around 3, which is the kurtosis value of a normal distribution. A kurtosis value of 1.699 suggests that the distribution is moderately peaked and has tails that are neither too heavy nor too light compared to a normal distribution

4.2.2. Descriptive Statistics:

The researcher used SPSS for cross analysis and verifying the descriptive statistics for each hypothesized variables under subtopics.

a) Relationship between Owner ship and waste disposal mechanism

The Little Akaki River suffers from significant water pollution, primarily due to industrial discharges, untreated sewage, and urban runoff. These pollutants degrade water quality, affecting both aquatic life and human health.

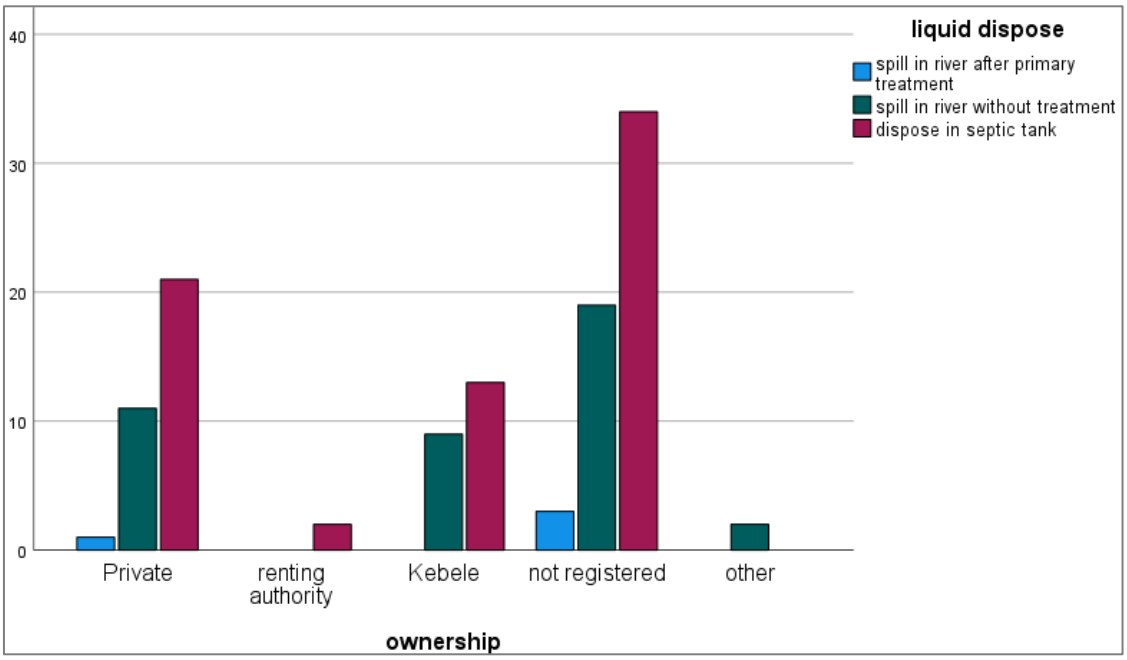


Figure10: Owner ship and liquid waste disposal mechanism

Property ownership (informal settlement) and type of road available and accessible in the area that have a negative perceptions with a mean value around three (3) which as disagree to the factors. a negative tendency towards "disagreement", respondents feedback indicates they do not seen these variables as causes of pollution to the downstream of the little Akaki River and neighborhood along it.

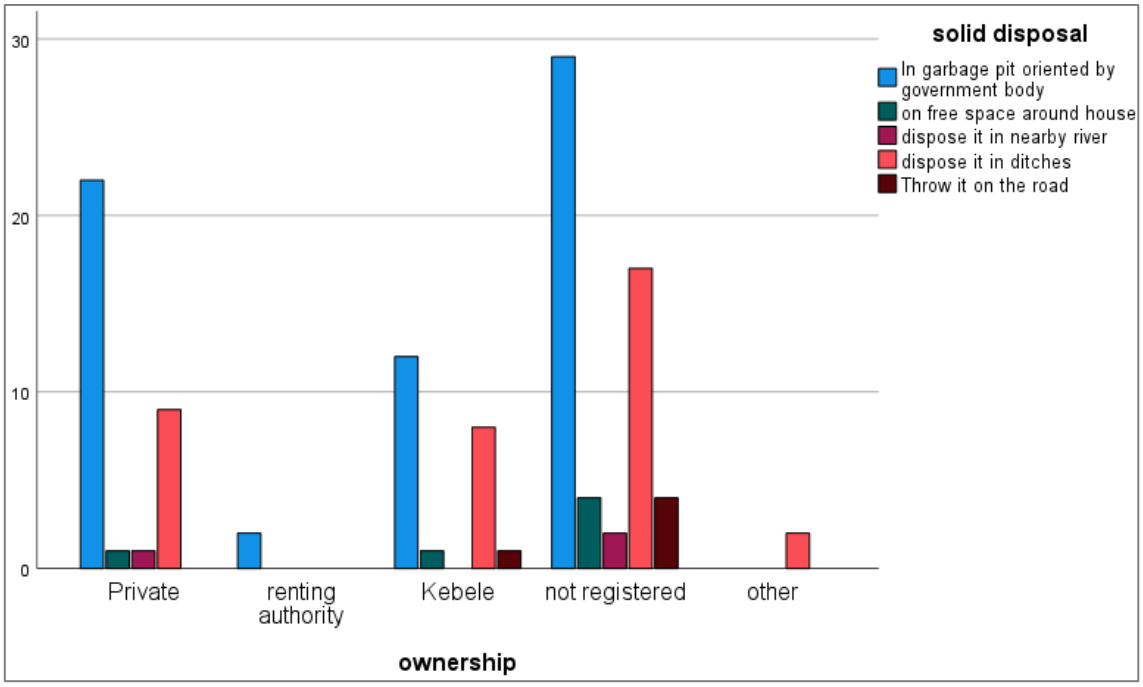


Figure11: Owner ship and solid waste disposal mechanism

The community's property distance from the river, their awareness and willingness to cooperate in their environmental cleaness seen as cause of pollution rarely and have neutral tendency. The responses are either mixed or suggests no strong consensus.

From variables raised, the community septic tank utilization scale for sewerage, garbage pit for solid waste, their life standard and factories way of disposing both liquid and solid waste are seen as significant causes of pollution to the downstream of the little Akaki River and neighborhood along it.

b) Relationship between Owner ship and planning issue

Most likely development in the are have large amount of non registered housing and zoning issue not applied. From 115 respondents, property edge of 56 of them lie in less than five meter away of the little akaki river

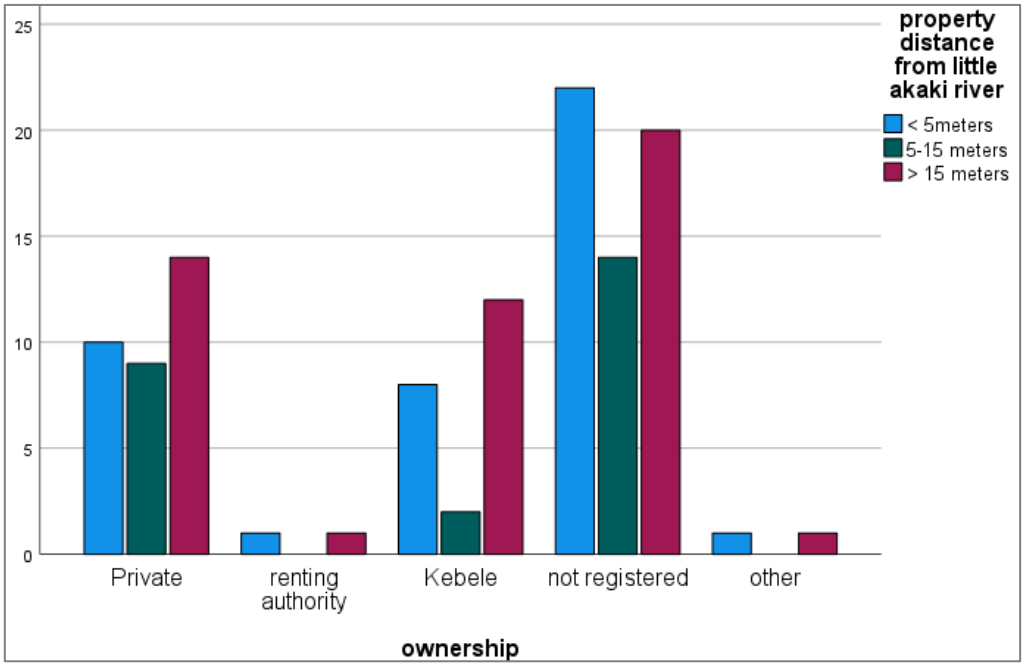


Figure12: Owner ship and property distance

a) Respondents background

From demographic information of the 115 respondents, most of them, 58.3%) are females. About 69.6% of inhabitants categorized in effectively working and productive age (i.e., 18-39). However, there is educational dependency or high number of people, 67.9% categorized under low educational qualification. As observed on the analysis of duration character, the development at the area is long aged hence, most of the lived in the area for more than ten years.

b) Social Factors

Community Engagement and participation of local communities in planning and decision-making processes are seen as low, leading to a lack of ownership and responsibility for maintaining the river and its surroundings. The communities living along the Little Akaki River are often among the poorest in Addis Ababa, facing significant socioeconomic challenges. They marginalized to Limited economic opportunities and inadequate access to education services. Building social capital and empowering communities to participate in riverside management is essential for sustainable regeneration along the little akaki river.

Communities in the study area assumes riverside regeneration in the Little Akaki River area as opportunity to stimulate their economic development, create job opportunities, and improve social equity by providing access to green spaces and recreational amenities.

c) Infrastructure and Land Use

Many improper and informal settlements have sprung up along the riverbank. Housing condition are typically characterized by substandard housing, overcrowding, and vulnerability to flooding and pollution. The riverside areas are also occupied by various industrial and commercial establishments, which contribute to both economic activity and environmental degradation. The coexistence of residential, industrial, and commercial uses along the river creates conflicts and complicates efforts to regulate pollution and manage land use

The existing infrastructure along the Little Akaki River is inadequate and poorly maintained, contributing to the area's environmental and social issues. Poorly designed and maintained drainage systems lead to frequent flooding, particularly during the rainy season, exacerbating pollution and health. Limited and poorly maintained roads restrict access to riverside areas, affecting both residents and businesses.

Existence of the treatment plant, ring road, factories, offices and stores along the little Akaki river is opportunity and threat for the regeneration development. Even though Arterial road, , collector road, sub roads, local streets, less than standard widen alleys and cul-de-sacs found in the area, the study site is not permeable. Land tenure issues, inadequate infrastructure, pollution from industrial discharges, solid waste, and sewage runoff and limited financial resources are possible challenges for riverside regeneration along the Little Akaki River.

d) Environmental Quality

As most of respondents from Factories and industrial facilities located along the river contribute heavy metals, chemicals, and other pollutants to the water. Inadequate wastewater treatment facilities lead to the direct discharge of untreated sewage into the river, increasing biological oxygen demand (BOD) and reducing water quality.

Cause of pollution	Frequency	Percent
Improper liquid waste disposal from residences	24	20.9
improper liquid waste disposal from factories	35	30.4
Improper solid waste disposal from residences	16	13.9
Improper solid waste disposal from factories	40	34.8
Total	115	100.0

Table6: Causes of pollution

The water quality of the little Akaki River and the upper stream Connecticut are not suitable due to bad quality and have great impact on amenities development. The accumulation of solid waste along the riverbanks is a major environmental issue. Illegal dumping of household waste, construction debris, and other refuse clogs the river, affecting its flow and aesthetic appeal. Poor waste management practices and a lack of adequate disposal facilities exacerbate the problem, leading to unsanitary conditions and potential health risks. These leads to Degradation to the natural habitats along the Little Akaki River due to urban encroachment, deforestation, and land conversion.

Impact of the Little Akaki	Frequency	Percent
Poor air quality	30	26.1
Poor water quality	22	19.1
Gave bad look	23	20.0
Soil erosion	24	20.9
growth retardation in plants	16	13.9
Total	115	100.0

Table7: impacts of the Little Akaki River

4.3. Spatial Analysis

In order to understand potential, problems and characteristics of the little Akaki River along the study area, its patterns, trends, and relationships within a geographic area, spatial data has examined and interpreted as under sub sections.

4.3.1. Existing Site Analysis and Assessment

The river side development of the Akaki River in Addis Ababa reveals a complex situation where environmental concerns intersect with urban development initiatives. The Akaki River, faces challenges such as pollution from industrial discharges, solid waste, and sewage runoff. The deteriorating water quality of the river has raised concerns about its usability for various purposes, including drinking, irrigation, and cooking.

Analysis of the little Akaki reflects a balancing act between environmental conservation, urban development, and community well-being. It underscores the importance of sustainable development practices that consider environmental protection, social equity, and economic growth to create a harmonious and resilient urban environment.

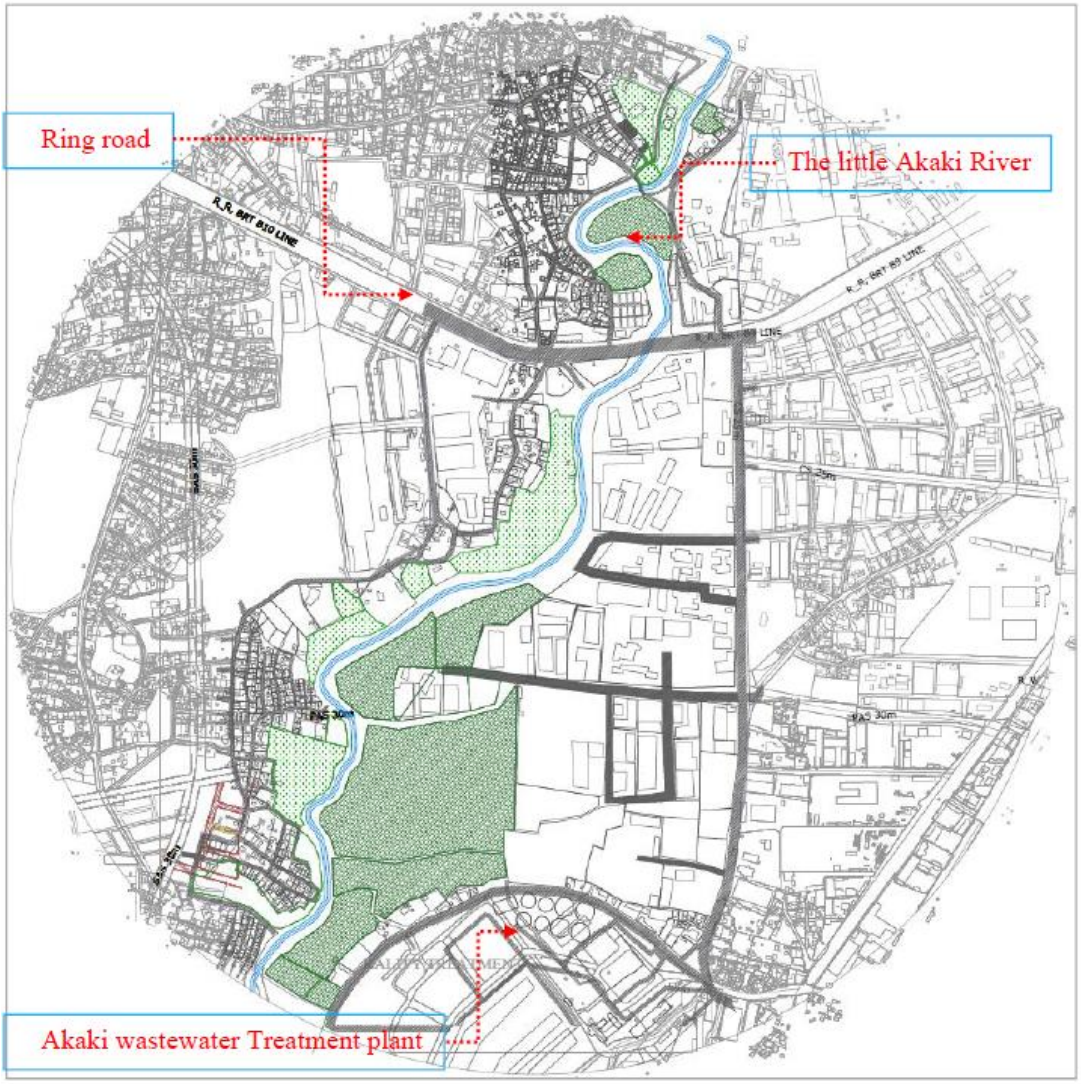


Figure13: Existing feature of the study area

4.3.2. Existing land use pattern

The map displayed in Figure below shows existing land-use pattern on the riverside and in the surrounding area. Land uses in downstream do not follow a clear pattern. The exception are the treatment plant, ring road, factories, poultry, offices and stores located along the riverside. Ring road once cross the study area and uses as the main entry route to the city of Addis Ababa. Residential uses are scattered, many of the structures are dilapidated and in a rundown condition. East side of the river is zoned industrial and owned by the private owners. Along the river some of urban agriculture trended.

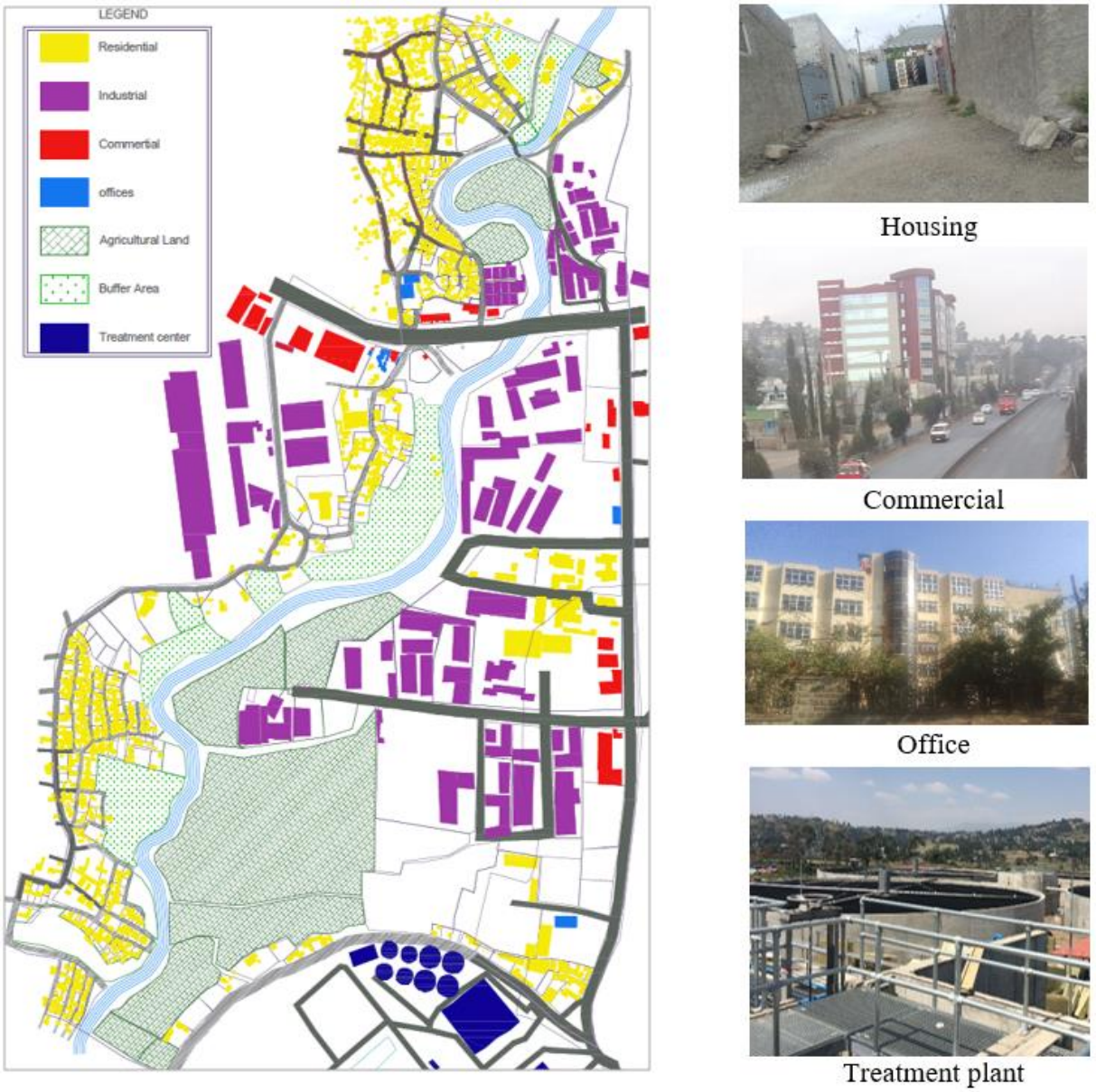


Figure14: Existing land use pattern

4.3.3. Existing road network

The Arterial road, ring road that has 30m width once cross the study area and uses as the main entry route to the city of Addis Ababa. Within more than a kilometer span crossing along the study area it has one over pass for passengers. In addition, two and single lane sub roads, 6-12m local streets, and less than standard widen alleys function as primary roads that connect the area with surrounding neighborhood.

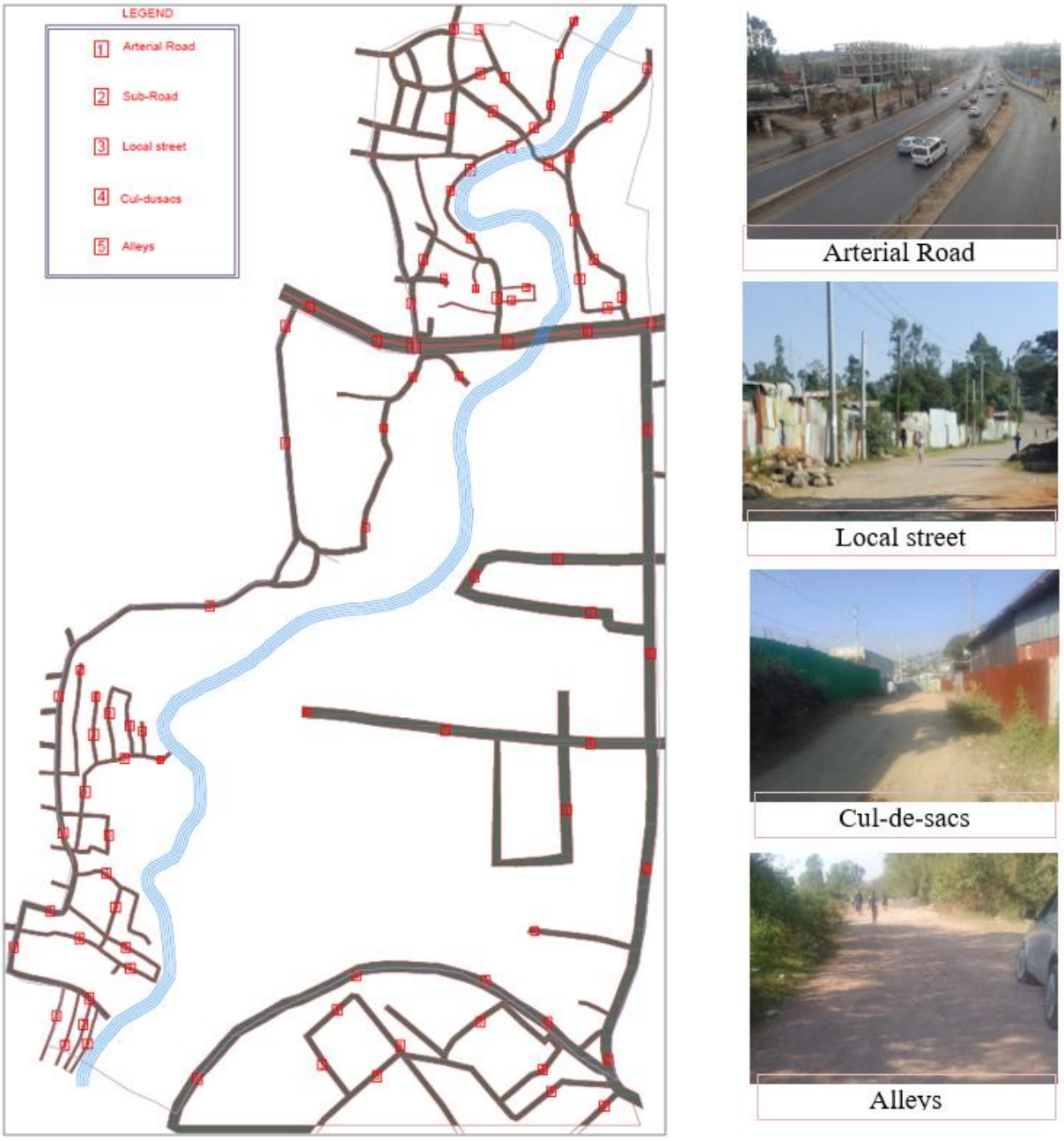


Figure15: Existing road network

4.3.4. Study area's grain pattern

The grain patterns found along the Little Akaki River is unique and diverse. As shown on figure14, the huge structures of planted industries and ware houses creates course grain. Informal housings and sediment composition are factors for fine grain. interaction of various geological elements and sediment deposits over time has created a distinctive pattern that adds to the natural beauty of the area.

Figure16: Existing grain pattern

4.3.5. The Riverside Development and Environmental Concern

The little Akaki riverside holds enormous potential to become a central focus of the area's urban life through the development of riverside oriented attractions like river beach for swimming and recreation. However, to develop these amenities, the water quality of the little Akaki river and the upper stream Connecticut are not suitable due to bad quality and Combined Sewer Overflow (CSO) system.

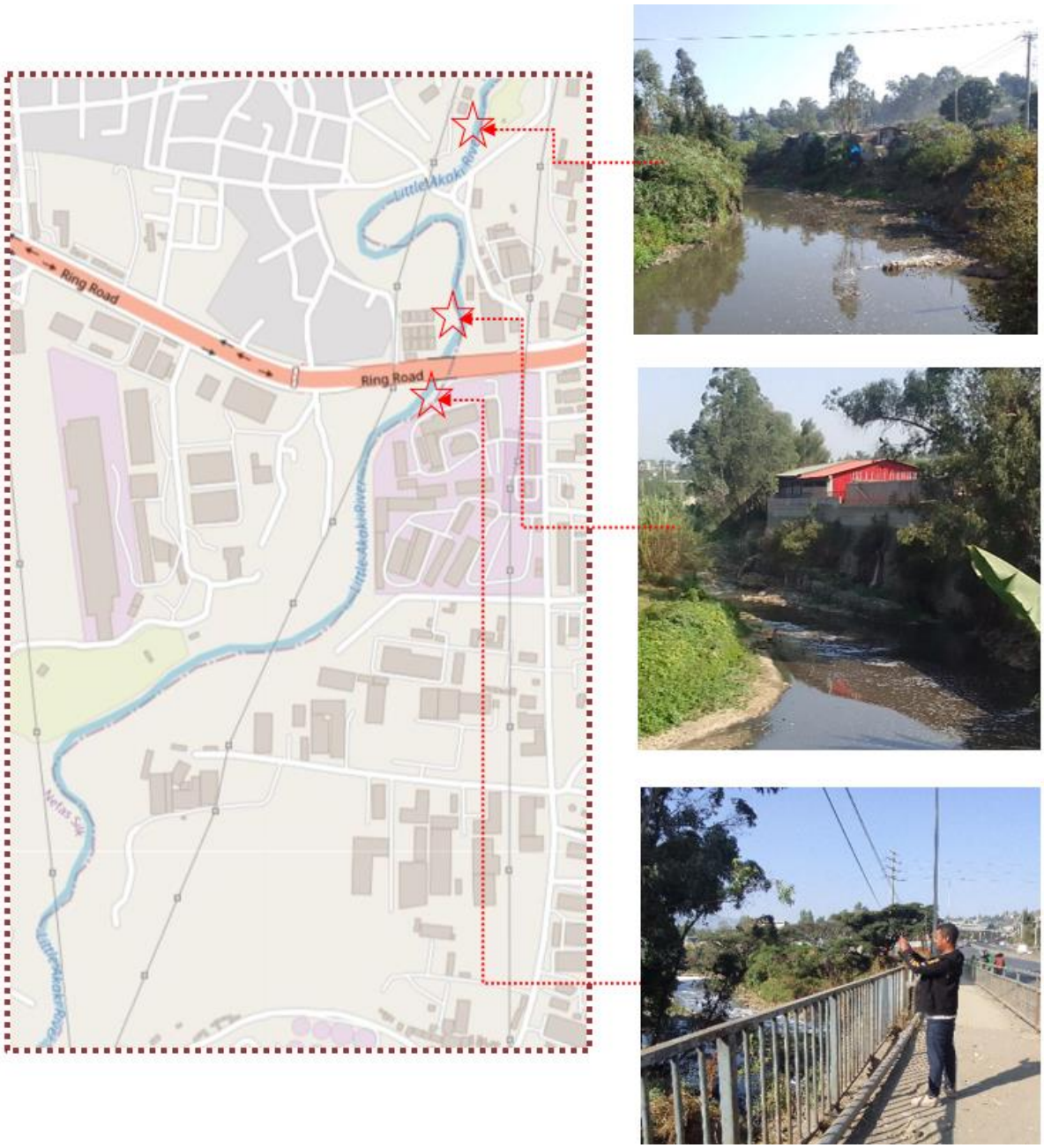


Figure17: map and photos showing existing development and the river water quality

4.3.6. Topography of the site (map, section and respective photos)

The topography of the Little Akaki River is characterized by distinct segments with varying land use patterns, industrial activities, and slope and altitude profiles. The geological and hydrological characteristics of the catchment are also diverse, with a mix of ware houses, residential, commercial, and industrial activities influencing the river's water quality and flow patterns.

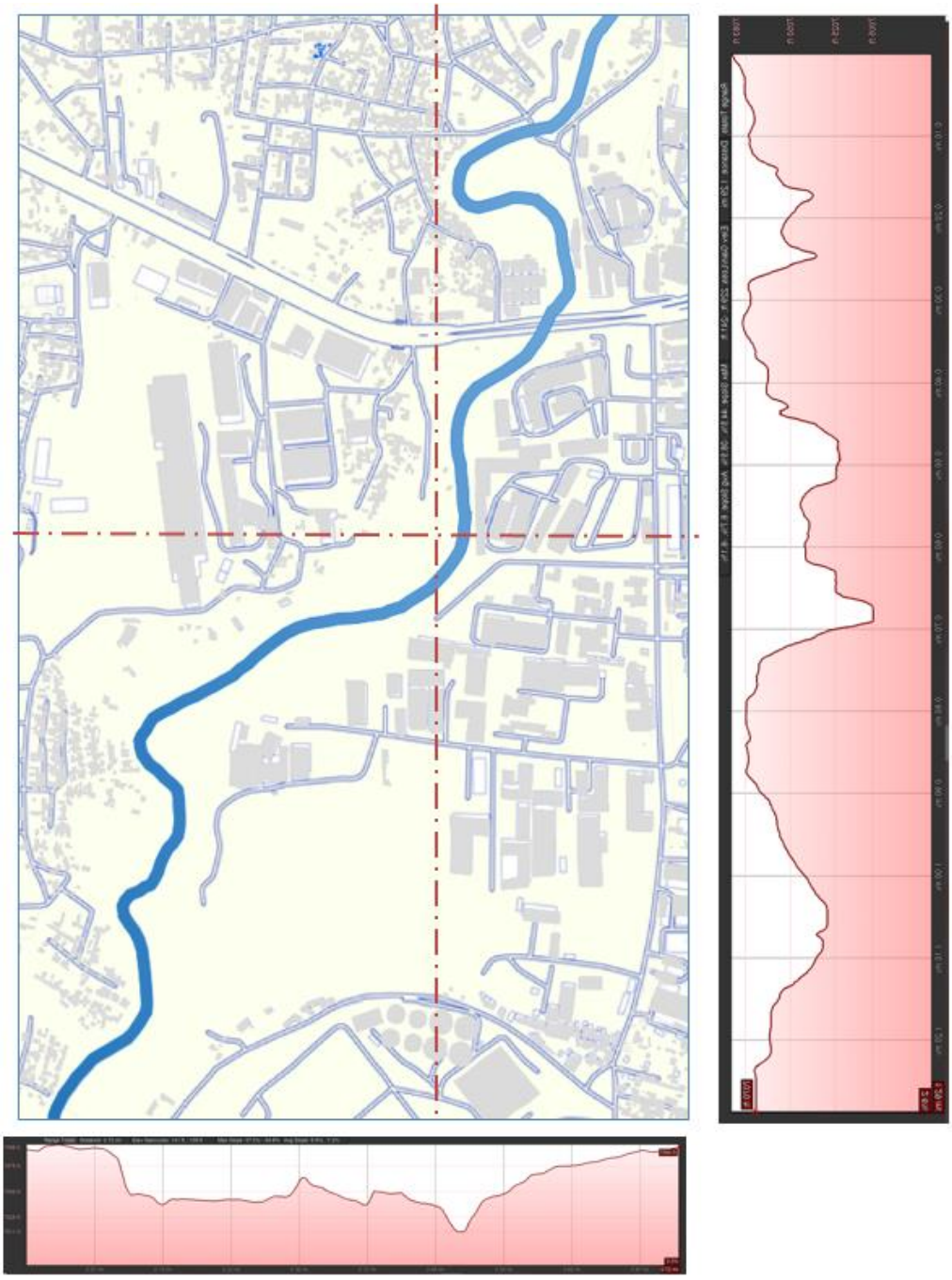


Figure18: The site section

4.3.7. Contour analysis (Topography of the site)

The catchment's slope varies from flat to gentle and very strong to steep, with the highest elevations found in the study area. The altitude ranges from 2115.04 m amsl at the downstream section to 2160.15 m amsl within the study area buffer edge span.

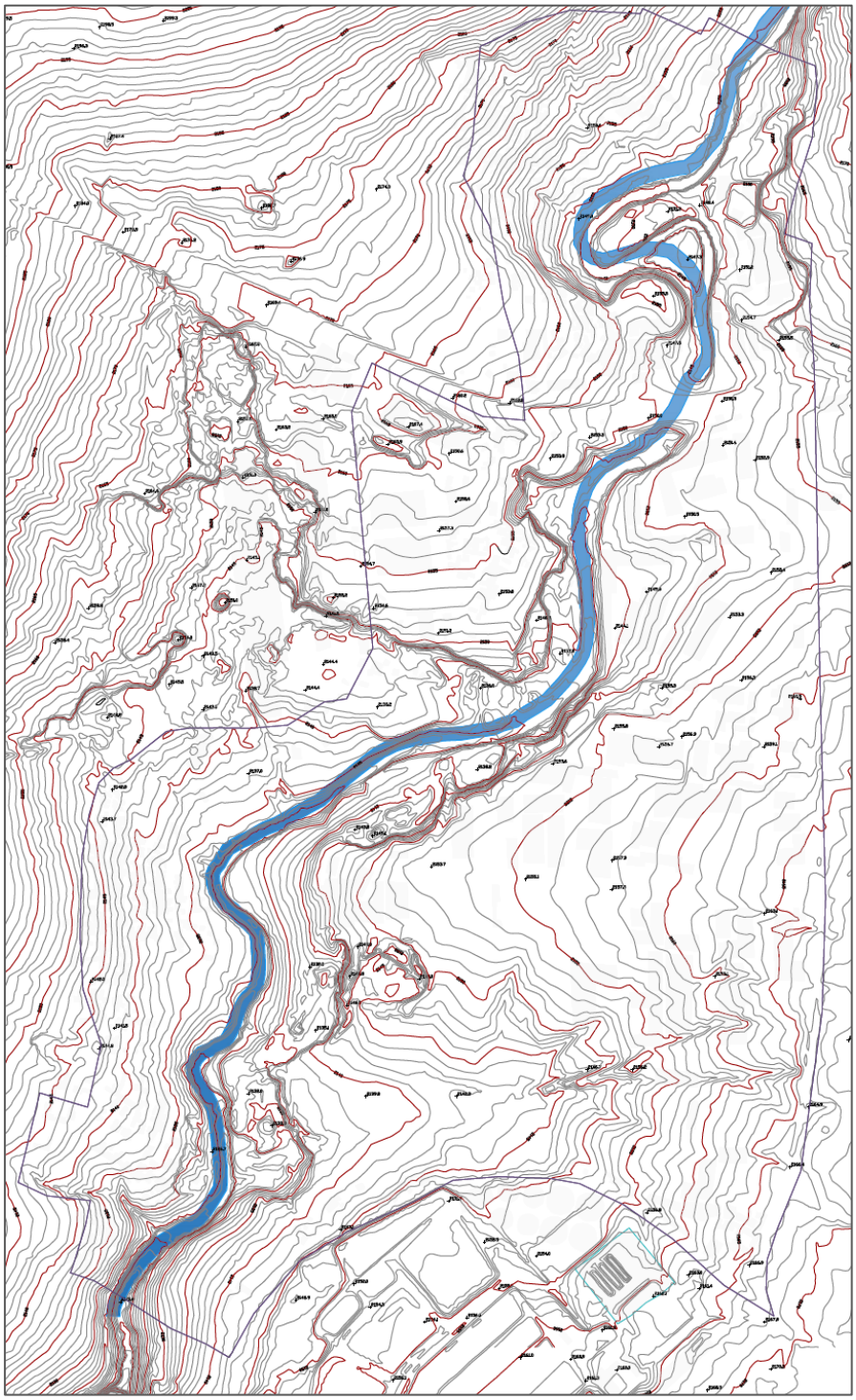


Figure19: The site contour

4.4. Sustainable Regeneration Design

4.4.1. Urban Design Focus

- **Urban Design Focus**

- Development along the little Akaki riverbank have informal and improper settlements, improper street layout, unplanned plot division, and use of temporary building materials.
- Green Infrastructure elements along the Little Akaki River corridor, that can enhances the ecological resilience is shallow enough.
- Ineffective Policy and governance frameworks for guiding and coordinating riverside development.
- It is risk associated with waste disposals hence the River is highly polluted and accumulated heavy metals those have huge contamination impact on food chain.
- The site opportunities such as existence of the treatment plant, ring road, factories, and offices.
- The study site is not permeable.

a) **Upgrading infrastructures in the corridor:** The study area is disconnected from its river primarily lacking infrastructural corridors such as walkways, bridges, Riverside Park and bike lanes that can attract people from inner city. Mitigating all the barriers related to infrastructure at the corridor, can link the area to the riverfront.

b) **Improving the little Akaki river water quality:** As the finding reveals, the river water pollution is the most serious problem in this study area. Promoting the use of advanced wastewater treatment technologies in industries and municipal treatment plants.

c) **Community Engagement:** The community along the river have great social cohesion and supportive preferences. To improve sustainable social development in the study area, participating the community in designing and planning and implementation of the regeneration development is one of crucial point.

4.4.2. Design challenges

- Existing topography of the site
- Uncontrollable upstream of the river
- Existing housing or structural development
- Existing giant industrial infrastructures

4.4.3. Design elements for successful urban riverside regeneration:

- ✧ Development of open spaces,
- ✧ Integration of native planting and habitat,

- ✧ Improved cooperation between the community and local government,
- ✧ Creation of mixed-use developments,
- ✧ Enhancement of public access and amenities,
- ✧ Implementation of sustainable drainage systems,
- ✧ Integration of green infrastructure at multiple scales, and
- ✧ Emphasis on creating beautiful new places that are attractive, sustainable, and resilient.

4.4.4. Zoning and land-use plan

This zoning plan recognizes the need for river-sensitive zoning and land use planning to protect urban river ecosystems, mitigate flood risks, and create green corridors along waterways. Proposed measures include restricting development in sensitive areas, creating parks and green spaces, and aligning land uses with the river's function and within each other relative to minimizing pollution.

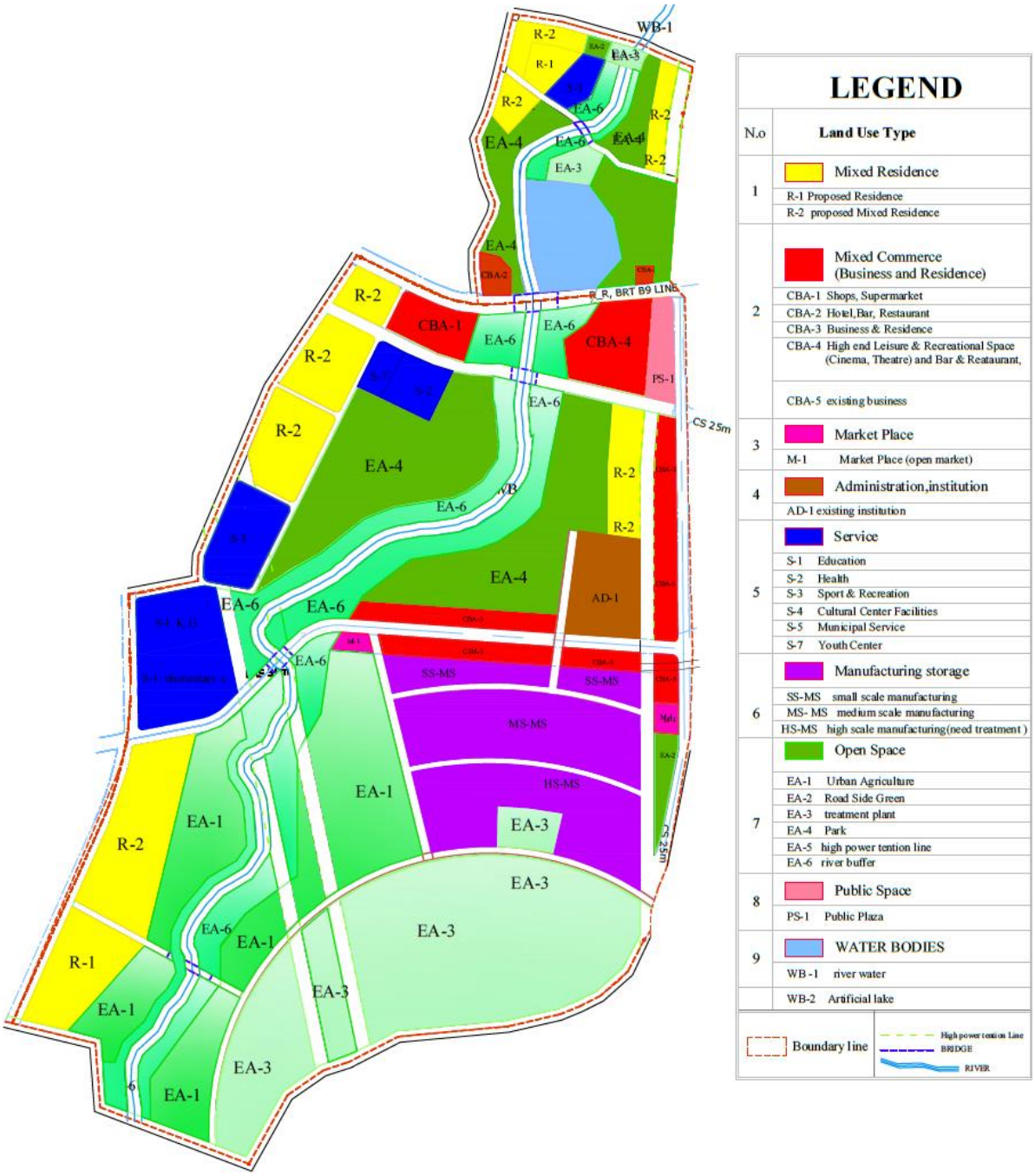


Figure 20: proposed land-use plan

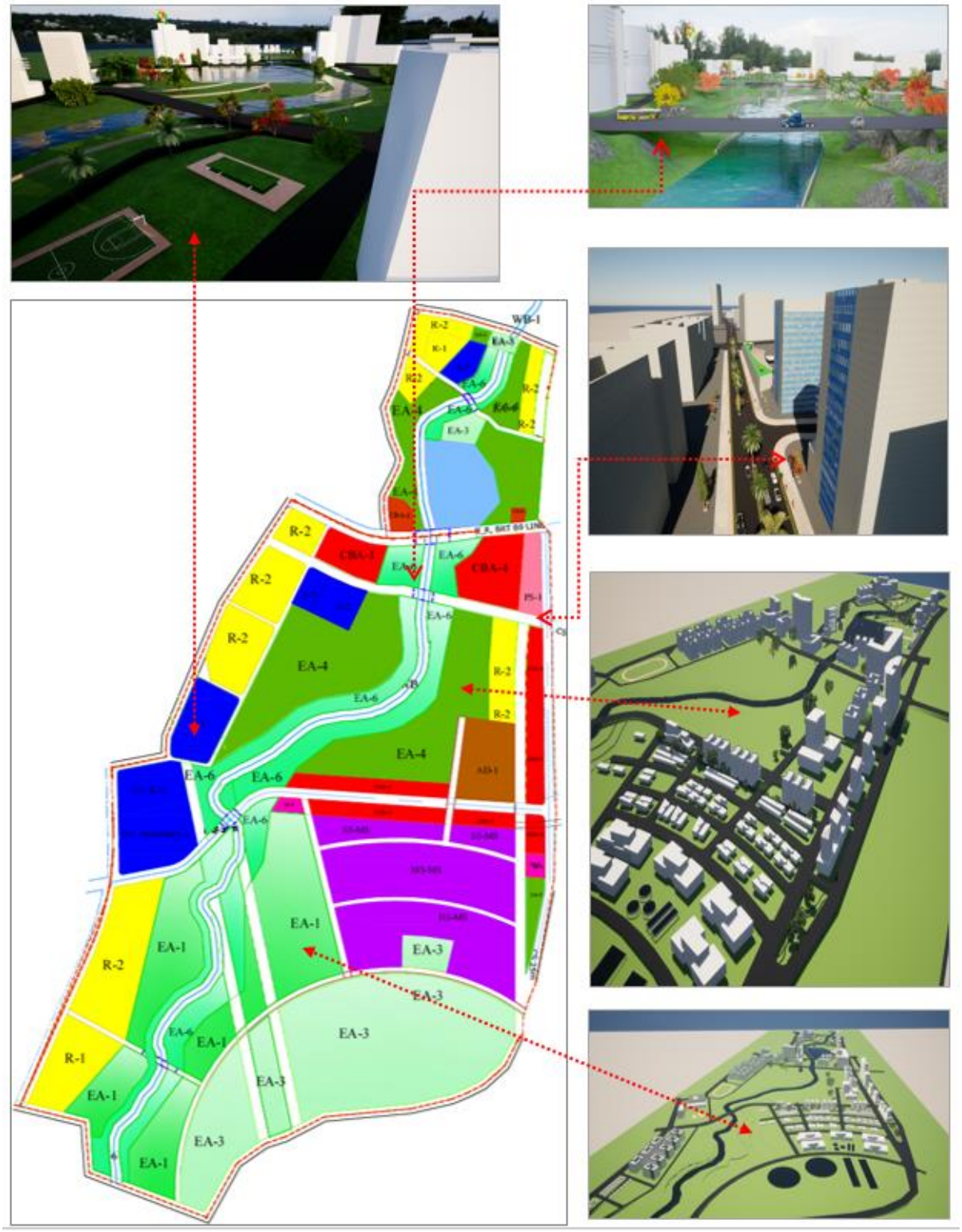


Figure 21: Schematic design of Riverside Regeneration around the little Akaki River

4.4.5. River side Neighborhood design

This design involves careful planning to ensure a harmonious relationship between the built environment and the natural surroundings of the river. Accordingly, the neighborhood design incorporates green spaces and sustainable building materials to minimize the environmental impact on the river ecosystem.

Figure 22: proposed Neighborhood design

This neighborhood design proposal mainly integrates a mix of residential, commercial, and recreational spaces to create a vibrant and diverse neighborhood that supports local businesses and a range of amenities for residents. The design creates pedestrian-friendly pathways, bike lanes, and public spaces that allow residents to enjoy and interact with the riverfront, promoting a sense of community and connection to nature.

Figure 23: Schematic design of Riverside Regeneration

4.5. Discussion

Assessment of the Existing Condition in the study area (downstream of the Little Akaki River) reveals that, the area has been subject to various environmental and socioeconomic challenges. Beneath the following paragraphs, the evaluation and analysis result of the current condition of the area under subtopics discussed: socioeconomic, environmental quality, land use, and infrastructure. The result of study shows the major cause of pollution in the downstream sections of the little Akaki River attributed to interconnected factors, with industrial discharge, inadequate wastewater management, agricultural runoff, and urbanization. Numerous industries located in and around Addis Ababa discharge untreated or inadequately treated effluents into the little Akaki River. These industries include textile factories, tanneries, food processing units, and pharmaceuticals, among others. The industrial effluents typically contain heavy metals (such as lead, chromium, and cadmium), chemical dyes, organic pollutants, and other hazardous substances.

The city's wastewater treatment infrastructure is insufficient to handle the growing population and industrial activities. Much of the sewage from residential areas and industrial zones is either untreated or only partially treated before being released into the river. Agricultural activities along the riverbanks and in the surrounding areas contribute to the pollution through the runoff of fertilizers, pesticides, and herbicides. These agricultural chemicals lead to nutrient loading, which causes eutrophication, a process where water bodies become overly enriched with nutrients, resulting in excessive growth of algae and depletion of oxygen in the water.

Rapid urbanization has led to increased construction activities and informal settlements near the riverbanks. These areas often lack proper sanitation facilities, resulting in direct disposal of solid waste and domestic sewage into the river. Solid waste contributes to physical pollution, while domestic sewage adds organic matter, pathogens, and household chemicals.

Proposed spatial Regeneration plan

However, the concept of 2017 structural plan of Addis Ababa promotes mixed-use development that ensures working living and getting different services nearby. In study area there is no distinct land uses specifically assigned for commercial, social service and environmental protection. The existing trend shows more mixed of residences and industries that creates land use incompatibility and discourage the area development and environmental protection. Hence, successful riverside Regeneration must be economically viable, balancing financial

sustainability with community and environmental goals; the spatial proposed Regeneration plan mainly focusing on creating sustainable development along little akaki river by mitigating adverse impact on little akaki river.

Accordingly, Proposing industry zone along downstream near to treatment plant enhance to manage liquid waste disposal from industries and proposed common treatment plant for higher industries like tannery industries and creating hierarchy to minimize adverse impact on river and environmental pollution. Due to poor planning and poor accessibility caused to river side social, economic and environmental degradation to little akaki river so proposed plan creates resilient neighborhood community by mixed and compact use development. It develops new zoning that segregate industry zone from residential, promote riverside buffer and create transitional zone for urban agriculture, green area, entertainment and social services. Social amenities like children play ground, sport field and parks helps to manage lands to protecting soil erosion to the river and creating of attractive environment. Wall construction at 15 meter set back of left and right lateral sides of little akaki river used to minimize soil erosion and mitigate the impact of soil sedimentation down stream of aba Samuel reservoir.

Proposed regeneration plan follows urban design principles such as legibility, permeability, accessibility and connectivity to enhance and ensure viability of the riverside development. Furthermore, this proposed spatial regeneration plan along the little Akaki River helps:

- City administration offices like environmental protection office and land administration office to easily manage little akaki river and along its banks development.
- Ease liquid disposal management by installing sewerage line system in to kality treatment plant.
- Minimize environmental pollution, foul smell and soil erosion creating transitional zone.
- Proposed land use plan promotes riverside protection and regulate informal development.
- Recreational spaces Created considering the potential of surrounding urban fabrics and green, blue grey spaces providing artificial lake, plaza, and children play ground, sport field to make the space for leisure purpose and minimizing advert impact river pollution.

CHAPTER FIVE

5. CONCLUSIONS AND RECOMMENDATIONS

5.1. Conclusion

This research has provided comprehensive insights into the current state of the area along downstream of the little akaki river, identifies mitigation measures to the adverse impacts due to pollution in the study area and proposed regeneration plan that promote sustainable life in the study area.

Generally, the research concluded are as follows:

The Little Akaki River suffers from severe pollution due to domestic sewage, industrial effluents, and solid waste disposal. The lack of adequate waste management systems exacerbates the problem, leading to significant environmental issues for the surrounding communities. Pollution of the Little Akaki River has had detrimental effects on local neighborhood, including felt odor, bad look, and under development.

Effective regeneration of the Little Akaki River requires an integrated approach that combines technical, regulatory, and community-based strategies. Addressing pollution sources, improving waste management, and engaging local stakeholders are essential for sustainable regeneration efforts.

Participation of Community found as crucial for the success of regeneration initiatives. Engaging local residents in clean-up activities and raising awareness about the importance of riverside development can foster a sense of ownership and responsibility. In addition, applying mitigation measures such as strengthening waste management systems, regulating industrial discharges, creating public awareness, improving urban planning, strengthening policy and implementing proposed regeneration design identified as useful strategy to achieve the objective of the research, “changing the study area from the pollutant downstream to livable riverside”

5.2. Recommendations

Based on the findings of this study, the following recommendations proposed to facilitate the regeneration of the study area along downstream of the Little Akaki River. In case, through collaboration and commitment among government agencies, local communities, industries, and international organizations, implementing here below listed strategic measures can significantly reduce adverse pollution and can make the Little Akaki River a livable area. Some of mitigation approach and strategies have to implemented are:

5.2.1. Strengthening Waste Management Systems

Adopting legal frameworks to implement proposed plans and integrating water resource management approach is crucial to coordinates the management of water, land, resources and infrastructures. Implementing systematic waste collection services throughout the city to prevent solid waste from being dumped into the river and encourage recycling programs to reduce the amount of waste that ends up in the river. Expanding the capacity of existing sewage treatment plant to handle the city's wastewater effectively and connecting the sewer lines to the central treatment plants as much as possible. Constructing wetlands and utilizing constructed wetlands for natural filtration of wastewater before it enters the river is also good mechanism to keep the river clean.

Establishing comprehensive waste collection and disposal systems to prevent solid waste from entering the river and accumulating on unallowable spaces. In case recycling and reusing initiatives are recommendable to reduce the volume of waste generated. Developing facilities and protocols for the safe disposal of hazardous wastes, including industrial effluents.

5.2.2. Regulating Industrial Discharges

Strict enforcement of environmental regulations on industries use to treat their effluents on the study area before discharge. These includes regularly monitoring industrial discharges and impose penalties for non-compliance and supporting the adoption of cleaner production technologies in industries to minimize waste generation.

5.2.3. Creating Public Awareness

Conducting awareness campaigns about the impacts of pollution and the importance of keeping the river clean. Organizing community clean-up activities along the riverbanks to engage locals

in river conservation efforts and integrating environmental education into school curriculums to instill the importance of water conservation and pollution control from a young age.

5.2.4. Improving Urban Planning

Upgrading infrastructure according to the proposed regeneration design can filter pollutants and reduce runoff, hence land use such as buffer zones and agricultural zone along the river aimed to solve such problems too. It also used for natural filtration of wastewater before it enters the river.

Integrating sustainable practices into urban planning to manage storm water runoff and reduce pollution loads by applying green infrastructure such as green roofs, permeable pavements, and rain gardens to manage storm water and reduce surface runoff. Reforestation programs to restore native vegetation, which can help stabilize soil and reduce erosion.

Relocating and redeveloping industries based on the proposed regeneration design and regulating discharges by enforcing stringent environmental regulations to ensure that effluents treated before discharging. This would be minimize cost for sewerage line and add to vibrant zoning.

5.2.5. Strengthening Policy and Institution

Strengthening inter-agency coordination is useful to ensure effective implementation of pollution control measures, to secure funding for regeneration projects, to identify pollution sources easily, to understand and develop targeted mitigation strategies. Adopting Resource Management approach to maximize economic and social welfare without compromising the sustainability. It is about strengthening coordination between different governmental agencies responsible for water, environmental protection and funding for pollution control projects through government budgets. Establishing regular monitoring programs and identify pollution sources use to understand the impacts of pollution on the Little Akaki River.

5.2.6. Recommendations for further research

Prepared regeneration plan focuses on specific parameter discussed in the objective part of this thesis paper. Hence, sustainable development is future of cities the author of this research call for further regeneration research in Addis Ababa for remedial measures particularly along all riverbanks.

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APPENDIX 1: Questionnaires

Questionnaires

How do you do! My name is Mr. **Anwar Abrar**, a candidate for Masters of Science (**MSc**.) Degree in Urban Planning and Design from Adama Science Technology University. Dear respondents, this questionnaire is designed to collect data that will be used to complete a research paper entitled ***"Riverside Regeneration in Addis Ababa: a case of little Akaki river"***.

Since the information you would provide is highly essential for successful completion of the study, I kindly ask you to provide objective and accurate answers as well as you understood. Acknowledging your cooperation, I assures you that questionnaires and information provided will kept confidential and used only for an academic purpose.

A. DEMOGRAPHIC INFORMATION:

0. ID/Name of respondent____
1. What is your gender?
   a) Male b) Female c) Prefer not to say
2. What is your age range?
   a) 18-29 b) 30-39 c)40-64 d)>=65
3. What is your religion?
   a) Orthodox b) Muslim c) Protestant d) Catholic e) Waqefata f) other (specify)
4. Your higher education level?
   a) Illiterate b) elementary (1-8) c) high school (9-12) d) Degree/diploma e) >=Masters

b) SOCIAL LIFE

5. How long you have been lived in this neighborhood along little Akaki river?
   a) Less than one year b) 1 to 5 years c) 5 to 10 years d) above 10 years
6. In which community based organization you are actively participating?
   a) Idir b) Mahber/tsiwa c) senbat d) in none of them e) other (specify)
7. Which of social problem is mainly trended in this neighborhood? (you can choose multiple)
   a) Theft b) Beggary c) dacoity/Burglary d) Drunkard

c) INFRASTRUCTURE AND PLANNING ISSUES

8. To whom this building/land property registered (LDP/NDP)?
   a) Private owner b) house renting authority c) Kebele/local government d) not registered yet e) other (specify)
9. How do you get potable water?
   a) From tap in the compound b) from community tap c) from natural spring d) from River e) other (specify)
10. Which Energy source you use primarily?
    a) Electricity (private) b) Electricity (shared) c) Waste and biomass d) Firewood & charcoal e) Gas/Kerosine
11. Which Road type is directly accessible to your home?
    a) Alleyways (<6m) b) cul-de-sacs c) local street road (6-9m) d) main road (12-24m) e) arterial road (>/=30m)

d) SOLID AND LIQUID WASTE DISPOSAL ISSUES

12. How do you dispose liquid waste mainly?
    a) Spill in river after tertiary treatment b) spill in river after secondary treatment c) spill in river after primary treatment d) spill in river without treatment e) dispose in septic tank
13. How do you dispose Solid waste usually?
    a) In garbage pit oriented by government body b) on free space around house c) dispose it in nearby river d) dispose it in ditches e) Throw it on the road

I

14. How far is your House/factory from little akaki river?
    a) Less than 5meters b) 5-15 meters c) >15 meters

e) ENVIRONMENT AND NATURAL RESOURCE ISSUE

15. Which do you think is being significant Cause of pollution to little akaki River?
    a) Improper liquid waste disposal from residences b) improper liquid waste disposal from factories c) Improper solid waste disposal from residences d) Improper solid waste disposal from factories
16. Which do you think is being a the most cause for foul/bad smell in this neighborhood?
    a) The Little Akaki river b) Solid waste disposal from residences c) liquid waste disposal from residences d) Solid waste disposal from factories e) liquid waste disposal from factories
17. Which one is harsh impact of the Little Akaki river pollution on the Environment?
    a) Poor air quality b) Poor water quality c) Gave bad look for the neighborhood d) Soil erosion e) growth retardation in plants

f) AWARENESS TO REGENERATION AND PREFERENCES

18. Are you aware of about urban riverside regeneration development?
    a) Yes b) No
19. Would you be interested in supporting future urban riverside regeneration initiatives?
    a) Yes b) No c) Maybe
20. Which feature or amenity would you like to see included in urban riverside regeneration along the little akaki river?
    a) housing development b) urban agriculture c) recreational centers d) lodges
21. On a scale of 1 to 5, how would you rate the current state of the urban riverside in terms of aesthetics?
    (1 = Poor, 5 = Excellent) a) 1 b) 2 c) 3 d) 4 e) 5

g) Dependent Variables

22. Do you confirm that the neighborhood along the little Akaki River is at **polluted status**?
    a) Yes b) No
23. Do you think the regeneration development along the little akaki river would be successful?
    a) Yes b) No

h) SUCCESSFULNESS OF REGENERATION

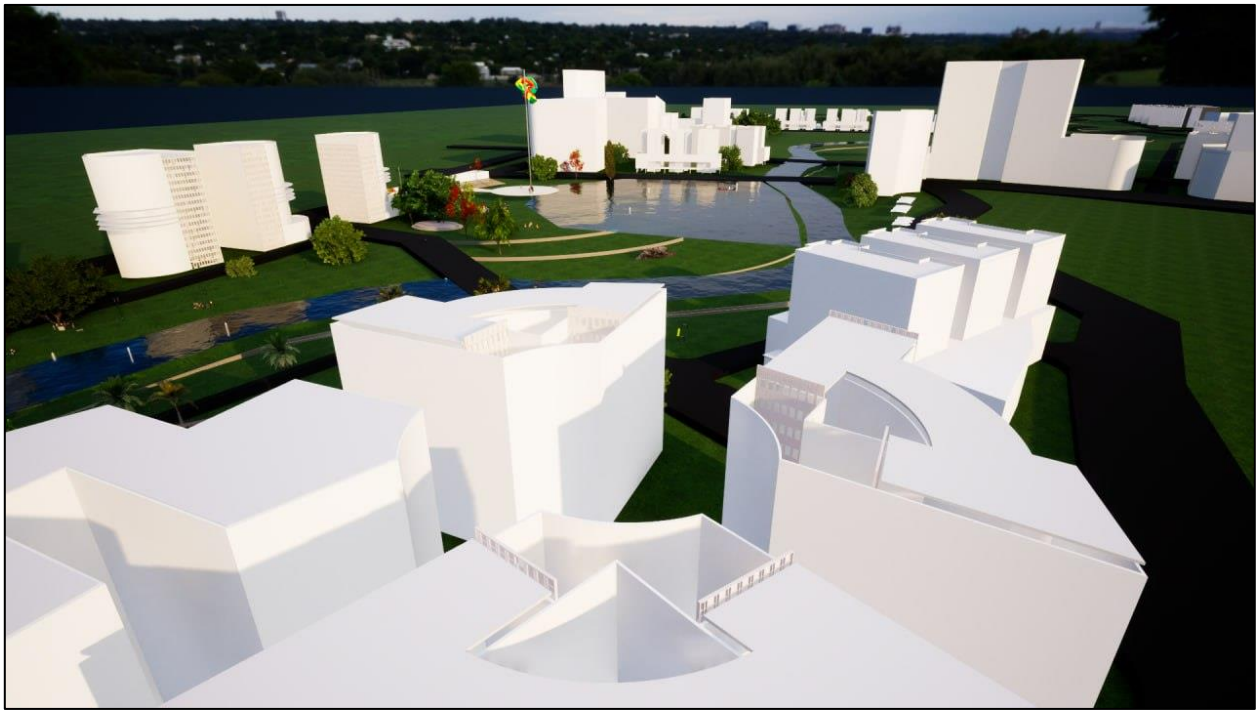
24. Please provide your comments or suggestions regarding successfulness of regeneration along the Little Akaki River that you think would be valuable for this study.

_____

_____

_____

APPENDIX 2: 3D Views of Proposed Regeneration Plans



APPENDIX 3: Images from Study area Observation