

**TRANSFORMATION OF URBAN RIVER SIDE
THROUGH ARCHITECTURAL INTERVENTION:
THE CASE OF HULUKA RIVER, AMBO, ETHIOPIA.**



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A Thesis submitted to
The Department of Architecture
School of Civil Engineering & Architecture, Urban Planning and Design

Partial Fulfillment of the Requirements for the Degree of Master of
Science in Environmental Architecture

Office of Graduate Studies
Adama Science and Technology University

Adama, Ethiopia
June 2022

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Advisor: Asfaw Mohamed (PhD)

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DEDICATION

I would like to dedicate my thesis to **Dr Fikrte Demissie Tullu**. Dr. Fikrte was a skilled and capable member of the architecture department at Adama Science and Technology University's School of Civil Engineering and Architecture.

APPROVAL OF BOARD OF EXAMINERS

I, the advisor of the thesis entitled **“Transformation of Urban River Side through Architectural Intervention: The Case of Huluka River, Ambo, Ethiopia.”** And developed by Dagimlidet ketema Mekonnen, hereby certify that the recommendation and suggestion made by the board of examiners are appropriately incorporated into the final version of the thesis.

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Finally, approval and acceptance of the thesis is contingent upon submission of its final copy to the office of post graduate studies (OPGS) through the department graduate council (DGC) and school graduate committee (SGC)

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School dean	Signature	Date

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DECLARATION

I declare that this thesis proposal entitled “**Transformation of Urban River Side through Architectural Intervention: the Case Of Huluka River, Ambo, Ethiopia.**” 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.

Dagimlidet ketema Mekonnen

Name of student

Signature

Date

RECOMMENDATION

This is to certify that the thesis entitled: **“Transformation of Urban River Side through Architectural Intervention: the Case of Huluka River, Ambo, Ethiopia.”** submitted in partial fulfillment of the requirements for the degree of Master of Science in Environmental Architecture, the Graduate Program of the Department of Architecture, and has been carried out by Dagimlidet ketema Mekonnen, under my supervision. Therefore, I recommend that the student has fulfilled the requirements and hence hereby he can submit the thesis to the department.

Asfaw Mohamed (PhD)_____

Major Advisor

Signature

Date

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ABSTRACT

The overall goal of this research was to create an integrated riverside development platform centered on conserving the riverfront's utilitarian, social, and environmental features in the case of the Huluka River in Ambo town. The principal contaminant that affects the river, as well as the town's whole water, is riverside informal construction and settlements. The study's major objective is to generate integrated waterfront development platform that preserves the riverfront's utilitarian, social, and environmental features. Both primary and secondary data sources are employed to perform the research. The primary data was gathered via a questionnaire and an interview on the affects of garbage along a riverside development and the influence of informal settlements along the river. Based on the difficulties found, the data was examined using percentages and presented in tabular form. The research focused on how to examine previous development along a riverside in the town, present development along a riverside, assessing the implications of problems associated with riverside development, and creating a sustainable riverside. Riverside projects provide various advantages, including improving the environment and water quality, giving tourism possibilities, improving social services, and increasing social contact. As a result, the river has lost its symbolic value for the community. To encourage sustainable riverbank development, advanced development in budget allocation, capacity building, legislative framework, awareness generation, and stakeholder participation is required. To concentrate social, economic, physical, environmental, political, and cultural functions, planning and establishing a variety of stages to generate new projects is necessary. Finally, recommendations were made for this study, as well as a case design solution.

Key words: Huluka River, informal settlement, pollution, river side development

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List of Abbreviations

AS- Arterial Street

CS- Collector Street

LS- Local Street

VOC- volatile organic compound

CHAPTER ONE

1. Introduction

This thesis was created in part to complete the requirements for the master's degree in environmental architecture at the Adama Science and Technology University. The study was carried out in Ambo Town, Ethiopia. The research sought to enhance the potential of the Huluka River's current state, obstacles facing the riverbank in this situation, and offer suggestions for resolving such issues.

I was aware of a number of components of this overall problem because I am an environmental learner and have lived in Ambo town for the previous 5 years. These factors encourage me to gain a deeper understanding of the Huluka River's current state, identify areas for improvement, and propose countermeasures against dangers. To that end, this chapter discusses the study's history, problem statement, study objectives, research questions, scope, importance, description of the study region, location, area, and form, terrain, climatic conditions, and study limitations.

1.1 Background

Water is one of the most essential natural useful resources that are vital for the survival and its health of most dwelling organism. Its extended use for drinking, agriculture, shipping, industrialinput, electric energy technology and recreational facility shows to what volume water is a critical part of human life. The health of streams and rivers depends to a tremendous extent on the lands that surround them. Like all ecosystems, water systems also are threatened with the aid of ever-growing human populations and urbanization. (Yassin, 2011).

Urbanization has an outstanding effect on human settlements and those effect causes have some other impact on ecosystems. Urbanization and massive modifications on land floor may be the principle manmade influences on move. The number of riverbank settlements in each town grows as a result of population development, urbanization, and financial innovations. Waterfront development has been a subject of global significance due to its contribution to city development and regeneration. .(Irma N & Syahreza A, 2017).

Many towns within the global started out reimagining their courting to the water because it gives many social, cultural, monetary, and environmental blessings for the city, and its residents. (Chen, 2015).

Different types of urban regions are linked to the operations of various social groups. Unexploited and underutilized public space, as well as space with no social aim, frequently reflects its physiological shape. Its utility and attractiveness are harmed by unorganized transit, parking, and other physical restrictions. Individuals create and co-create space, while the quality of space impacts the individual of people at the same time. (Sebsib H et. al., 2019).

The government is eager to develop riverfronts in developed nations because they have the resources to do so. However, management and regeneration are the current issues facing riverbank development in affluent nations. Due to a number of factors, riverside development and buffer zones have not yet been successfully implemented in practice in developing nations. The main common factor among these factors is likely misperceptions about the significance and value of riverside development in terms of its benefits to the economy, society, and environment (Chen, 2015). One of the gaps in the literature that the study hopes to close is this one.

1.2. Problem Statement

The reality explains in sheltering numerous settlements at the side of extraordinary casual activities inside the river-area. The rivers and the river edges are relatively polluted, as these regions grow to be destination points for most of the garbage and sewers from family and a few industrial houses. River side development and settlements are the primary pollution that influences the river and the whole water and green device of the town.

Different pollution causes include clothes washing along river channels and bathing, both of which release detergents into the river. Solid wastes poured into the river by residences, business areas, and slaughterhouses are the other significant pollution causes. Some of the biggest pollution sources include defecating on riverbanks and connecting septic tanks, toilets, and other effluent pipes directly to river courses. The slaughterhouse's untreated effluent is also released straight into the Hulluka River. As a result, many individuals are experiencing health issues and living conditions that are unsettling, particularly those who live near the river.

Squatter and Formal settlement in and near river buffer and their impact on river is defined as a residential area which has developed without legal claim to the land and /or permission from authority to build.

Squatter communities suffer from limited infrastructure and service as a result of their unlawful or semi-legal land ownership status. In most circumstances, squatters are classified as low-income individuals. Their livelihood is sometimes dependent on rivers and river banks. Squatters' actions, on the other hand, have a detrimental impact on the health of the river they live near. Defecation, residential solid waste disposal, and animal waste release are only a few of the activities that pollute rivers.

There have been few studies on riverbank development in Ambo. Alternative design options, tactics, and techniques for resolving the current riverbank concerns are not recommended in the study. As a result, it's been difficult to focus much emphasis on taking the required steps to solve the difficulties and promote sustainable urban riverfront development. As a result, the goal of our research is to help close these gaps.

There have been very few prior studies on the riverbank development in Ambo. The studies don't provide any alternate design options, tactics, or methods for dealing with the current riverfront issues. Due to this, it has been challenging to devote much attention to taking the required steps to solve the issues and promote sustainable urban riverbank development. Therefore, the goal of this work is to help close these gaps.

1.3 Objective

1.3.1 General Objective

To provide a riverside development integrated platform focused at preserving the river front's utilitarian, social, and environmental qualities.

1.3.2 Specific Objective

1. Assess the status of the Huluka river side environmental functions based on available standards
2. Evaluate the existing settlement conditions, shelter construction materials and its effect on the riverside.
3. Investigate the Riverside Environment and Inhabitants Interaction.
4. Indicate schemes or methods for Huluka riverside transformation in self-sustaining, environmentally pleasant, healthy, reachable, and recreational center.

1.4. Research Question

1. What is the current state of the riverside environmental functions along the Huluka River?
2. What are the current settlement circumstances, shelter building materials and their impact?
3. What is the relationship between the Riverside Environment and its Inhabitants?
4. How can the Huluka Riverside become selfsustaining, ecologically friendly, healthful, accessible, and recreational?

1.5 Significance of the Study

The significance of this study is to centralize various organizations throughout the town that are seen as stakeholders in the process to achieve the study's goals. These organizations include municipal bodies, local government bodies, etc., as well as the residents of Ambo town who benefit from the study area by receiving a good river and being protected from various types of bad odors that come from it when it is managed well.

Contributions to the ecology, ecological corridors, and biodiversity conservation are significant. Improving the classy look of flow corridors (which could boom assets values) by using making riparian buffers human beings-pleasant places, clever communities acquire allies for river protection and encourage citizen participation.

People will notice that a forested buffer/park is especially enjoyable because it reduces noise from nearby roads, development and industry, and offers a cool, shaded place with a nice view.

1.6. Scope of the Study

The spatial scope of this study is restricted to the Huluka River and river side development. This study looks at targeted directly to alternate awful horrible area to appealing and sustainable region.

This location was chosen due to the various issues caused by disposal waste management and its functioning. Compared to the other portions of the town, it is the region most affected by the dumping site. The goal of the research is to find solutions to the problems that currently exist along the river and to enhance the area's aesthetic value in order to provide the community around the Huluka River with opportunities for economic growth.

1.7. Limitation of the study

The study was hampered by a number of constraints that limited its scope.

Practical flaws in the methodologies used by the researchers, a lack of access to the right data, a lack of current literature in the fields, and time and resource constraints are just a few of them.

1.8. Organization of the study

The preparatory pages, which comprise approval, acknowledgments, abstract, table of contents, list of figures and tables, body portions, and extra pages, are divided into five sections. Reference and questioners are included on the supplemental pages.

The body of the article is divided into five major chapters.

The first chapter deals with a broad overview of riverside development and impact of informal settlement and wastes. Its global and local comprehension, which includes the study's objectives, problem statement, research questions, importance, and scope.

The second chapter will look at the literature study, which will look at the many concepts and systems of riverside development and people's activity impact on the topic region, as well as the consequences and challenges with management alternatives both internationally and locally.

The third chapter will cover description of the study area and research methods and how to seek for sources, which are the foundations and pillars for constructing the paper with arguments, facts, figures, debates, and conclusions, among other things.

The fourth chapter will focus on the area's discoveries, findings, and analysis.

The fifth chapter examines thesis conclusion and recommendations.

CHAPTER TWO

2. Literature Review

2.1 Introduction

Theoretical reviews of the related studies on the assessment of transformation of urban river side through architectural intervention. Different materials that provide a review of literature on transformation of urban river side through architectural intervention.

The first type is the water point or fountain; while second type is the pool and the third is the coast. The last type of the water feature which is associated with city is the linear water course that is streams and rivers (ibid, 2003). Simondset al. (2006) described that river is a course of water that originates in the mountains and flows downwards until it reaches the oceans.

2.2. Benefits of Urban Rivers

Urban rivers have environmental, cultural, social and economic values (Darby et al, 2008). Human beings are using river for drinking water, irrigation, industry, power production, transport, fishing boating, swimming and aesthetic enjoyment (Darby et al., 2008 and Hopper et al., 2007;). Rivers provide connection between landscape and communities. Hopper et al. (2007, p.104), throughout human history, people have settled along rivers and lakes for the purpose of transportation, water supply, and waste disposal. As a result, most cities and towns, which are near to rivers, have converted riparian areas to settlements and waste disposal areas (ibid, 2007, 104)

2.3. River Front

River front is a region along the river often in the larger cities that border a river; the river front will be lined with marinas docks parks trees or minor attractions. (Christine We beet al. 2005).

2.3.1. Repherian zone/buffer

There are many ways of defining a buffer zone. Generally, the idea of the buffer zone is a greenbelt between the problematic area and the water. This green area is to protect the water from different types of negative impacts like pollution, nutrient loads and sediments. (Christine We beet al. 2005).

2.3.2. Approaches on river buffer zone

Various approaches for improving ecological systems can be distinguished. The two most important approaches are **restoration and rehabilitation**, Restorations defined as the collective efforts for returning ecosystems to their original, unimpaired condition (Christine we beet al.2005). In the case of active restoration, direct structural measures are carried out, in order to obtain the original ecological functional capability. By contrast, passive restoration simply excludes the anthropogenic activities, which are responsible for the degradation of the ecosystem, or which prevent it from regenerating (Christine We beet al. 2005). Riparian restoration projects: reestablishing healthy and functional riparian zones can be accomplished by planting native grasses, wetland and tree species. The objective of the measure is not to remedy the symptoms of an impaired system (e.g. reduced fish density), but to eliminate their causes (e.g. Reduced habitat diversity, reduced connectivity). However, the terms restoration and rehabilitation are not used in a consistent manner, neither in practice nor in the literature. (Christine We beet al. 2005).

2.3.3. Functions of buffer

Riparian buffers perform a range of functions with economic, social, and ecological value. These include the following: Contributions to the environment, ecological corridors, and biodiversity conservation are significant.

Preservation of open space and creation of green land using vegetated buffers to set back human developments and land uses from shorelines is cost effective protection against the hazards caused by flooding, shoreline erosion and moving streams. Development of recreation and tourist sites although offering recreational and educational opportunities to residents and tourists. Welcome the public to hike or bike, walk or run on trails, or try their luck in fishing tournaments. Riverside festivals and concerts have a special appeal. Public gardens offer pleasant passive recreation. People will notice that a forested buffer/park is especially enjoyable because it reduces noise from nearby roads, development and industry, and offers a cool, shaded place with a nice view.

Improving the aesthetic appearance of stream corridors (which can increase property values) by making riparian buffers people-friendly places, smart communities gather allies for river protection and encourage citizen participation.

Citizen groups can develop a feeling of ownership that translates into monitoring, volunteer labor, and a welcome source of stewardship for town property. Corporate citizens owning riverfront property can contribute to the quality of life for their employees and the community at large

Pollution of water, soil, and the environment is avoided. Nature, landscape, and biodiversity conservation. Regulation of drainage and protection of open spaces from floods. Maintaining habitat for fish and other aquatic organisms by moderating water temperatures and providing woody debris. A natural area around the river provides direct economic benefits from: Fishing enthusiasts, River rafting and Visitors to Riverside Park. (Christine We beet al. 2005).

2.4. Standards and Design

2.4.1. River side development design

River front has work on storm water buffering to provide a broader safeguard area for river. River front has work on storm water buffering to provide a broader safeguard area for river. The width of a riparian zone is influenced by many factors including the width of the stream, the drainage area, slope of the adjacent land surface and types of soils. City main center or inner city minimum of 15meter, Major sub- center minimum of 25 meter and Minor sub center or peripheral center minimum Of 50 meters

These places all belong to the wider community. It is important never to forget that they are there for their use, benefit and enjoyment. In designing and developing buildings and environments which interrelate with the public realm, it is therefore essential to ensure that this tremendous value of the public realm to the wider community is acknowledged, respected and enhanced.

2.4.2. Design criteria

The following Design Criteria's are the results of the theoretical and thematic research conducted in this booklet, through the study of both theorists and the sustainable guidelines of the DGNB criteria. Thus, the aim is to set the goals that the project needs to pursue.

- I. **Identity of the area:** Reinterpretation of the local architectural expertise. The architectural language of the design should result as a contemporary
- II. **Respect the landscape:** Considering the uniqueness of the site context, the architecture should fit the landscape without creating a fracture with the context itself, while creating a new identity pole for the users.
- III. **Northern lights view:** Special attention must be paid to the design of windows so to increase the possibility to catch the Northern Light from indoor.
- IV. **Ambience:** The ambience should vary according to the space use, indoor and outdoor, always preserving a strong feeling of connection to the natural landscape.
- V. **Attention to materials:** The choice of materials needs to consider their technical and qualitative features. The colors are chosen taking into account the way they affect the internal perception of the space in terms of atmospheric comfort and visual pleasure.
- VI. **Disassembly and Flexibility:** The project must take into account the dismantling of the business and the environmental consequences that this entails
- VII. **Sustainability connected to local potentials and reality:** The exploitation of the local potentials must be undertaken from every point of view, also in terms of energy supply, taking advantage of the geothermal power and focusing on the reduction of the CO2 emissions related to the life cycle of the building.
- VIII. **Indoor environmental conditions:** High standards of indoor comfort must be achieved, in order to enhance the pleasure of the indoor experience.

2.4.3. Environmental Criteria

- I. **Local Environmental Impact:** The choice of the construction materials should take into account the eventual harmful chemical compositions and the physical characteristics
- II. **Land Use:** This criterion takes into account the irreparable use of the soil. Ideally, it is preferable to build on soils which were previously used for construction, and therefore already made impermeable by the use of materials such as concrete:

2.4.4. Social Criteria

- I. **Thermal Comfort:** The thermal comfort is determined by the absence of moist and draught, with no excessive cold, nor warm temperatures. It affects the livability and the general comfort of the place, thus the pleasure of being or not in a place.
- II. **Indoor Air Quality:** User's health and wellbeing is affected by the quality of the air; the level of indoor pollution needs to be calculated in order to prevent unpleasant smells and harmful substances.
- III. **Visual Comfort:** Users comfort is also linked to the amount of daylight that they are able to catch indoor. This in fact affects people in terms of health and on a psychological side.
- IV. **Quality of Outdoor Spaces:** Including Est. and recreational areas in the design of buildings increase the acceptance of the structure by the users and greatly affects their perception of the place.
- V. **Design for All:** Both external and internal spaces need to allow the maximum level of accessibility for everyone, including them into the design to allow disabled persons not to ask for assistance and to fully take part to the social life of the place.
- VI. **Layout Quality:** The capability of floor plans to be adapted to different uses increases the livability of the space itself and it is strength for the whole project use: the use as some spaces could in fact be in need of being re-adapted during the life cycle of a building.

2.4.5. Economic Criteria

Flexibility and Adaptability: In terms of economic success, the capability of the structure of being flexible and adaptable can reduce the risk of vacancy and to enhance the potential of the space.

2.4.6. Technical Criteria

Building Envelope Quality and Cleaning and Maintenance:

Maintenance and cleaning affect the building cost and the general environmental impact. The correct choice and use of construction materials, makes their life cycle lasting longer and cheaper.

2.5. Impacts of Activities by Formal and Informal Dwelling on River and Its Buffer

2.5.1. Land use and land cover change around river banks

The human use of land is referred to as land use. Land use entails the management and transformation of natural and semi-natural habitats such as arable fields, pastures, and managed forests into constructed environments such as settlements and semi-natural habitats such as arable fields, pastures, and managed woods.

2.5.2. Connection between the City's Settlers and Riverfront.

- I. **Riverfront Comfort:** Comfort is a prerequisite of successful public spaces. The amount of time individuals spend in a public area is both a function and a measure of how comfortable it is. The dimensions of a sense of comfort comprise environmental (relief from sun, wind, etc.) physical comfort (sufficient seating, lighting etc.) social and psychological comfort (a sense of security) and by quality of design and management (ibid).
- II. **Relaxation:** Is a more developed state with the 'body and mind at ease. In public space the most vital things that make it easier to be relaxed are natural elements - trees, greenery, water bodies and separation of the place from vehicular traffic (ibid. 2003). However, such features also obstruct visual access (visual permeability), creating safety problems and sometimes discouraging use. As in all aspects of design, it is necessary to achieve a balanced whole (ibid. 2003).
- III. **Passive engagement:** It needs to come across with the setting, even if without becoming actively involved. Opportunities for passive engagement are also provided by fountains, views, public art, performances, and so forth. Passive activities are like watching and hearing other people watching children, vegetation, water, wildlife, activities, and other people reading, meeting friends or visiting the garden are some of them
- IV. **Active engagement:** It involves a more direct experience with a place and the people within it.

2.5.3. Benefits of creating a Natural River's Edge and Restoring Habitat

- I. **Economic:** Improves the river front's attractiveness to investors, raises property values and creates potential for increased fishing, boating and other water recreation. Landscape planning of riverfronts can also revitalize the local economy.
- II. **Environmental:** Cleans up the river's edge, restores habitat and brings fish and migratory birds back to the river.
- III. **Community:** Cleans up the river's edge, improves community pride, creates the opportunity for visitors and residents to understand and appreciate.
- IV. **Harmony and sustainability:** The concept of harmony in design means that human beings and the ecological system can receive benefits at the same time, creating a harmonious atmosphere between the manmade and natural landscapes, while also meeting the requirements of the body and mind, both of which are features of sustainability. It is not harmonious if the riverfront landscape is destroyed, the resources are lost and the environment is polluted.

2.6 Principles for Successful Development of Urban Waterfront Areas

The following are basic principles for urban water front development.

Secure the quality of water and the environment. Waterfronts are part of the existing urban fabric. The historic identity gives character. Mixed use is a priority. Public access is a prerequisite. Make the waterfront a community priority. Planning in public private partnerships speeds the process. Secure strategic public investment and attract private resources. Public participation is an element of sustainability. Waterfronts are long term projects. Regeneration is an ongoing process. It requires a multidisciplinary work. Look beyond your boundaries. Orientation and Views of the site. Open Space, Landscape Concepts and Building Character are basic concept.

Acoustics part should be orienting outdoor areas/bedrooms away from noise sources. Sheltering doors and windows from noise sources. Glass walls around outdoor balconies. High walls around outdoor decks/patios. Glass blocks walls. Acoustically rated glazing. Sheltering of open able portions of windows. Provision of alternate ventilation. Managing interior noise levels.

CHAPTER THREE

3. Study Area and Research Methodology

Under this chapter the methodology used in this research work will be included and it will provides information about the research design, research instrument, data collection, method of data analysis and model specification, procedure of data collection, data analysis, Ethical consideration. This gives justification in the choice of methods used to achieve the objective of the study.

3.1 Description of the Study Area

3.1.1 Location of the Town and the Study Area

The town is surrounded by Ambo wereda “Dobi” kebele in North, Gosukebele in South, Awaro” kebele in East, and Toke „Kutayewereda in West.Total area of Ambo town is 8587.5 hectares (85,875,871.0715)m² according to new (revised) 1999/2007master plan of the town.

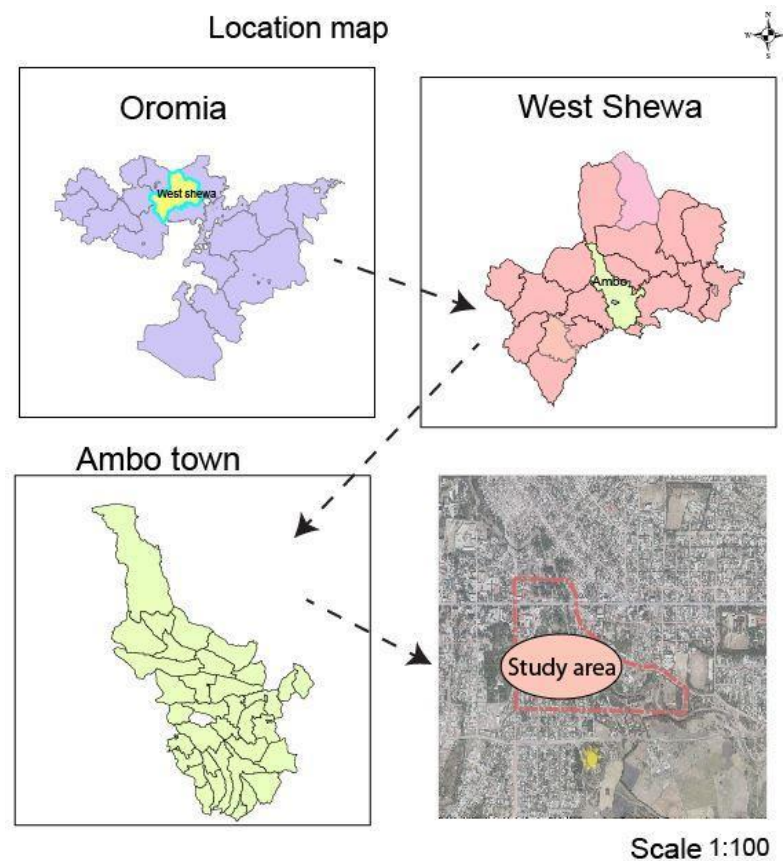


Figure 1 Location map of ambo city and the study area

3.1.2 Climatic Data of the Study Area

According to the data obtained from National Meteorological Agency of Ambo branch that is located in Ambo University 10 years consecutive meteorological data was taken and the following result is observed on the temperature, rainfall, humidity and wind direction.

The mean annual temperature, the mean annual maximum and mean annual minimum Temperatures of the town are reckoned to be about 18.87oC, 23.76 oC & 10.67oC, respectively.

The mean annual rainfall is about 987.78mm. The highest from June and inundation of Low gradient areas and incidence of sheet and gully

The mean monthly relative humidity of the town varies from 6in December which is very comfortable for human life.

From the meteorological data obtained the prevailing winds of autumn (Locally Meher), winter (Locally Bega) and Spring (Locally Belg) seasons are Easterly and South Easterly Winds while that of Summer (Locally Kremt) season is Westerly and South Westerly Therefore, industries and other urban activities, which can pollute the town in terms of smoke, dust particles, noise and stench, smell, are recommended to be located opposite to the most dominant prevailing wind direction.

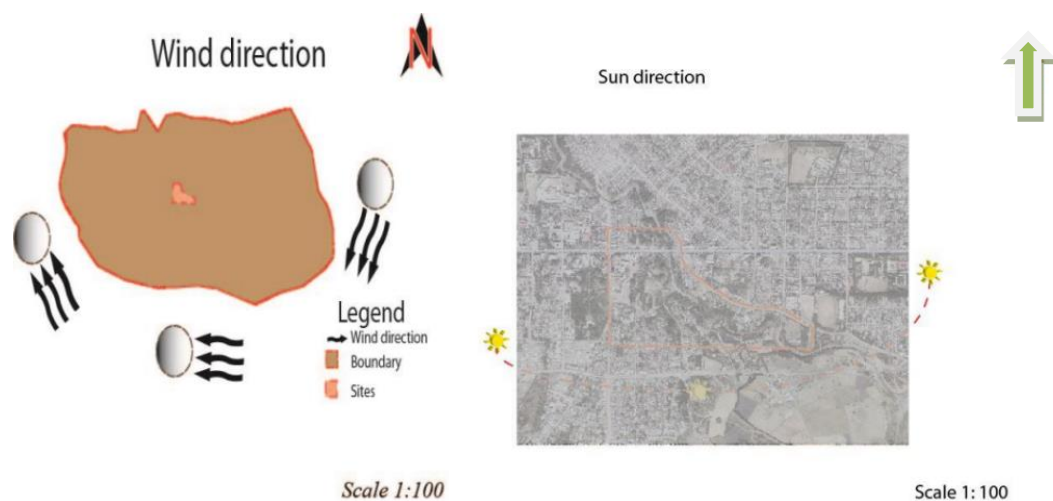


Figure 2 Climatic data of the study area

3.1.3 General Overview and Historical Background of Ambo Town

Ambo is located in the central parts of Oromia regional state that has geographical(Astronomical) location has a latitude and longitude of 8°59'N 37°51'E and an elevation of 2101 meters.. Relatively Ambo town is located 114 kms faraway west of Addis Ababa, 60kms North West of Weliso town and 12kms East of Guder town.

3.1.4 Historical Development Stage of Study Area

Before 1990 E.C. Huluka River was characterized by safe and clean water as well as its surrounding was serves as area for cultivation land, barren land, forest land. But as growth of the towns it becomes and characterized by high number building, area for disposing wastes, low quality and unsafe water. In different stages there is a great difference on and along Huluka River that going to study in this section in detail.

When the researcher study the background of the town there is a various transformation within different years. From Stage of 2011 G.C. transformations comes with due to increasing number of population to the town with new building, scarcity of open space, infrastructure, social services and the main study of is to analyses and investigate those various transformation and their impact they cause on the main Centre of study areas.

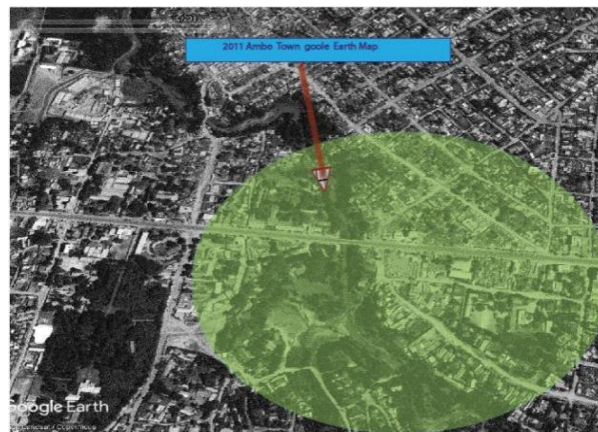


Figure 3 Evolution map of study area for the year 2011 G.C.

Transformation of the town from Stage of 2016 G.C was characterized by number are settlers are migrated to a town more than 2011 G.C. So the transformation in that year was greater than others and their impact was high in relate to 2011 G.C.

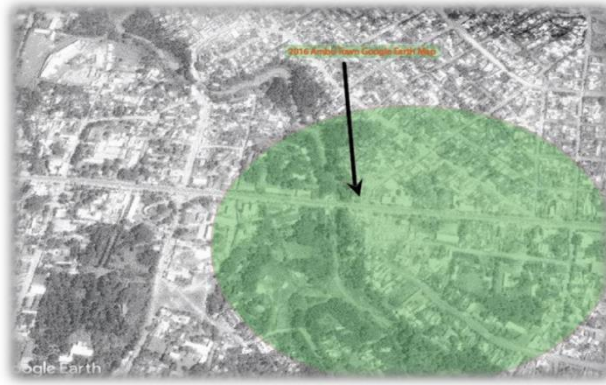


Figure 4 Evolution map of 2016 G.C

As time increase urban growth is also increases and when those activities are held that have negative impact on area also.



Figure 5 Current map of study area

3.1.5 Population of the Town

Population of the town determines conditions about rivers during there is small number of population the river quality was good that the society was uses for various activity rather than currently. But currently due to high number of population migrate to urban areas the river side is affecting by wastes.

Table 1 Total Population of Ambo town

Sex	2010	2011	2012	2013
Male	58,714	6,0123	61,566	63,044
Female	60,033	61,474	62,950	64,460
Total	118,747	121,597	124,516	127,504

The size of population is increasing from year to year outwardly, this implies that, high amount of desires that people to live in the town because of many factors with compared to the neighboring wereda towns these are; nearness to the capital city Addis Ababa,

needs for attending higher education in Universities and Colleges. On the other hands the main causes for rising of number of population is that the town is a centre for Zonal and wereda governmental and NGOS working centers. In this case according to Population theory the towns will increase its population.

Migration refers to spatial movement of people that involves a change of place of usual residence and the crossing of a political boundary. Migration can affect the growth and decline of population of the area of origin and destination respectively.

The case of migration is one of the pulling factor that can increase the existing population size, migration can occur because of plenty of reasons among these one and most accepted one is the issue of economy, population wishes to change his and his families status of economy ,for that reason they prefer to go to better town to be advantageous of being their economic situation, as a result both sex are attracted to prefer the migration process from one town to another town or from rural to urban. The contribution of migration to growth can therefore be either positive or negative. Depending on the direction of movement the event of migration can be classified into immigration and out-migration. In case of Ambo .there is not as such significant result is seen on out migration, but the in-ward migration is observed by a lot of reasons mentioned above, that results for the rise of population size.

Table 2 Migration status of Ambo town

Sex	Total	Migration status			Area of previous residence		
		Non-migrant	Migrant	Not stated	Urban	Rural	Not stated
Male	13,316	5,313	7,917	86	3,695	4,213	9
Female	14,256	6,484	7,731	40	3,854	3,875	5
Total	27,572	11,797	15,649	126	,7549	8,086	14

3.2 Research Method

3.2.1 Research Design

For this study, the researcher used the descriptive research approach. The practice of carefully defining and studying something's traits, attributes, or characteristics is known as descriptive research. It is a sort of research that uses observation as a method of acquiring data for the study. I utilize descriptive research to investigate the link between two independent and dependent variables, which are informal settlement and negative river effect, respectively.

One of the most significant benefits of descriptive research is that it allows examining data and aids in the development of a thorough understanding of the research problem. Another advantage of descriptive research is that it allows seeing individuals in their natural habitat. The researcher can acquire information using both qualitative and quantitative research methodologies in this sort of examination. This study assess transformation of urban river side through architectural intervention in case of Huluka River. A comprehensive related literature review of different previously published works, data from internet sources and other related files have been organized to assess transformation of urban river side through architectural intervention.

For analyzing the data gathered from questionnaire, the researcher use quantitative approach. Quantitative research be selected to find out facts about a concept, question or an attribute and also to collect factual evidence and study the relationship between facts to test theory. After analyzing all collected information, conclusions and recommendations are suggested based on the findings. This research study carried out within the prescribed time frame as per attached work schedule/plan from December 2021.

3.2.2 Data Collection Process

A number of approaches are used for data collection. These are survey questionnaire, key informant interview and case study by taking the selected projects. Data gathered from site survey, observations and questionnaires. After analyzing all collected information, conclusions and recommendations are suggested based on the findings.

3.2.3 Types and Sources of Data

The data provided from both primary and secondary sources. The research of the pattern and general conditions under inquiry was made possible via field observation. In general, the sources of data for the desired study are as follows. Officials from different levels of government, including planning and monitoring organizations, will be data and information sources. Individuals such as plan violators, informal/illegal holders, and local elders/historians are interviewed and discussed as sources of data and knowledge.

a) Primary data

These data are gathered from primary sources such as open-ended and closed-ended surveys, structured/semi structured interviews, field observation, interviews with nearby neighbors, and municipal authorities regarding the settlement and affects of garbage along a riverside development.

b) Secondary data

Secondary data is gathered from a variety of secondary data sources, including municipal or Kebele report records, numerous registries and publications (such as books, journals, research reports and papers, magazines), and more. It is mostly gathered from the municipality of Ambo. We obtain secondary data from Ambo municipality offices, environmental protection and quality office.

3.2.4 Methods of Data Collection

Data was collected utilizing checklists that had been pre-tested before going out into the field. The majority of the information gathered for this study was qualitative. Waste collection stations, where various solid and liquid objects are displaced to it, and waste handling sites along the river's side that were not supposed to be dumping sites, were also employed as sample units to collect qualitative data.

Supporting data gathered from household heads in the research region, as well as pictures and map digitalization. The quantitative data was collected by enumerators utilizing a scheduled interview schedule. The information gathered from secondary sources, as well as a qualitative and quantitative survey, was used to examine the data. As previously said, main data is used, whereas secondary data is used more frequently. The techniques for gathering primary data include site observation and interviews, and for gathering secondary data, the methods are obtaining recorded files from the offices, plan and implementation, and various journals, books, researchers, and related resources.

a) Interview (questionnaire)

In this data collecting strategy, the researcher communicates directly with people who live in the chosen place and have better knowledge about the research region. They are aware of the activities that have an influence on riverside projects and how to enhance them.

theresearcher employ Interviews are used to gather a richer source of information or data from a small group of individuals regarding the site's benefits and drawbacks, as well as their feelings about it.

b) Questionnaire

Using a comparable questionnaire for respondents in the selected sample, the questions were first written in English and then translated into Afaan Oromo and Amharic throughout the surveys.

Questionnaires were utilized to collect both qualitative and quantitative data from respondents, such as detailed information and data on their living conditions, housing type, site amenities, and feelings about living on the site.

c) Site observation

Most significantly, for site design, it is required to guarantee that people would perceive the location as a suitable environment for their activities. This entails exploiting current place features and understanding their importance in how people perceive place in part, and constructing new places with new characteristics in part. As a result, a field expedition was organized to gather physical information about the operation of the spaces and how the general public uses them in terms of various activities.

3.2.5 Sampling Technique

The study location was chosen because it receives direct positive and negative impact from the river. In addition, the area has more people living areas and economic activity, resulting in informal settlement and river pollution. Furthermore, the location is located in the city's central district, which has direct positive and negative impact on the local population. It requires a proper solution that provide some benefit to the city community. The researcher employ stratified sampling methods. Because stratified sampling divides a population into sub populations that may differ significantly it helps to make more exact conclusions by ensuring that each subgroup in the sample is appropriately represented. Stratified sampling provides with significant advantages, such as ensuring sample diversity and allowing for a wide range of data.

Due to time restrictions, the researcher randomly selected 52 homes from two distinct kebeles by counting the number of households residing there and using the population's average. These 52 households made up by random sample. but the result are accurate and encompass the entire study region.

3.2.6 Method of data analysis

Excel was used to calculate quantitative data, graphs, Word was used to describe qualitative data, document preparation, and Illustrator, GIS was used to generate the location map, land use land cover, and so on, and AutoCAD was used to make the 2D design drawings.

Study Variable

Table 3 Study variables

NO	Variables	Types of variables	Measuring techniques
1	Gender	Independent	Descriptive statistics graphs were used
2	Level of educations		
3	Marital status		
4	Built-up area	Dependent	Quantitative statistics were done by software tools
5	Waste disposal site		
6	Land use		
7	Buffer zone		
8	Negative river effect		

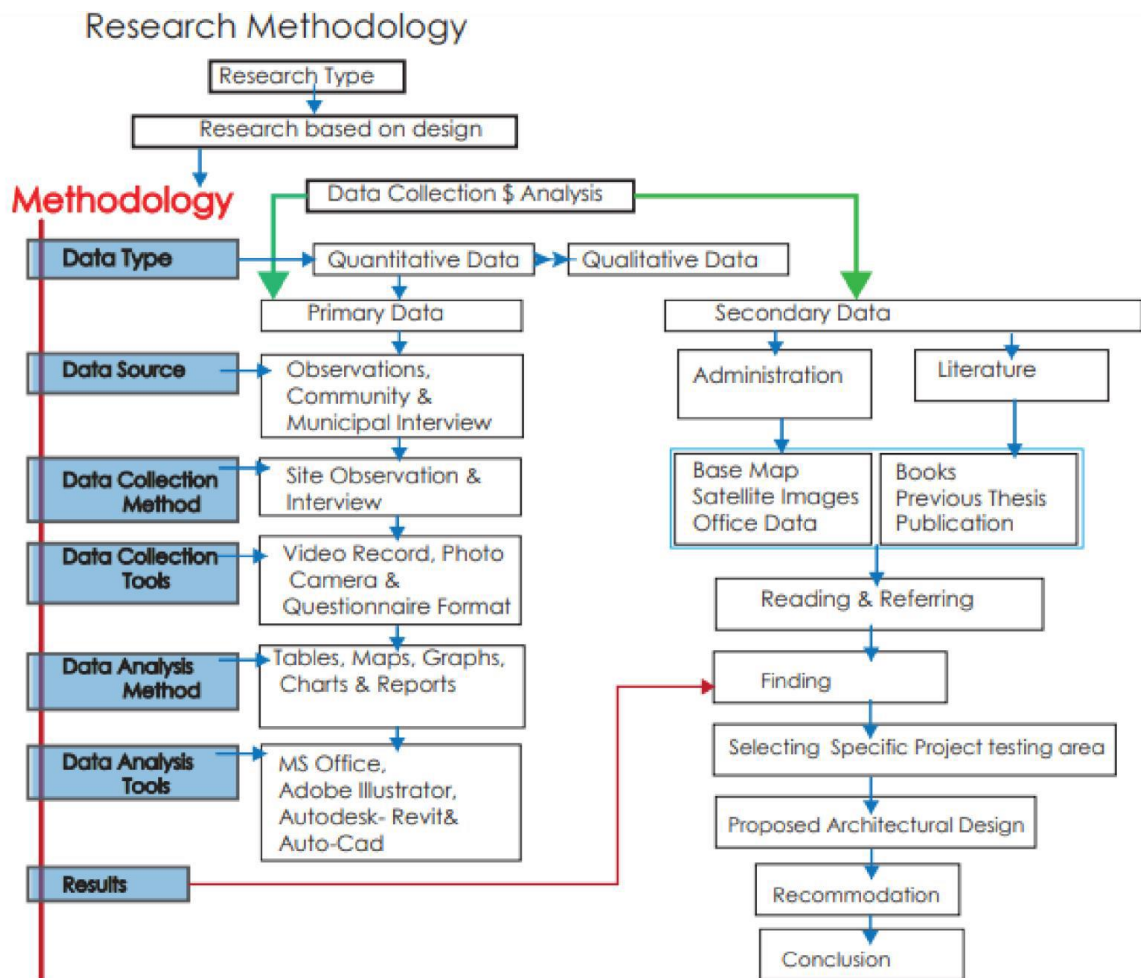


Figure 6 research methodology

3.2.7 Ethical Consideration

It is very critical to understand the basics of ethical research and how it might affect the research project. The researcher is well inattention and take care of all ethical issues that may inadvertently harm the participants in some unintended way during interaction with them and some of these issues are included as follow:

- Psychological Harm
- Financial Harm
- Social Harm

I use university letters for various authorities such as the administration office and when I investigate on the site for security guards and residents.

CHAPTER FOUR

4. Result and Discussions

4.1 The Status of Huluka Riverside's Environmental Condition

This section deals with an investigation of the existing condition in currently information of selected areas on Huluka River in the central part of Ambo town. The selected areas cover the largest part of the city. Change is used to imply the different stages that existed in the urban development process and the actions that the different actors have taken to shape each of the stages with in different times. It is done by the analysis of elements of the built-up urban environment, which are of theoretical importance in the investigation of urban transformation.

4.1.1 Infrastructures Development Implication on the Well Being of Huluka River

a) Road Analysis

The research attempts to examine the current state of road conditions, such as road network, road layout, and street amenities, in this section of the analysis. and assess its influence on the present riverside community and future riverside growth.

Road Network: The study area consist different types of road network types such as AS (Arterial Street), CS (Collector Street), LS (Local Street) and pedestrian. I classify them depend on their dimension for AS (Arterial Street) is 14-25m, CS (Collector Street) is 12 and for LS (Collector Street) 8m.



Figure 7 Existing road network of the area

Road Pattern

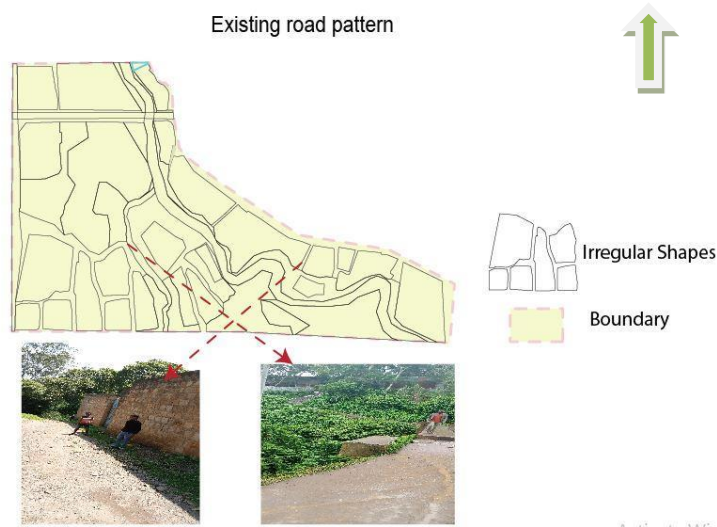


Figure 8 Existing street pattern

Street Section

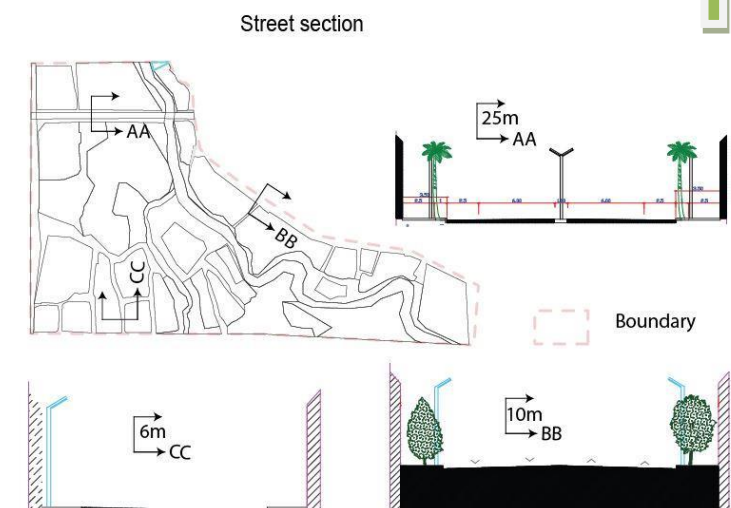


Figure 9 Existing street section

The width of the road is not regulated, and varied road sides exist on the same sorts of roadways. Rather than its vastness, the route has major issues such as poor street condition, limited accessibility, heavy traffic congestion, and a lack of sufficient pedestrian bridges and facilities.

The present road plan has been more dominated by irregular forms, which is not conducive to traffic accessibility. The roadways' irregularity causes heavy traffic congestion and negative space.

Major Arterial: It is 14-25 meters wide and has only automotive, pedestrian, vegetation, and construction zones. Have the capacity to pass two automobiles traveling in opposing directions, even Bajaj taxis. A crowded pedestrian promenade with street sellers. There are no bike lanes. There is no waste pipe connected to the septic tank that is adequate. Asphalt is used in the construction industry. There is no public traffic lighting or signs, and no parking is available.



Figure 10Major arterial

Minor Arterial: The route is 8..10 meters wide, and it can accommodate one car, including Bajaj cabs. There are no pedestrian walkways, bike lanes, proper garbage lines, street signs, active street lighting, or trees or greenery on the road. Due to the concentration of informal markets, the road is quite small. Does not take into account the handicapped. Cobblestone is a type of building material.

Collector Street: It has 5-6 meters broad. Capable of simultaneously overtaking two Bajaj and one car. There are no pedestrian walkways, bike paths, garbage lines, active street lights, or landscaping. The material for the road is cobblestone and gravel.



Figure 11 Minor arterial & Collector Street

Street Amenities

Lighting

It has a distance of 20-30 meters between them and a height of 4 meters. It is equipped with a one-way lighting system. It is Inactive and not spread around the site. On the arterial route, use a high-pressure sodium lamp, and on certain collector and minor streets, use a florescent.



Figure 12 Lighting system on the site

Trees

At a distance of ten meters, trees may be spotted. The remaining trees are unprotected and prone to garbage, and they can only be found on the site's main road.



Figure 13 existing condition of Trees on the site

Pedestrian walk

Only on main roads with a maximum width of 3m is there a pedestrian walk way. It has a narrow pedestrian path and does not accommodate cycling or people with disabilities.



Figure 14 pedestrian walk on the site

Parking.

On the roadways, there are no suitable parking spaces. Cars park on the side of the major thoroughfare, narrowing it.



Figure 15 way of parking on the road side

b) Housing

Residential: The majority of the houses are g+0. Slum housing is prevalent across the site, with over mass housing in one block. There is no open space or opportunities for social interaction, no children's play spaces, and no properly placed flora. Tin, mud, and wood are among the construction materials used.



Figure 16 residential types on the site

Commercial: The majority of structures are G+0, G+1, and G+2 structures. They are not evenly placed along the arterial roadway and the market areas. There are similar commercials in one location. The building materials include tin, mud, and wood, and there is no open market. The majority of marketplaces are informal, resulting in a poor market system.



Figure 17 commercial buildings type

c) Wastage disposal

Located on the side of road and Not proper disposal system.



Figure 18 existing condition of Wastage disposal

d) Implications of Infrastructures Development around Huluka River

The existing road pattern has become increasingly irregular, which is not sustainable for traffic accessibility and may have a negative influence on riverside activities.

Undefined road dimensions cause severe traffic congestion on the site, resulting in crowding and inefficient use of the buffer zone.

Because of the weak lighting infrastructure on the site, it is unsafe to exploit the site's benefits, and light has a significant advantage in many activities such as trading.

The lack of proper or informal commerce operations and informal settlement around the property is the main cause for creating a narrow pedestrian walkway and limited parking space. It also has a direct impact on major road congestion and crowding.

Tin, mud, and wood are the most commonly utilized building materials. Mud is the most commonly used building material, and it has its own set of benefits, including low cost, high fire resistance, good temperature insulation, good sound insulation, and the fact that it is a readily available natural resource. Muds, on the other hand, have disadvantages in terms of construction, such as being quickly destroyed by wind, rain, and water if not properly protected. When it's first finished, it could have a musty odor.

Land use: From the total area the study area was highly dominated by informal settlements they use the surrounding for residential site. They have no highly developed accessibility. On the main road the study area was characterized by commerce and mixed use.

Secondly the area was highly characterized and dominated by open spaces which along river side and others where those inhabitants discharge a waste to it.

Existing Land Use Map

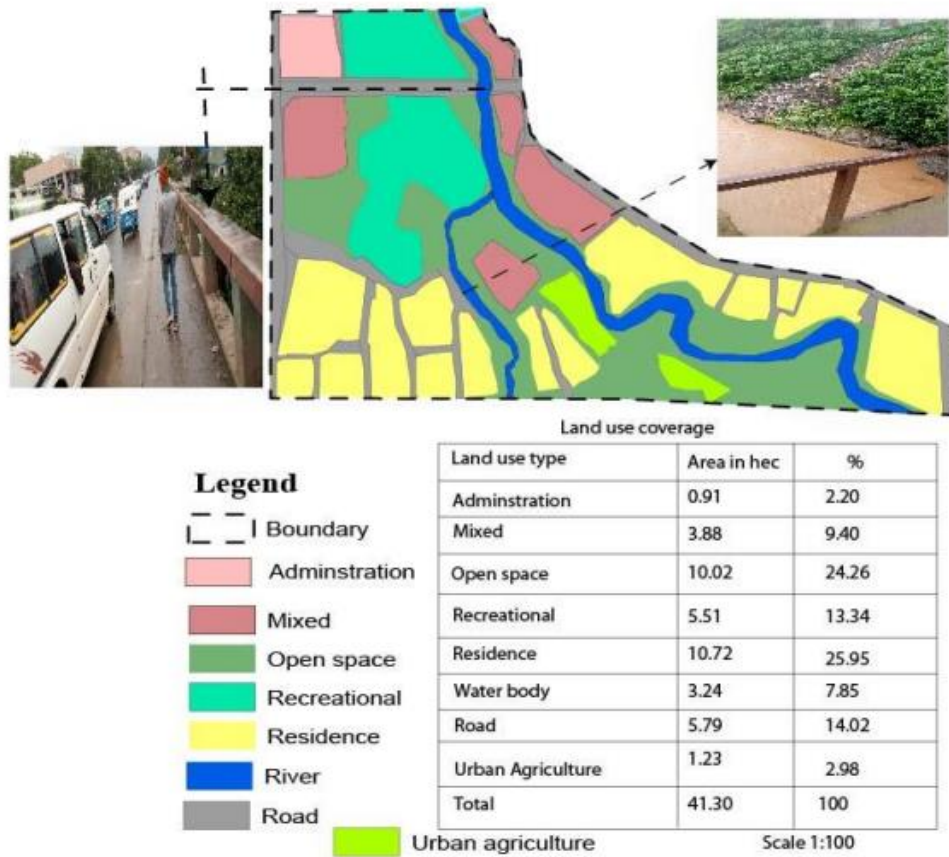


Figure 19 Land use map

There is a lack of connectivity and accessibility across neighborhoods. Unstandardized usage of the region, such as a road or a playground, incompatibility of land use, such as waste along a river's edge, constructions along a river's edge, and irregular block forms. There is an inadequate trash disposal location. There is a growth of informal trade and street accessibility is limited. In addition, there is no buffer zone and no street facilities or components.

Figure ground: In study about the top views of structures and to decide the activity done on the area and to know how is the open space look like.



Figure 20 Figure ground map

It is characterized by detached and some of attached building as well as there is large areas of open spaces which are un built up. It use to determine what function of the space was giving currently through observation. From this the built up area of the site contains 18% and un built up area covers 82%.

There is a lack of regard for the buffer zone established by rules and regulations. Low-cost land development is required. Accessibility requires a long distance.

Slope analysis: The study area contains flat, gentle, hilly, steep and moderate. However, the area highly dominated by steep slope which covers 27% part of the study area.

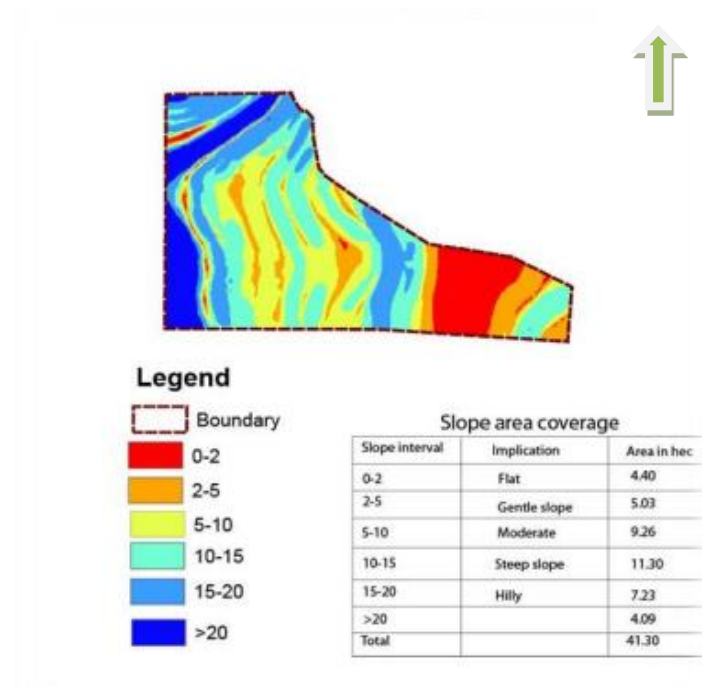


Figure 21 Slope analysis of study area

Table 4 Slope analysis of study area

n o	Slope interval	Area in hec	%	Existing situation	Suitability
1	0-2	4.40	10.65	Mixed use, Un built up, mid density residential site, ecology along river side, informal settlement	Suitable for urban agriculture
2	2-5	5.04	12.20	Mid residential density	Suitable for large scale developments such as sport fields, educational
3	5-10	9.26	22.42	Residential house, informal settlements	Suitable for low and mid density residential
4	10-15	11.30	27.37	Informal settlement	Suitable for low density residential and terrace houses with strict regulation and control
5	15-20	7.21	17.46	Hotels, low density residential	Suitable for areas terrace houses and resort hotels could be developed with low built up ratio
6	>20	4.09	9.90	Commerce, Administration, Service, low residential density	Suitable for areas terrace houses and resort hotels could be developed with low built up ratio
7	Total	41.30	100		

The property features a variety of slop kinds, each with its own set of benefits and drawbacks for riverside construction. In the current circumstances, many websites do not provide any functionality due to a lack of concern. However, during the revers side development stage, it can provide a variety of favorable functions, as shown in Table 4.

4.1.2 Buffer Zone of Huluka River and Their Environmental Function

a) Existing 15 Meter Buffer Zone

The buffer distance in Ambo is 15 meters. Because of the sloppy character of the region, most of the structures retain a set buffer distance. When the researcher analyzes the built up area based on buffer distance. However, certain structures are constructed without regard for the buffer distance, and some areas are exploited for trash dumping, which is the primary cause of river contamination.

Informal settlements in and around river buffers, as well as their influence on the river, are characterized as residential areas that have grown up without a legal claim to the land and/or authorization to build from authorities. Squatter communities suffer from limited infrastructure and service as a result of their unlawful or semi-legal land ownership status. In most circumstances, squatters are classified as low-income individuals. Squatters' actions, on the other hand, have a detrimental impact on the health of the river they live near. Defecation, the disposal of home solid waste, and the release of animal waste are only a few of the activities that pollute rivers.

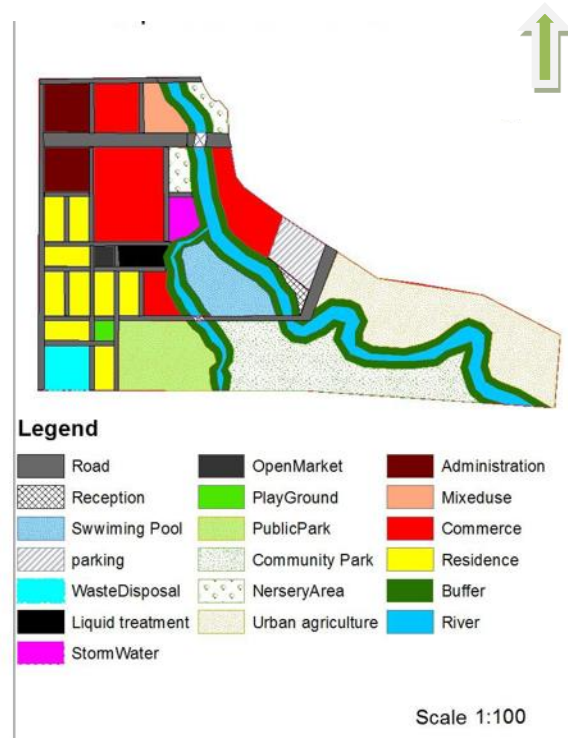


Figure 22 Buffer Zone of Huluka River

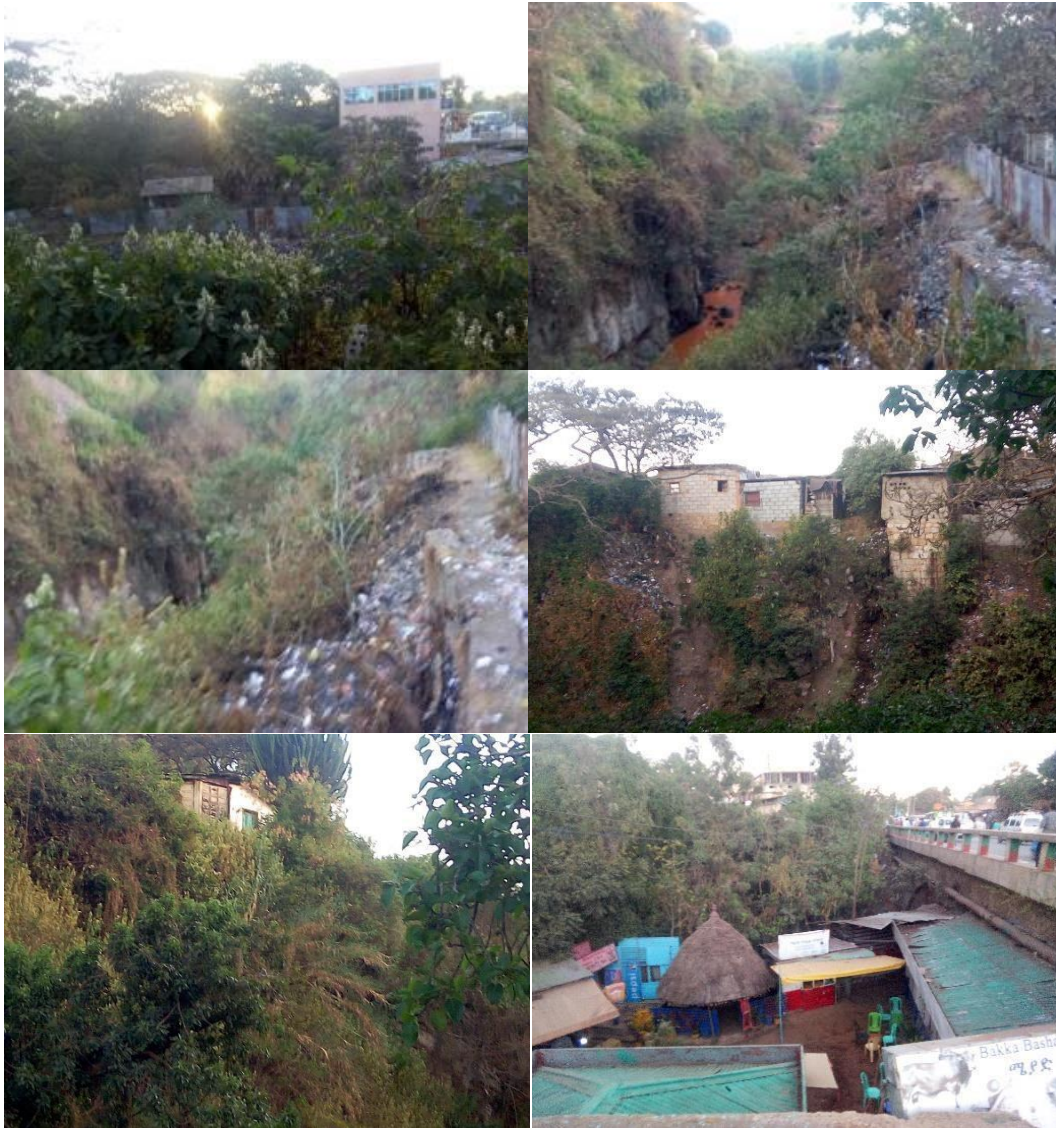


Figure 23 some settlement on the buffer zone

Buffer zones, they have ecological or cultural value; act as an additional layer of protection for the natural environment by preventing the effects of unfavorable environmental or human influences.

However, some informal settlements around the Huluka River are more concerned with their daily income than with the site's environmental benefits. Their activities have a direct influence on the river, despite the fact that they live in a flood-prone area.

The 15-meter buffer distance along the Huluka River, Local environmental conditions were not adequately considered. This is what happens when zones are selected without enough biodiversity data. New agricultural or forestry species that are not suited to the river's benefits and the climatic circumstances of Ambo city are not brought into the buffer zone. The buffer zones role in respect to individual species was not considered. This is especially true with broad-based. Due to special efforts in the buffer zone, there is a risk of species extinction in economic development zones or commercial plantations.

Nature protection goals frequently clashed with new development projects around the site, placing a burden on buffer zone development. Many considerations go into finding the perfect balance between the two. A focus on conservation may result in too many limitations on the buffer zone's use.

In the event of a researcher's oral interview, the majority of respondents have no understanding what a buffer zone is. The buffer zones goals did not match the expectations of the local population. The local population will have to agree on the objectives linked to the development of a buffer zone. The method will fail if the aims do not align with, or even contradict, the people's desires. When buffer zones are created, individuals often exaggerate the buffer zones socioeconomic benefits and advantages for no good reason. This may cause frustration among people, particularly natural resource consumers, in the future.

It will be necessary to assess the added value of a buffer zone before discussing the possibility and/or need for the creation of another one. Is a buffer zone required to better maintain or safeguard the conservation area's value, or is it required to obtain support from the surrounding community, resulting in greater respect for the conservation area's values?

b) Analyzing Other Buffer Distance

The 15-meter buffer distance along the Huluka River is primarily intended to protect people from flooding, but in order to maximize the river's benefits and create a sustainable environmental area, the researcher believes that other alternative buffer distances of 30 and 100 meters should be investigated.

The ideal buffer zone size varies based on the goals, land availability, conventional land use patterns, hazards, and opportunities. Better for the conservation area and its biodiversity, this includes natural processes.

When the buffer distance is increased Buffers or green ways with trails can create economic advantages by increasing property values, attracting tourists, and lowering public costs. Property values can be boosted by green-ways. Green-ways with appealing aesthetics and recreational activities are associated with greater property prices, which in not applicable in Ambo city.

A large buffer zone distance give the advantages of Windbreaks benefit agricultural yields by minimizing erosion, increasing microclimate, preserving moisture, and preventing crop damage from strong winds since they have a big buffer zone distance. Buffers can help with foraging and pollination efficiency by reducing wind. Buffers may supply crop pollinators with a variety of resources, including shade, nesting areas, water, nectar and pollen, and pesticide protection.

on the research site with a 15 meter buffer Some of these aesthetic aspects are undesirable in the pursuit of objectives such as water quality and animal habitat. the buffer distance is increased Naturalistic landscapes with important ecological services are frequently regarded as messy and unattractive, whereas groomed landscapes with limited ecological functions are seen as exhibiting stewardship and are visually appealing.

4.2 Existing Riverside Settlement Condition and Shelter Construction Materials

A questionnaire was the main tool used in this study; it included a demographic section that asked participants to disclose their age, gender, and reason for visit Huluka River. The questionnaire had six sections: Respondent's Characteristics, Respondents Integration with the Site, housing type and decision to live on the site, housing construction material and their selection criteria, facilitates on the site and peoples feeling for the site, behaviors and activities around the site. The research activity did not interact with the people's activity and personal interest. The survey questionnaires were randomized and. I obtained the peoples permission prior to asking him/her to complete the survey.

4.2.1 Respondents Social and Demographic Characteristics

Table 5 Respondent's Characteristics

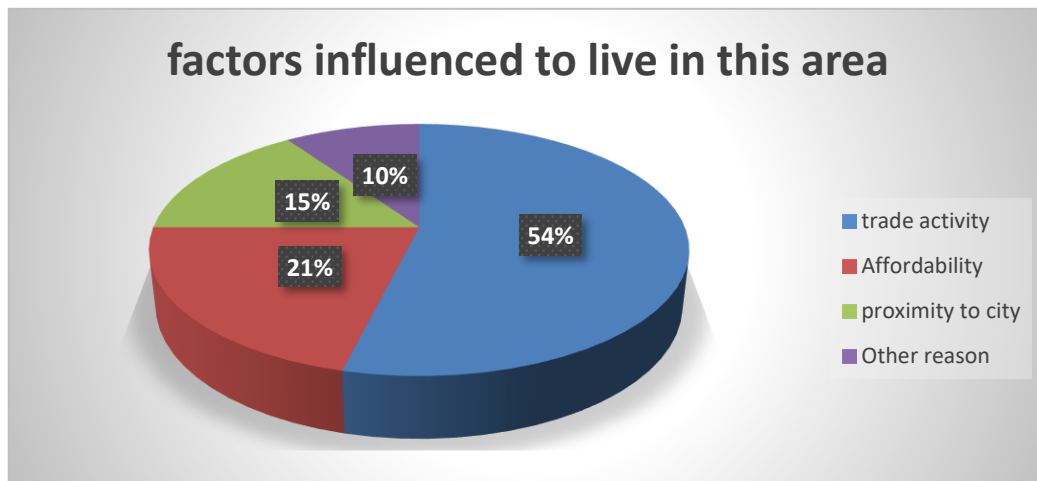
Characteristics	Frequency	Percentage
Age		
<20	6	11
20-30	13	25
30-40	11	21
40-50	17	33
>50	5	10
Sex		
Male	31	57
Female	23	43
Education		
Uneducated	9	17
School level	32	62
Graduated	11	21
Marital Status		
Single	19	36
married	30	58
divorced	3	6

4.2.2 Housing Type, Function and Tenure

This question was used to investigate the variables that impact people's decision to reside in this region and how they get this property. It was also used to investigate the housing kinds and functions of the dwellings discovered on the site.

Table 6 factors influenced to live in the area

Factors influenced Peoples decision to live in this area	Trade activity	Affordability	proximity to city	Other reason	TOTAL
	28	11	8	5	52
people's possession of this property	purchase	rental/ kebele	family house	built it	
	27	10	6	9	52
House type	detached	semi-detached	terraced	shack	
	8	41	0	3	52
Function of the house	residential	working	both	Other	
	20	12	12	8	52

a) Factors influenced to live in this area**Figure 24** Factors influenced to live in this area

Person can be influenced by a variety of factors to live in a specific region depending on their interests and the benefits of the site, which allows them to go in a variety of ways. Most people in the study region reside around the Huluka River for four primary reasons. The main reason for living here is trade activities, which provide them with a lot of economic opportunities. The individuals that reside near the Huluka River do so for a variety of reasons, including affordability and proximity to the location.

b) Possession of this property

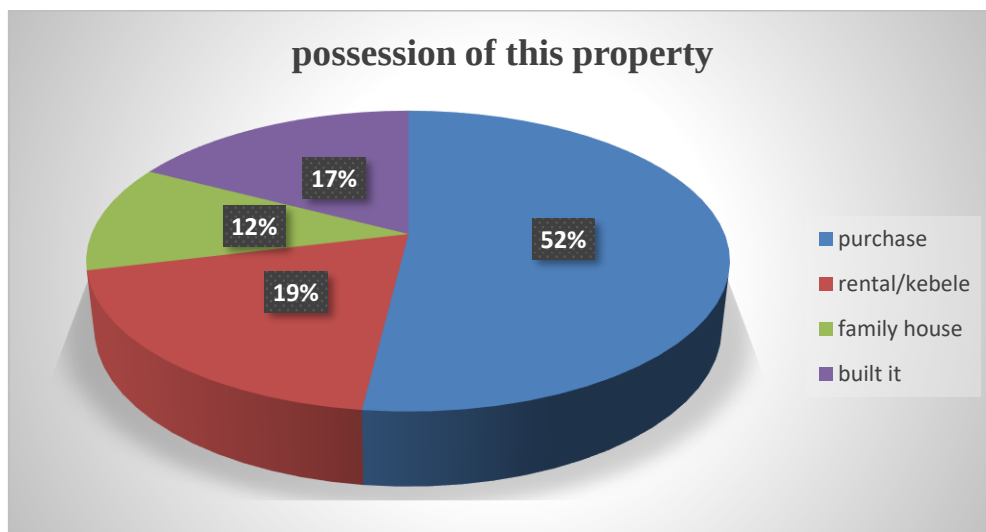


Figure 25 possession of this property

The majority of people buy their location since it is in the heart of the city and has a lot of business activity. And other individuals rent houses for their commercial activities since the site is located on the city's major road and was formerly the city's main bus terminal; to take use of the site's benefits, around seventy one percent of people purchase and rent the space.

c) Housing type on the site

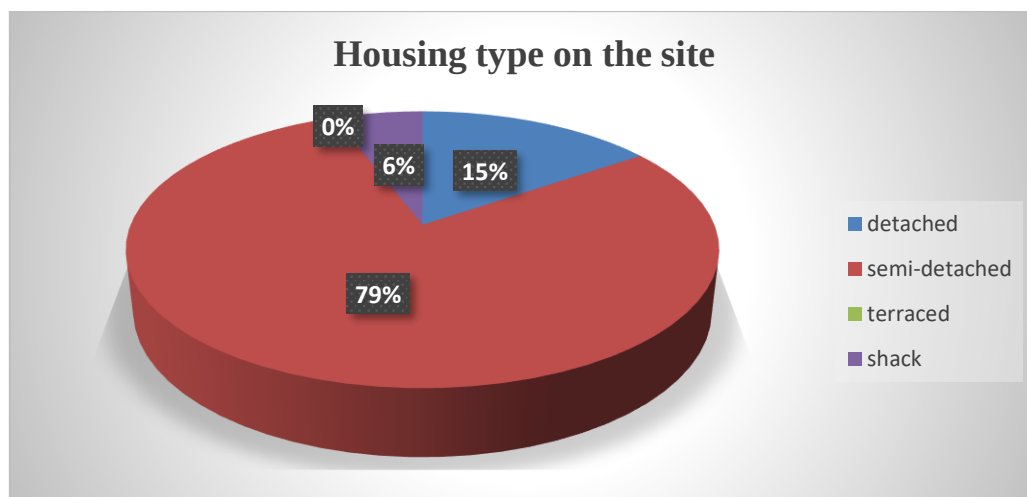


Figure 26 housing type on the site

Most of housing type in semi and non detached which takes seventy nine percent of total area. Detached houses are free-standing buildings, also called single-family houses. They usually are provided with a garden but its size may vary. Semi-detached houses are connected to other separate houses only by one wall.

d) Function of the house

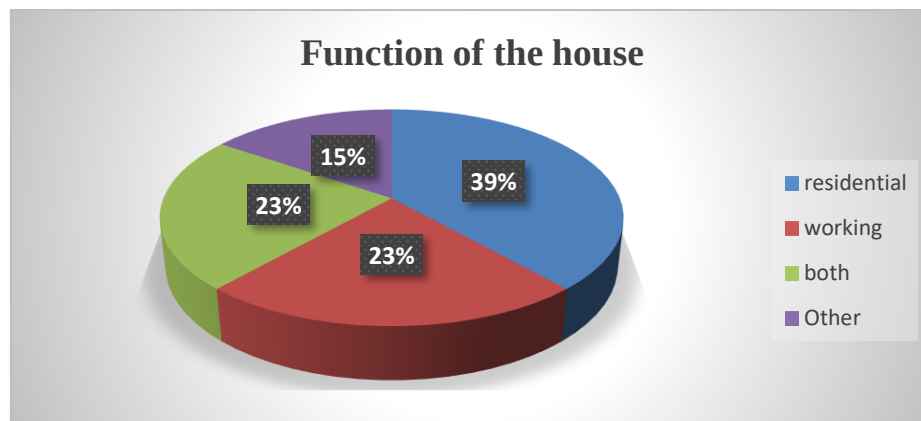


Figure 27 function of the house

They utilize the houses for both residential and working purposes, and some people use them for both purposes. Forty six percent of people use their homes for both commercial and residential purposes, but the majority of these homes construct commercial areas with unsafe temporary building materials that are used in prohibited areas, and the building materials have limited capacity to withstand natural disasters such as floods and other man-made disasters.

4.2.3 Housing Construction Material

The purpose of study is to analyze the ability of building materials that people use to regulate weather conditions on the site and capacity to manage man-made and natural risks is analyzed using the house's construction materials. Because the majority of the houses on the property are in an informal settlement and are located directly on the river's edge, they are vulnerable to flooding.

Table 7 The house's construction materials

The house's construction materials					
Walls	stone/concrete	Mud	plastic/wood	other	TOTAL
	8	37	4	3	52
flooring	stone	concrete	mud	other	
	9	12	26	5	52
Roofing	corrugated iron	plastic	other		
	41	7	4		
Choice of material:	cheaper	available	affordable	other	
	29	15	8	0	52

a) Walls materials

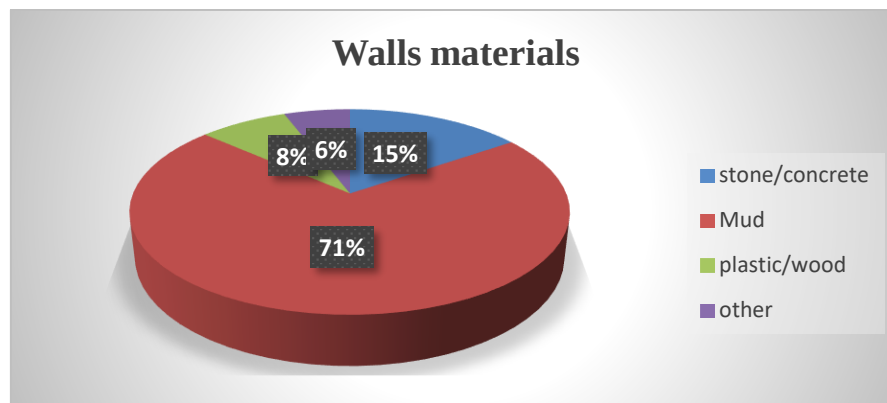


Figure 28 wall construction material of the house

Mud is used as a wall building material in the majority of the seventy one percent of houses located on the site. Mud as a construction material has a number of advantages, including low cost, strong fire resistance, good temperature insulation, good sound-proofing, and the fact that it is a widely available natural resource.

Muds, on the other hand, have drawbacks in terms of building, such as if not properly protected, they can be easily destroyed by wind, rain, and flooding. It may also have a musty odor when it is initially completed.

b) Flooring materials

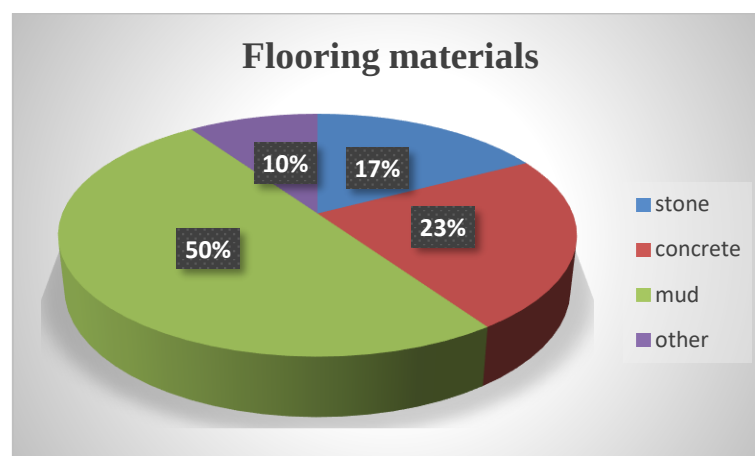


Figure 29 flooring construction materials

Fifty percent of individuals utilize mud as a floor finish material, and the primary reason for this is expense. Muds, on the other hand, have a variety of benefits and drawbacks. The biggest benefit of mud flooring is that it is environmentally friendly.

When compared to PVC or any other sort of flooring, mud flooring is a relatively affordable alternative. Mud flooring poses no health risks, however PVC flooring releases a high level of volatile organic compound (VOC), which is harmful to one's health. Mud flooring has the capacity to regulate temperature changes. During the summer, it is cool, while during the winter, it is cold. It has the ability to create a warm environment. In comparison to PVC flooring, it is fire resistant. Mud flooring does not necessitate the use of skilled labor.

But also it has disadvantages. It is not as long-lasting as PVC flooring. Mud flooring needs weekly or bi-weekly upkeep. When compared to PVC flooring, the surface of mud flooring is not as smooth. Walking, moving furniture, and other activities cause mud floors to deteriorate. Because it is not moisture resistant, there is a risk of bacteria growth, which is unsanitary. It cannot withstand big loads since the floor would dent. Mud flooring has a low stain resistance due to its high porosity.

c) Roofing material

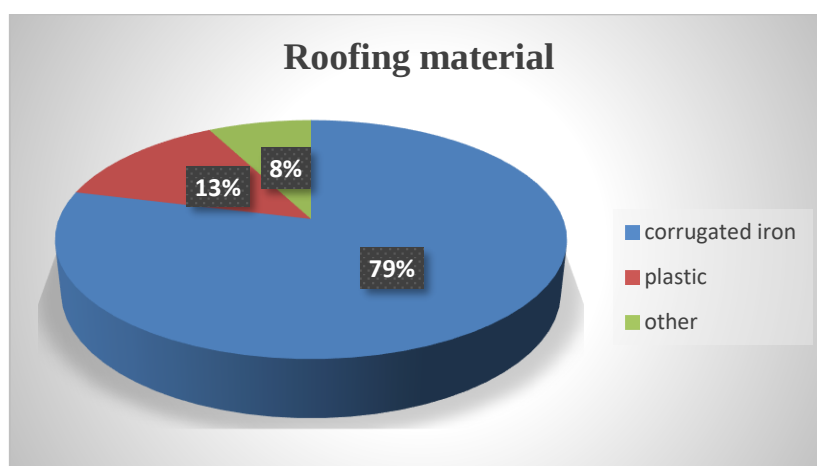


Figure 30 roofing construction materials of the house

Corrugated iron sheet is used by seventy nine percent of people as a roofing material. It provides a variety of benefits, including durability and longevity, ease of installation, heat management, fire resistance, low maintenance costs, and higher resale value. However, some individuals utilize plastic as a roofing material, particularly in outdoor business operations, because of disadvantages such as cost of replacement and cost of installation. The cost of plastic roofing sheets is cheaper than the cost of metal roofing sheets. Roofing sheets have certain drawbacks, such as the ability to corrode fast. The installation procedure is simple.

d) Reason of material Choice

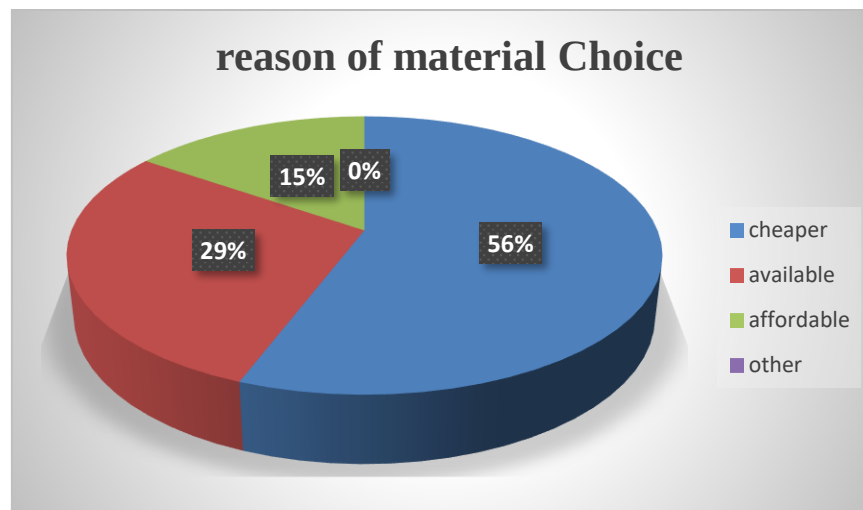


Figure 31 reason of selecting building materials

4.3 Riverside Environment and the Inhabitants' Interaction

4.3.1 Respondents Duration of Living in the Site and Frequency of Visiting Huluka River

This question was chosen to gain a direct influence of the river on the population because they have lived in the region for a long time and know everything there is to know about the river.

Table 8 Duration of respondents residing in study area

Duration of respondents residing in study area	Frequency	Percentage
0-5	4	8
5-10	9	17
15-20	17	33
>20	22	42
Total	52	100

Four respondents residing there who relocated from rural regions were among the few respondents i surveyed who are living there between the ages of zero and five. Following that, eight respondents have lived there for five to ten years, and twelve have lived there for fifteen to twenty years. The bulk of the respondents had lived in Ambo town for more than twenty years, with seventeen respondents having lived there for more than twenty years.

The following question was used to assess the site's ability to serve as a city center for various reasons such as commercial and recreational.

Table 9 Time it takes to Reach Huluka Riversides

Time it takes to Reach Hulluka Riversides	Frequency	Percentage
1-5 minute	23	44
5-10 minute	15	29
10-20 minute	10	19
>20 minute	4	8
Total	52	100

It reveals that 44% respondents take one minute to five minutes to reach Huluka River, twenty nine percent of respondents take five to ten minutes, and the remaining nineteen respondents take ten to twenty minutes. There is four people who takes more than twenty minutes to get to the river. As a result, the majority of respondents live in close proximity to the Huluka riverfront for various reasons. The majority of travelers choose the shortest route to the riverside, with seventy three percent arriving in less than ten minutes. Because most people can reach the location in a short amount of time, this may be used as an advantage to build various amenities along the river. This question was used to assess people's desire to visit the site due to its much functionality.

Table 10 the Frequency to Visit Huluka River

The Frequency to Visit Huluka River	Frequency	Percentage
5 times	10	19
10 times	21	40
Many times	16	31
I do no/ not sure	5	10
Total	52	100

What is the regularity with which they visit the riverside for various reasons? Ten respondents claimed that they visited five times; twenty one respondents stated that they visited ten times, and sixteen respondents stated that they visited numerous times, while five respondents stated that they did not know how many times they visited. The essential facilities should be well stocked to increase the frequency of visits to the Huluka riverside.

4.3.2 Facilities on the Site and Respondents Perception

This question was used to obtain direct information on the accessibility of a waste disposal site, a location to wash their facilities, people's desire to change their living and working spaces, and their feelings about living on the site in terms of safety and happiness.

After analyzing, the researcher attempted to determine the primary cause of the negative and positive impact of the based on garbage disposal site and water availability, because some Ethiopians use river as a cleaning material and waste disposal due to the lack of having a proper waste disposal site and clean water.

Table 11 facilitates on the site and peoples feeling for the site

				TOTAL
Garbage disposal location for solid waste.	YES		NO	
	Private (if Yes)	Communal (if Yes)		
	11	26	15	52
Availability of clean water	YES		NO	
	Private (if Yes)	Communal (if Yes)		
	31	6	15	52
Place to wash facilities.	YES		NO	
	Private (if Yes)	Communal (if Yes)		
	36		16	52
Modification of the house from its original state.	YES	NO		
	28	24		52
Peoples feeling on the Settlement.	safe / happy	safe/ unhappy		
	8	19		
	Unsafe / happy	Unsafe/ unhappy		
	11	14		52

a) Garbage disposal location

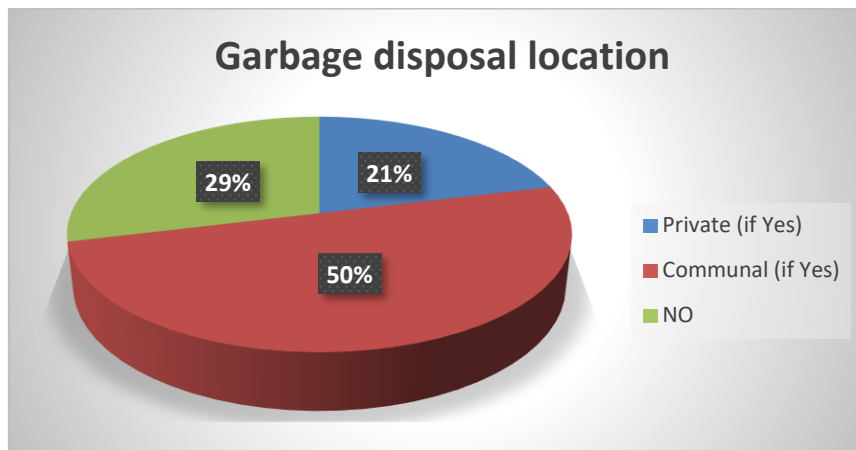


Figure 32 garbage disposal location

Only twenty one percent of individuals have their own private garbage disposal place, while fifty percent of people utilize a community garbage disposal site and twenty nine percent have no garbage disposal space at all. They don't have the competence to control all disposals at the Ambo City municipal rubbish disposal facility. Because of the capacity of community waste disposal and the availability of waste disposal sites, most people improperly dispose of their waste and utilize the river as a waste disposal site, which is the primary cause of Huluka river pollution. River pollution has a variety of consequences, including harming people's health through exposure, contaminating the ecosystem, and poisoning animals.

b) availability of clean water

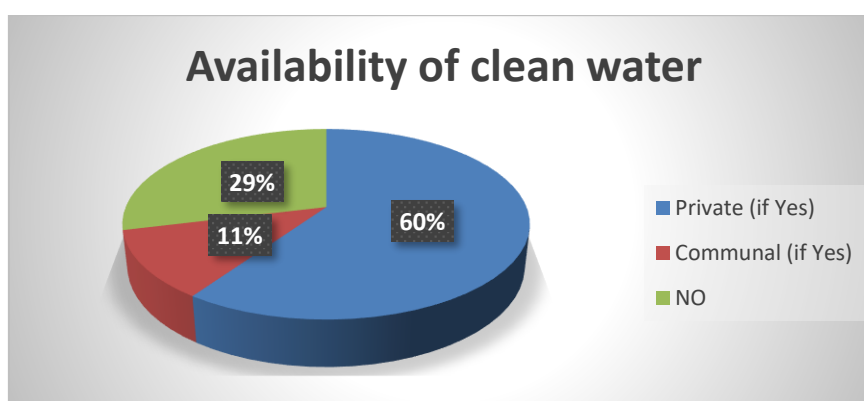


Figure 33 availability of clean water

The site's greatest asset is its proximity to the river, but most residents are experiencing water shortages due to a lack of clean water. They clean themselves with dirty river water. The majority of people have their own place to wash their clothes, but about 40% of people wash their clothes in a polluted river

Water is a need for every life on the planet. When a water supply gets contaminated as a result of pollution, it can cause human health problems such as cancer and cardiovascular disease. Bacteria that cause diarrhea, cholera, dysentery, typhoid, hepatitis A, and polio can be found in contaminated water.

Despite the fact that other youths are swimming in the dirty river. Rashes, pink eye, respiratory infections, and hepatitis can all be caused by swimming in polluted water.

c) Modification from its original state

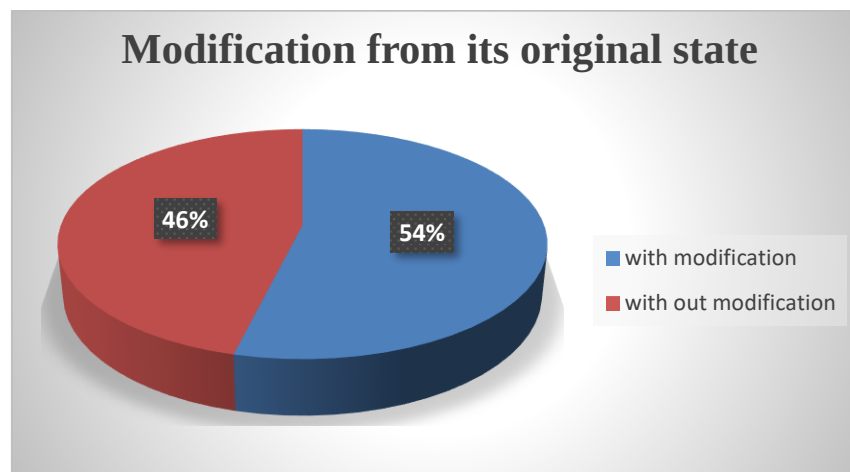


Figure 34 modification from its original state

More than half of individuals attempt to change their living and working environments, yet they are not satisfied. Around forty six percent of individuals remain in the same area for a long time without making any major changes.

Cleaning, orderliness, and upkeep are all aspects of housekeeping. Housekeeping is an important part of workplace safety since it helps to avoid accidents and lessen the severity/consequences of those that do occur.

People who live in inadequate housing are at danger of being exposed to a variety of health risks. As a result, substandard housing may contribute to or cause a variety of avoidable accidents and illnesses, including respiratory, nervous system, and cardiovascular problems, as well as cancer.

d) Feeling on the settlement

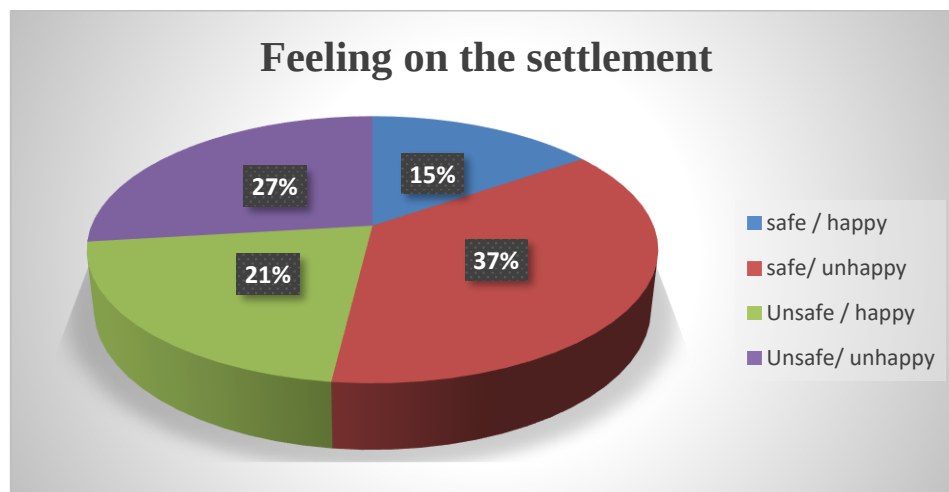


Figure 35 peoples feeling on the settlement

Peoples have their own different feeling on their settlement around the river. Most people's have safe condition with un happy condition because of their location is more safe but there is some polluted areas around the river which can create disease. Also around sixty six percent peoples have unsafe place with unhappy condition around the site because the location have the big advantage to floods and polluted river side but they agree to this un safe place to some economic activities. Only fifteen percent peoples have good feeling to live and work on this site. Most people add some modification to create business activities and to build rental house foe increasing their income.

4.3.3 Characteristics and Major Activities Provided On the Site

a) The Dominant Pollutant of Huluka River

Table 12 Dominant Pollutant of Huluka River

	Frequency	Percentage
Solid waste	34	65
Liquid wastes	18	35
Total	52	100

According to the respondents, solid garbage pollutes the river in greater quantities than liquid waste. As seen above, sixty five percent of respondents believe that solid garbage generated by households and hotels is more plentiful than liquid waste. Because most of the sites do not have their own waste disposal space, most individuals utilize the river to dispose of their waste, resulting in direct river contamination

b) The cause of Huluka river water pollution

Table 13 cause of Huluka river pollution

Cause Water Pollution	Population	Percentage
Waste Discharged From Hotels	18	35
Domestic Waste	24	46
Human excreta	6	11
other	4	8
Total	52	100

The Huluka River is largely contaminated by residential trash, according to the gathered data. According to the statistics, forty six percent of the respondents said it is polluted by both liquid and rubbish discarded by families. And thirty five of people believe the Huluka River is polluted by trash discharged from hotels, while the remaining eleven percent believes it is poisoned by excreta. As a result of these factors, the study area loses its aesthetic and economic worth.

c) Function of Huluka River

Table 14 Function of Huluka River

Function	population	Percentage
Recreation	7	14
Washing	33	63
Agriculture	12	23
Total	52	100

Rivers have a variety of uses as a natural resource. People have a tendency to misuse their talent. The Huluka River is used as a leisure place such as swimming, washing clothes, drinking, and for agricultural purposes, according to inhabitants in stable regions who responded to the question. Because the Huluka River is Ambo City's principal river source, residents strive to collect water from it for washing, swimming, and agricultural purposes.

d) Activity around Huluka River

Table 15Activity around Huluka River

Purpose of river	population	Percentage (%)
People doing a physical exercise	3	6
irrigation	7	13
People washing cloth & swimming	37	71
Other activity	5	10
Total	52	100

According to the data gathered individuals in the vicinity of the Huluka River engaged in a variety of activities, the most common of which are swimming and washing clothes in the river. The people's responses show that the most popular activities on the Huluka River are washing clothes and swimming, with the remaining 13% claiming that the river is used for agriculture. As a result, there isn't much activity on the river right now. But Rivers offer water for agriculture, home use, power production, and industry, as well as a variety of other ecosystem services and biodiversity benefits.

e) Modern commercial center around Huluka River

Table 16 availability of modern commercial center around the site

Modern commercial center around Huluka river	Population	Percentage
Yes	11	21
No	41	79
Total	52	100

Around 80% of those people say that there is no modern business activity along the Huluka River. As a result, there has been a surge in the creation of informal commercial settlements along the river. This results in an inefficient marketing system and a disregard for the town's buffer zone, which is bound by the Huluka River. This habit has as a significant benefit in that it allows individuals to dwell in unsafe areas that are directly affected by flooding and pollution.

f) Type of Waste water System of the Respondents

Table 17 Wastewater sewerage System

Wastewater System	Population	Percentage
Common Sewerage System	26	50
Septic Tanks	11	21
Discharge Directly To River	15	29
Total	52	100

The connecting of sewers and untreated storm waters straight to the river is one of Ambo town's significant issues, particularly in waterfront districts. Direct sewage line connection prevention techniques and processes should be established. It will be desirable to establish sewage lines using the topography potential of river-side locations. The majority of respondents in the research region fifty percent use a public sewage system, twenty one use self-discharged septic tanks, and twenty nine percent discharge sewer wastes directly into the Huluka River.

As a result, the Huluka River has become severely contaminated. By washing and drinking from the contaminated river, this has a severe impact on aquatic wildlife as well as the children in the research region.

g) The Advantage of the Population Live around Huluka River

Table 18 Advantage of the Population Live around Huluka River

Advantage of the Population Live around Huluka river	Population	Percentage
With advantage	18	35
Without advantage	34	65
Total	52	100

That was said by the respondent. The Hulluka River did not provide the Ambo settlement with the promised benefit. We don't have the predicted advantage from the river, answered 65 percent. Yes, we have benefited from the Hulluka River, according to 35 % of respondents.

h) Urban Economy

The specific area is said to urban if more than 50% of the population economic activity is not dependent on Agricultural products directly. According to the town administration Finance and Economic Development Office Ambo town dwellers are engaged predominantly, Secondary economic sector (mining, industry) and Tertiary economic activities (like trade, public servant and etc) to sustain their livelihood, especially mixed economic activity (trading agricultural products), are the main economic activity in the town to sustain economic livelihood of the settlers.

i) Economic base of the town

Economic base of the town be determined by secondary economic division/ industrial and economic activities that run in the selected area. The main economic foot of the town is expected to be mainly trade. The towns' economic base is characterized by the economic activities mainly in Ambo town is Trade and trade related activities takes the largest share.



Figure 36 trade activities on the site

j) Wastes in a town

As the town growth increasing rapidly there are faced problems concerning river side development, urban agriculture and the main reason for those problems makes people to settle along the river side. Through data collected, with in highly increments of population in case of no permanently designed waste disposal site people use area along a river side for waste discharging area and there are some individuals who has their own place for discharging wastes. All of those waste comes out from residential areas are like take channel of their toilets to river, solid and liquid wastes are all discharged along a river side developments. Relating to these people highly faced with various problems like typhoid, cough, and different bacteria.



Figure 37 waste dispose on the river

4.4 Discussion and Alternative methods to transform Huluka riverside environment

This section deals with an investigation of the existing condition in currently information of selected areas on Huluka River in the central part of Ambo town. The selected area covers the main part of the city. Change is used to imply the different stages that existed in the urban development process and the actions that the different actors have taken to shape each of the stages with in different times. It is done by the analysis of elements of the built-up urban environment, which are of theoretical importance in the investigation of urban transformation. Within the case of the study area it focuses on Huluka River and its surrounding conditions which are services, residential, open spaces of the area that focuses on it.

The site characterized by developing trade activities, Informal settlement and different activities. Due to the availability river there is different transformation has overcome with it is the boundary for rural and towns it creates highly migration on its surroundings and makes the legal framework of buffer zone not to be respected. But within this condition due to lack of waste disposal site those highly settled informally and migrated population discharge wastes along a river side development arises not to use that river. Huluka River has its own potential which is not still used effectively. The study area is an underutilized which is used as waste disposal area because of this the area is contaminated and polluted area so the people around the area are suffer by bad smell. Therefore, finding an appropriate solution to solve these problems is necessary for underutilized river fronts around the Huluka River.

The contaminated and underutilized lots along the Huluka River and its tributaries in ambo town share a lot of problems with other polluted riverfront sites. Accordingly, it is advantageous to select the contaminated and underutilized riverfront site along Huluka River and its branches to provide the demonstration to other similar projects.

When the researcher go into depth about the actions that lead to informal settlement and river pollution, explain three types of polluting agents. Institutional, thematic, and riparian concerns are all addressed. Institutionally, the key polluting actors are public institutions, businesses, households, and people. Solid wastes and liquid wastes were recognized as themes, while riparian polluters were categorized as higher, medium upper, middle lower, and lower riparian pollutants.

Informal settlement, a weak solid waste management system, and the lack of a liquid waste management system are all important sources of pollution in the river's environment. Surface waterways and informal settlements suffer from substantial quality degradation due to rising human population, unregulated urbanization, and inadequate sanitary infrastructure.

Ambo's citizens are dealing with a variety of issues. For example, have a water pollution problem. If the Hulluka River is properly treated, it might be a valuable source of water for home use.

According to current activities along the Hulluka riversides, the area was previously used by residents for a variety of purposes including washing clothes, swimming, illegal slaughter, and garbage disposal, but now that the study area is in place, the community's familiarity with the river has decreased, the visual image of the area has decreased, and the river is polluting, implying that the river is missing.

The findings of the study include the absence of a recreational park, the use of negative activities along the riverbank, poor sanitation services, particularly the lack of toilets and a high incidence of toilet sharing, and the connection of sewage directly to the river, all of which cause environmental, ecological, and health issues.

According to the study, this procedure may be enhanced by assembling a team of qualified individuals and officers who must collaborate across the entire system. The following entities and official parties were included:

4.4.1 Community

The community/public is the most important included stakeholder; since they have the right to fully engage in the development process. The public should be aware of the true costs and advantages of river side development. Rivers have the potential to provide a wide range of benefits to society, including supporting key livelihood activities and economic sectors, nurturing social relations and spiritual well-being, and contributing. Everything is connected to society; society should be an active user of such an area. Paying the requisite tax based on their consumption and, if applicable, the value of providing public services and facilities. Taking the time to educate each other about environmental safety and quality should follow the advice given by municipal offices, and they must play a critical part in improving the quality of their surroundings as well as safeguarding and maintaining the ecological system.

4.4.2 Urban planner, designers and architects

When a plan serves as the basis for all actions, the urban planner must first consider how to put everything into action. The function of urban planner and designer is required by the following ways/activities to adapt to all of the challenges that have been encountered. It is feasible to achieve project success by centralizing the relationships between such items.

4.4.3 Local governance

Local governance at different levels has the responsibility to distribute resources. Allocating the necessary budget to deliver access of roads and different kinds green infrastructures of a riverside development as well as its surrounding.

The major impacts to design a riverside require the relocation of surrounding inhabitants and high requirement of cost to design a waste disposal site for liquid. Relocation of population to other places create high influence on the inhabitants who are low-income groups and difficult to create job vacancy. As well as for low income town revenue it is impossible to design liquid wastes. To avoid these drawbacks of river side redevelopment design, local governments have to manage; It is vital to move the population of the surrounding region in lawful methods while still providing necessary employment. Redevelopment project planning and execution design and rules. Participation in the maintenance and operation of environmental safety and quality in order to fulfill land use compatibility. Locating regions for suitable waste disposal site design. Developing the concept of bottom-up planning and planning with people is an important step for a local government to take.

4.4.4 Buffer Zone



Figure 38 Recommended Buffer Zone

The buffer distance in Ambo City is 15 meters, which poses a number of issues, including a lack of basic consideration of the site advantage and value of rivers to people. People's economic interests drive the majority of informal settlements, yet establishing a beautiful and clean riverside development may benefit people's economic activities. This will help to eliminate the informal settlement on the land, which contributes to the town's poor aesthetics.

It can boost a variety of other advantages, such as biological, social, economic, institutional advantages.

a) Biological benefits

Providing a filter or barrier to prevent human entry to the core zone or conservation area and unwanted use; Extra protection from storm damage, drought, erosion, and other types of harm.

b) Social benefits

Improving local people's earning potential and the quality of their surroundings; providing a reserve of animal and plant species for human use as well as restoring species, populations, and ecological processes in degraded places; Increasing local and regional support for conservation programs.

c) Economic benefits

Increased advantages from the protected area for direct users, such as tourism revenue, research permit fees from scientists, and money from locals employed in the region.

New job possibilities, changes in productivity, and the advantages of newly introduced crops or technology are all examples of revenue created in the buffer zone. Other sources of income include roadside vendors, rest stops, food and beverage enterprises, and recreational spaces. Other advantages include enhanced tourist flows (and revenue production) at the regional and national levels better access to public services, new and upgraded infrastructure, new and enhanced market opportunities

d) Institutional and policy-related benefits

Methodologies for participatory planning are being introduced. The understanding of the importance of natural places among direct and indirect users, as well as their desire to contribute to their preservation. Establishment of local monitoring systems with participation of the local population Increased responsibility with local government for regional planning and execution that incorporates environmental conservation components.

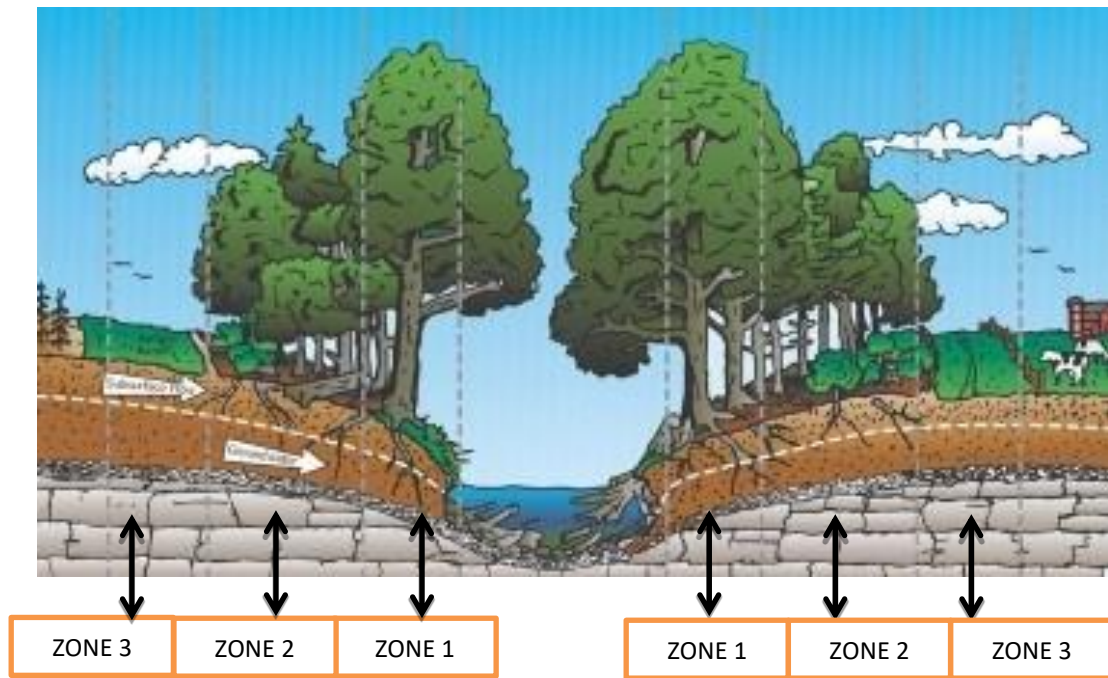


Figure 39 sample section for buffer zones

Zone 1

This zone starts at the stream's edge and supplies both aquatic and terrestrial creatures with habitat and stream bank stability. The primary purposes of this zone are to provide shade and to provide detritus and big woody debris from mature forest plants to the stream or river. This zone's vegetation also aids in flood mitigation, stream bank stabilization, and sediment and nutrient removal. The vegetation should be made up of native, non-invasive trees and shrubs that are dense enough to allow for understory growth and can withstand flooding. The breadth of this zone is between 5 and 8 meters. When trees grow in Zone 1, they shade the stream, lowering the temperature and improving circumstances for cold-water fish.

Zone 2

This zone extends a minimum of 5 meters from Zone 1. Native, faster-growing, smaller, shade-tolerant tree or shrub species should be planted in the zone uphill from Zone 1. The goal in this zone is to create a managed riparian forest with a plant composition and character that is comparable to the region's natural riparian forests. The vegetation that is employed in this zone should be flood and drought resistant. Zone 2's main job is to filter sediments, fertilizers, and other contaminants out of surface and groundwater. This zone, when combined with Zone 1, provides the majority of the habitat advantages, as well as leisure and aesthetic benefits.

Zone 3

Zone 3 should have a minimum width of 4.5 meters. By reducing runoff, penetrating water, and filtering sediment and its associated pollutants, this zone often comprises grass or herbaceous filter strips and delivers the highest water quality advantages. plants filter sediment and slow down fast-moving water discharge.

The researcher advises A buffer with a total width of at least 30 meters. Water quality and stream protection are guaranteed by riparian buffers that are at least 30 meter wide. Plant diversity is essential in each zone. Zones with a diverse plant community are more resistant to adverse weather (drought or strong storms), deer or rodent disturbance, and invading species or pests.

CHAPTER FIVE

Conclusion and Recommendation

5.1. Conclusion

River front planning/development is a critical phrase for a municipality to manage and correctly utilize a river in a town in order to build a sustainable ecologically friendly and economically successful river front. Since then, a variety of entities relating to rivers and their growth at various degrees and talents.

In the research area, poor waste management and control habits are prevalent, resulting in the loss of both natural and constructed riverside development. High population has caused a problem with rubbish disposal near a river's edge. As a result of these factors, river quality has deteriorated, and urban renewal/slum growth has accelerated.

The area's poor socioeconomic background, terrible habit of identifying rivers as sewage and trash disposal sites, lack of appropriate drinkable water, and irregular/organic street layout result in low quality, illnesses, and inefficient block development.

Generally the researcher think about urban design around water features, think about river front planning with best management practices of waste disposal systems and green infrastructure. Also think about intervening in improving natural ecology, especially in urban areas, as a priority to efficiently and effectively manage rivers and their front side development.

5.2 Recommendation

- Providing a complete design for regions where all challenges are being addressed should have analyzed the site survey to study the physical state of an area and establish the notion of a bottom-up approach among communities.
- Increasing society's responsibility and demand by aligning their ideals with environmental norms.
- Planning and creating many types of stages to produce new projects to centralize social, economic, physical, environmental, political, and cultural functions.
- It is necessary to consider preservation and conservation in order to avoid harming biotic and biotic components.
- Allow family members to utilize working space in order to supplement their income, both home and commercial sources of income.
- Social services and amenities should be accommodated.
- Use the natural advantage to boost the area's attractiveness by creating a constant focus of activity.
- Pedestrians, cyclists, and physically challenged individuals should have safe and unhindered access to the riverside.

5.2.1 Design Recommendation

Based on the research findings, the following design or program recommendations are made: The local river buffer and neighboring land must be considered in any new building proposal. Using several programs to activate the river's edge. Water features created artificially (ponds and pools). To encourage social meetings, provide public open and green places. More community spaces from the border zone to the riverside are being allocated. Local governments are in charge. Residential communities, whether cooperatives or individual private residents, should be held accountable and responsible for maintaining the river and river buffer zone. Plots facing the river should have the most frontages possible. Riverfront residents should have the authority to conserve river biodiversity.

Without a good program, land or space would lack a sense of belonging and may degrade the environment. As a result, river-edge locations should be designated for particular or multipurpose activities that are both appropriate and beneficial. Distracting programs on natural ecosystems and river water should be avoided at all costs.

Along buffer zones and open community places, income-generating activities should be integrated. Housing design plans should include income-generating elements for low-income families. Along the river corridor, a series of public-friendly activities should be implemented. Along waterfront regions, a mix of social, commercial, and residential activity should be blended.

5.2.2 Land Use and Site Plan

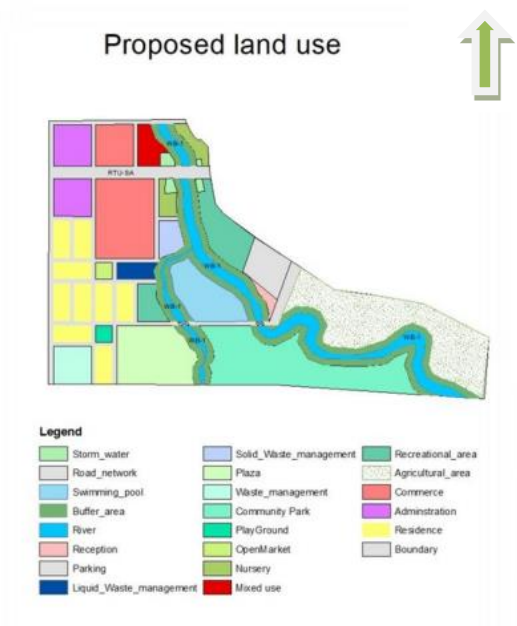


Figure 40 Proposed Land Use Map

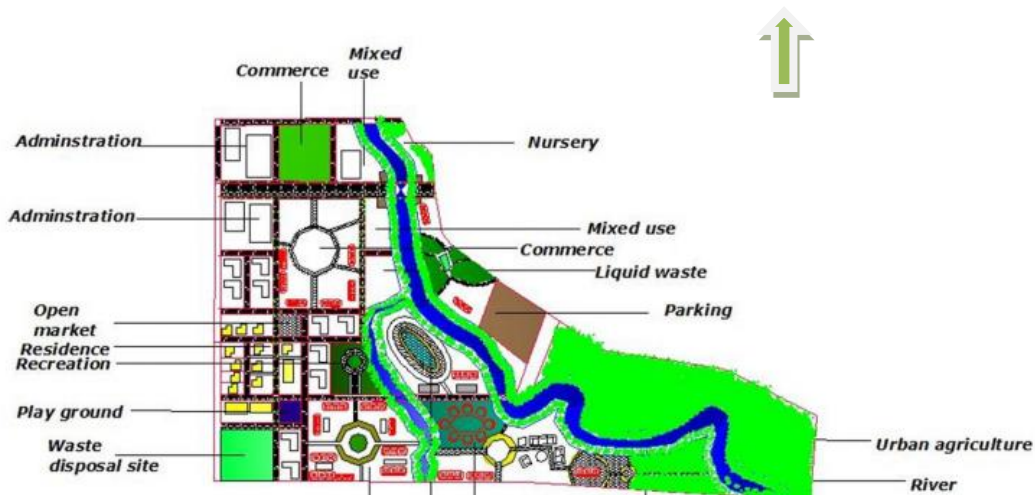


Figure 41 proposed site plan

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APPENDIXES

Questionnaire paper for data collection distributed to Ambo city society.

Adama Science and Technology University

School of Civil Engineering & Architecture, Urban Planning and Design

Department of Architecture

Part 1 Respondent's Characteristics

Age: <20 ☐ 20-30 ☐ 30-40 ☐ 40-50 ☐ >50 ☐

Sex Male ☐ Female ☐

Education: Uneducated ☐ School level ☐ Graduated ☐

Marital Status: Single ☐ Married ☐ Divorced ☐

Part 2 Respondents Integration with the Site

Duration of respondents residing in study area (year)

0-5 ☐ 5-10 ☐ 15-20 ☐ >20 ☐

Time it takes to reach Huluka Riversides (minutes)

1-5 ☐ 5-10 ☐ 10-20 ☐ >20 ☐

The Frequency to Visit Huluka River (per month)

5 times ☐ 10 times ☐ Many times ☐ I do no/ not sure ☐

Part 3 housing type and decision to live on the site

Factors Influenced Your Decision to Live In This Area

Trade Activity ☐ Affordability ☐ Proximity to City ☐ Other Reason ☐

How you possess this property

Purchase ☐ Rental/Kebele ☐ Family House ☐ Built It ☐

House type

Detached ☐ Semi-Detached ☐ Terraced ☐ Shack ☐

Function of the house

Residential ☐ Working ☐ Both ☐ Others ☐

Part 4 housing construction material and their selection criteria

What is your house wall construction material?

Stone/Concrete

Mud

Plastic/Wood

Other

What is your house flooring construction material?

Stone

Concrete

Mud

Other

What is your house Roofing construction material?

Corrugated Iron Sheet

Plastic

Other

What is your reason to Choice of material?

Cost

Availability

Affordability

Other

Part 5 facilitates on the site and peoples feeling for the site

Do you have Garbage disposal site for solid waste?

Private (If Yes)

Communal (If Yes)

NO

Do you get clean water?

Private (If Yes)

Communal (If Yes)

NO

Do you have place to wash your facilities.

Private (If Yes)

Communal (If Yes)

NO

Do you have any Modification on the house from its original state?

YES

NO

What is your feeling on the Site?

Safe / happy

safe/ unhappy

Unsafe / happy

Unsafe/ unhappy

Part 6 behaviors and activities around the site

Give your thoughts on the following topics in a few sentences.

The Dominant Pollutant of Huluka River

The cause of Huluka river water pollution

Function of Huluka river

Activity around Huluka River

Modern commercial center around Huluka river

Type of Waste water System of the Respondents

The Reason of Discomfort for Recreation

The Advantage of the Population Live around Huluka River
