



**LAND USE PLAN IMPLEMENTATION AND ASSOCIATED
ENVIRONMENT IMPACT IN NUNGA SITE, KICUKIRO DISTRICT,
CITY OF KIGALI**

Grace INGABIRE

College of Science and Technology
School of Architecture and Built Environment
Department of Geography and Urban Planning
Master of Geo-Information Science for Environment and Sustainable Development

2019



**LAND USE PLAN IMPLEMENTATION AND ASSOCIATED
ENVIRONMENT IMPACT IN NUNGA SITE, KICUKIRO DISTRICT,
CITY OF KIGALI**

By

Grace INGABIRE

10103560

A dissertation submitted in partial fulfilment of the requirements for the degree of
MASTER OF GEO-INFORMATION SCIENCE FOR ENVIRONMENT AND SUSTAINABLE
DEVELOPMENT

In the College of Science and Technology

Supervisor: Dr HAVUGIMANA Emmanuel

October 2019

Declaration

I, Grace INGABIRE, declare that this dissertation is my own original work except where specifically acknowledged and has never been presented elsewhere. Any reference in terms of books or any other written and electronic materials made concerning other people's works are indicated in the reference list.

Signature: Date:

Supervisor:

Names: Dr HAVUGIMANA Emmanuel

Signature: Date:

Programme Coordinator

Names: Dr. Theophile NIYONZIMA

Signature: Date:

Head of Department, Department of Geography and Urban Planning

Names: Dr. BIZIMANA Jean Pierre

Signature: Date:

Dean, School of Architecture and Built Environment

Names: Dr. Manlio Michieletto

Signature: Date:

Dedication

This dissertation is dedicated to

My parents

My whole family

My supervisor

My friends

Acknowledgment

The achievement of this research result is from the effort of different people to whom I am expressing my feelings of appreciation. Writing a thesis is a long task that nobody can complete it alone. After so long and attentive time of work, I am today indebted to a great number of people who contributed to getting it done.

Firstly, I am expressing my heartfelt gratitude to my supervisor, Dr. Emmanuel HAVUGIMANA who, during the entire period of writing, guided me, spending much time and efforts to give me thoughtful guidance, momentous support and valuable advices, which helped to accomplish this research.

I express my thankful to the University of Rwanda (UR), particularly to its College of Science and Technology (CST), School of Architecture and Built Environment (SABE), and Department of Geography and Urban Planning. I confer my profound gratitude to all lecturers I met for providing me practice oriented and skills in the field of Geo-Information Sciences.

My fellow classmates with whom I shared valuable life during MSc program at the University of Rwanda deserve special mention. I do recognize the valuable life we shared together and it will always have great significance in my mementos. I am thankful to all classmates for sharing with me the knowledge and being out of the ordinary classmates.

This study would not have been possible without the constant and valuable support from my friends, particularly Ernest RUZINDANA, Emmanuel UWIRAGIJIMANA, Nesta Narcisse RUTAGENGWA, my sister and my brothers who day by day were behind my shoulders encouraging me and feeding my hopes to get successful results. I would like to acknowledge the support from my family and friends; their different support during the entire period of study especially financial one has been a cornerstone of all my achievements.

I wish to convey my special thanks to the local authority of Nunga cell and Gahanga who have approved my request for collecting data. In addition, I would like to thank all people who allowed us to have an interview with them. The data and Information they provided to me were very helpful in accomplishing this research.

My great thanks be to the Almighty God for his great protection and strength he provided to me in my studies and in this research.

May the Almighty God bless you all!

Grace INGABIRE

Abstract

Land use planning is the practice that is growing rapidly in Rwanda and highly dominated in urban areas. In Rwandan urban areas, urban planning seeks to order and regulate land use in an efficiency and ethical ways, thus preventing land use conflicts. The government uses land use planning to manage the development of land within their jurisdictions.

Kigali as the capital city of Rwanda is having high urbanization rate of 4.1%. Through urbanization, the land use plan and its implementation are highlighted in order to organize the beauty of the city where it becomes easier to provide infrastructure and service to the citizens.

This research aims to analyze existing physical plan, investigate the progress in the physical plan implementation, assess the environmental impact that results from implementation of land use plan in Nunga site, Nunga cell, Gahanga sector, Kicukiro District and suggest alternative solutions to the environmental impacts. All those were obtained from the field visit and results collected from the questionnaires and interview conducted. The spatial analysis through GIS tools and Google Earth images have been used to know the evolution of land use in the site in different periods of years.

The implementation of land use plan in Nunga site is productive due to the infrastructures including roads which are created, market, schools, playground which will be provided, water and electricity which are in the process to site. The provision of those infrastructures, some environmental impacts have been observed including soil erosion, air pollution, and removal of some small forest which were presented in the site. Referring to the Environmental Impacts in Land Use Plan Implementation that is gradually regarded as a crucial basis of sustainable development, SEA (Strategic Environmental Assessment) or Sustainable Assessment (SA) may be undertaken to integrate environment considerations and sustainability of proposed policies, program and plans.

Key Words: Land use planning, land use plan implementation, Environmental Impact

Table of Contents

Declaration	i
Dedication	ii
Acknowledgment	iii
Abstract	v
Table of Contents	vi
List of Figures	ix
List of Tables	x
List of Abbreviations and Acronyms	xi
Chapter 1 General Introduction	1
1.1. Background of the Study	4
1.2. Problem Statement	6
1.3. Research Objectives	8
1.3.1. General objective	8
1.3.2. Specific objectives	8
1.4. Research Questions	8
1.5. Research Hypothesis	8
1.6. Significance of the Study	9
1.7. Researcher Benefits	9
1.8. Social Benefits	9
1.9. Research Motivation and Scope of the Study	9
1.9.1. Research Motivation	9
1.9.2. Scope of the Study	10
1.10. Limitation	10

Chapter 2. Literature Review	11
2.1. Defining key concepts.....	11
2.1.1. Land Use	11
2.1.2 Land use planning	11
2.1.3. Land use Paradigm.....	11
2.1.4. Principals of land use planning ;(Engel, 2011).....	12
2.1.5. Importance of land use plan	17
2.1.6. Land Use Plan Implementation,.....	18
2.1.7. Environmental Impacts of land use plan implementation.....	19
Chapter 3. Methodology	21
3.1. Research Design.....	21
3.2. Study Area Description.....	22
3.3. Topography	24
3.3.1 Landscape of Nunga site	25
3.4. Data Collection Methods	27
3.4.1. Primary Data Collection	27
3.4.1.1. Field Observation.....	27
3.4.1.2. Questionnaire Survey.....	28
3.4.2. Sampling Technique	28
3.4.2.1. Interview with key informants	29
3.4.2.2. Questionnaire Distribution.....	29
3.4.3. Secondary Data Collection	29
3.4.3.1. Library Research	30
3.4.3.2. Spatial Data Analysis.....	30

3.5. Data Analysis	31
3.5.1. Qualitative and Quantitative Data Analysis.....	32
3.5.2. Data Quality	32
Chapter 4. Results and Discussions	33
4.1. Analysis on Nunga Site.....	34
4.2. Land use evolution in Nunga site.....	35
4.2.1. Land use change in Nunga site from 2005 to 2010	35
4.2.2. Land use change of Nunga site from 2010, 2015 to 2018	36
4.3. Existing Physical Plan.....	38
4.4. Physical Plan Implementation.....	43
4.5. Environmental Impacts of Land Use Plan Implementation.....	47
4.6. Challenges to the people living in the site	49
4.7. Alternative Solutions to Environmental Impacts.....	49
Chapter 5. Conclusion and Recommendations	52
5.1. Conclusion	52
5.2 Recommendations.....	52
References.....	55
Appendices.....	59
Appendix 1. Questionnaire for household survey.....	i
Appendix 2. Interview guide:	vi
Questions to the local authorities.....	vi

List of Figures

Figure 1: Land use Paradigm, Source: www.RLMA.RW	12
Figure 2: Research Design illustrated chart, Source: Designed by the author.....	21
Figure 3: Nunga cell location map, Source : Data from RLMUA.....	22
Figure 4: Nunga cell administration map, Source: Data from RLMUA.....	23
Figure 5 : The percentage area of Nunga site in Nunga Cell, Source: from field survey.....	23
Figure 6: .Nunga site location in Nunga Cell and its associated house standing classes	24
Figure 7: Nunga site elevation map with contour lines, Nunga site elevation map with slope	25
Figure 8 : Slope Map/Nunga site and Watershed Map/Nunga site.....	26
Figure 9 : Nunga site land use map in 2005 and Nunga site land use map in 2010/Source: www.rcmrd.org	36
Figure 10 :Nunga land use map in 2015 and Nunga land use map in 2018/Source: www.rcmrd.org	37
Figure 11:.Factors that attract people in Nunga site, source: results from field	38
Figure 12 : Nunga site roads network/Source: Kicukiro District	39
Figure 13: The chart showing the average prices of plots according to their categories in Nunga site, source: results from field.....	41
Figure 14: .Nunga site existing plots according to housing categories/ Source: Kicukiro District	42
Figure 15: Houses in high standing area, source: taken from field	44
Figure 16: Houses in middle standing area, source: taken from field	45
Figure 17: Houses in low standing area, source: taken from field.....	45
Figure 18: Fetching water from the swamp, source: taken from field.....	49

List of Tables

Table 1. Requirements for effective land use planning/source (USAID, 2015).....	4
Table 2 .Specific research objectives and research questions.....	8
Table 3. Presenting Objectives, Research questions, Data and Information needed, Methods and Techniques used during data collection, source: designed by the author	31
Table 4: Selected Descriptive Statistics of the Study Population, source: from field visit	33
Table 5: Land use categories in the Nunga site, source: field observation.....	35
Table 6: Infrastructure and service accessibility: source: field survey	46
Table 7: Different challenges on environment, from respondents, source: field survey	48

List of Abbreviations and Acronyms

CoK	: City of Kigali
CST	: College of Science and Technology
EIA	: Environmental Impact Assessment
GoR	: Government of Rwanda
LUDP	: Local Urban Development Plan
LUP	: Land Use Plan
MDGs	: Millennium Development Goals
MIFOTRA	: Ministry of Public Service and Labor
MINECOFIN	: Ministry of Finance and Economic Planning
MININFRA	: Ministry of Infrastructure
MINIRENA	: Ministry of Natural Resources
MINALOC	: Ministry of Local Government
NGOs	: Non-Governmental Organizations
NLUDMP	: National Land Use Development Master Plan
NST	: National Strategy for Transformation
RALGA	: Rwanda Association of Local Government Authority
REMA	: Rwanda Environmental Management Authorities
RHA	: Rwanda Housing Authority
RLMUA	: Rwanda Land Management and Use Authority
RNRA	: Rwanda Natural Resources Authority
SA	: Sustainability Assessment
SABE	: School of Architecture and Built Environment

SEA : Strategic Environmental Assessment

UR : University of Rwanda

USAID : United States Agency for International Development

Chapter 1 General Introduction

Generally, the land use element is designed to set the country's vision for future land uses by identifying how the physical environment will be shaped. Land use plans define the future location, type, and intention of land uses, and desired mix by clearly indicating the relationship between them (County, 2006). With the new development which is accompanied by high population growth, Land use plan is one of the mechanisms of land use planning which is gradually being taken into consideration as one of the powerful tools that help in integration of sustainable objectives into spatial development decision making at local governmental level.

Land use plan is generally valued and cherished by planners, politicians, and communities that desire planning outcomes, once this document is developed and expressed through urban planning documents, it is delivered through the implementation process. A fundamental belief about the plan making process is that it provides a planning framework which delivers the planning outcomes as negotiated and agreed public planning policy (Beattie, d.). According to Jie, Jing, Wang, and Shu-xia (2010) land use plan is a means of optimal allocation of land resources, which is often used to plan and arrange the use of land of a given area by considering several aspects including land scale, land use structure and spatial distribution; they have also said that land use plan plays an important role in reasonable distribution of land resources and organization of land use (Jie et al., 2010).

Even if land use plan implementation is developed in both urban areas and in rural areas, its high implementation rate is in urban areas. Although, it is believed to be implemented at a high rate in those areas, a study carried out by Martínez (2015) has revealed that cities and urban areas in developing countries are now being challenged with poor planning and poor implementation of their associated land use plan, Martínez research findings continue indicating that modern urban planning and its implementation in developing countries has resulted in serving the interest of elites, contributing to social and spatial marginalization. On the other side, rapid population growth, vulnerability toward climate change, globalization, urban fragmentation, and decentralization are some of the challenges of the current period in implementation of land use plan (Burby & Dalton, 1994; Martínez, 2015).

Land use plan when it comes to urban planning serves as an important tool to guide and manage the growth of cities in a planned manner. The soul of land use plan lies in its implementation framework and if not implemented, the people are trapped in a mess of urban problems and laissez-faire development having serious long-term impacts. Unfortunately, land use plan prepared for several major cities in the world could not be fully implemented due to host of reasons (Hameed & Nadeem, 2008). It is a useful tool for sustainable development of the city as it tries to formulate proposed activities, administer potential changes and protect incompatible ones. Such administrative and management strategies through land use planning guide to ensure sustainability of a city and this make it an essential component of urban planning (Ullah, 2014).

An effective urban planning and implementation is needed to tackle the urban sprawling and its characteristics in the metropolis. Good governance is all about good planning and is nice in achieving the Millennium Development Goals (MDGS), through the good implementation of the urban and regional plans, particularly where land is adequately supplied for development accommodating investment and working with less privilege to improve the standards of living for the people (Campbell, 1996).

The physical planning strategies are geared towards identifying and targeting development, by conserving the available priorities, risk, opportunities and gaps, in the urban and regional areas. Land use plan is not a static blueprint plan, but an attempt to understand social, economic, and environmental resources within each jurisdiction, providing linkages within and between urban and regional areas and upgrade of infrastructure (Wapwera & Egbu, 2013).

Peri urban areas are often subject to intensive construction, through both formal and informal processes. As land transactions from rural to urban status, different land tenure and administration system may come into environmental impacts related to land use plan, leading to disputes and contestation (Lombard, 2016).

One of the most important tools used is Environmental Impact Assessment (EIA). This tool evaluates the effects of adoption and implementations of the proposed master plan by focusing on development of the physical plan are under the proposed master plan, it is done at a programmatic rather than a project-specific level. The same author indicated that Land Use Planning affects the regional environmental quality, ecosystem services and also influences

socio-economic environmental system by changing land use pattern and structure (Lombard, 2016).

In Rwanda, the strategic use of land is critical to economic and social growth. To support effective land use planning, it was recommended to: (i) strengthen the legal policy framework and coordination mechanisms, (ii) improve the development and implementation of land use plans, and (iii) increase the capacity of institutions, officials to manage the process.

Development planning shall be integrated, participatory, evidence-based, and focused on addressing the priority needs of citizens into consideration the overall national development vision and constraints of the resource envelope. As much as possible, national plans shall be composites of local development plans that are regularly prepared (Lombard, 2016)

Requirements for effective land use planning	
Citizens participation	<ul style="list-style-type: none"> ○ Define protocols for public participation ○ Building skills of district/sector officials to engage the public
Awareness and information sharing	<ul style="list-style-type: none"> ○ Invest in plain language materials on relevant laws, policies and land use processes ○ Raise public awareness of how to participate in land use planning ○ Create platforms for sharing best practices.
Action on climate change	<ul style="list-style-type: none"> ○ Analyze and incorporate local climate change impacts into district land use plans.
Coherent policy & legal framework; improved coordination	<ul style="list-style-type: none"> ○ Conduct expert consultation on legal and policy framework ○ Modify laws/orders to clarify requirements, e.g. climate change adaptation and citizen participation ○ Improve emphasis on land use planning in cross-cutting coordination mechanisms, e.g. sector working groups ○ Consider new mechanisms, such as a national land use planning commission.
Financing	<ul style="list-style-type: none"> ○ Develop and roll out a framework for capital investment planning

	<ul style="list-style-type: none"> ○ Increase local government resources through central government incentives and easier access to bank financing.
Strong administration	<ul style="list-style-type: none"> ○ Institute a rigorous permitting system ○ Increase accountability of official overseeing and monitoring planning ○ Expand budgets for technical resources such as GIS, GPS and computers.
Capacity building for individuals and institutions	<ul style="list-style-type: none"> ○ Devise comprehensive strategy and deliver training at all levels, especially district and sector officials ○ Assess ability of urban/rural structures to manage land use planning ○ Expand role and build capacity of land use committees ○ Expand the study of land planning in Rwanda ○ Foster the profession of land use planning.

Table 1. Requirements for effective land use planning/source (USAID, 2015)

In Rwanda, effective planning requires coordination and leadership of government and no-government actors, including the following : MINIRENA, REMA,NGOs, Institute of Planners, District governments, MININFRA,RHA,MINECOFIN,MIFOTRA,RALA,RNRA,MINALOC and Universities (INES,2015) , USAID,2015

1.1. Background of the Study

Land use plan implementation play a vital role in different aspects including promotion of sustainable land use and ecosystem restoration, Land use planning, sustainable infrastructure development, improvement of economic opportunities, strengthening land governance (G. Metternicht, 2017). For instance, in developed countries especially in North America and Europe there is a good environmental protection and welfare of people due to making a good relation and use between environment and people resulted from Land use plan implementation, but also in some countries where it has been implemented there are some impacts that were associated with this implementation, one among them is environment related impacts where there have change in landscape that results from environmental degradation, disappearance of some animal and plant species and other biodiversity associated impacts, change in quality of atmospheric air

and the world heating system, water resources related problem and soil resources including pollution and loss of fertility specifically for soil ,wastes generation, socio-economic situation trends, landslides, erosion and floods (Orhe, 2015).

According to (MINIRENA, 2013) that Rwanda is experiencing a steady period of growth, in terms of both population and economic development but the country's natural resources and in particular arable land are not increasing. At the same time, there are greater expectations for natural resources management, and improved living environments; increasing demands for greater public participation in the planning process, and rapidly changing technologies in infrastructure development.

As a consequence, since 2007, the Government of Rwanda (GoR) has initiated a planning procedure that has resulted in the preparation and adoption of a National Land Use Development Master Plan (NLUDMP). The role and efficiency of land use planning is therefore of considerable national importance. The issues faced by Rwanda in relation to land and land use planning are well recorded those include: a very high population density, land scarcity ,and a large percentage of land that is considered undevelopable (such as wetlands or steep slopes), increasing competition for land resources with a reduction in cultivable land due to soil erosion and inadequate soil and water management, comparatively low rates of urbanization, historically poor mechanisms to enforce the control of land use, a deficit in infrastructure and basic services, ineffective urban management systems, and an inadequate supply of affordable housing that is compounding (USAID, 2015).

A research carried out by Ministry of Infrastructure has also indicated other general problems that are associated with land use planning and implementation in Rwanda, which include a strong pressure on the already spatially limited land resources which results from rapid growing population, domination of the agricultural sector which lacks any specialization in terms of human resources and equipment, a land tenure system dominated by customary law which favors land fragmentation, a considerable number of landless persons who have to be resettled at all costs, Scattered farming plots that are difficult to manage due to the scattered mode of human settlement, Lack of a reliable land registration system that would guarantee the security of land tenure, weak and inadequate existing methods of land-use planning and land improvement (MINIRENA, 2004).

Even if there are challenges associated with Land use implementation itself but also there are other impacts that are associated with its implementation mainly environment one including a change in landscape that results from environmental degradation, disappearance of some animal and plant species and other Biodiversity associated impacts, Change in quality of atmospheric air and the world Heating System, water resources related problem and Soil resources including pollution and loss of fertility specifically for soil ,Wastes generation, Socio-economic situation trends, landslides, erosion and floods (Orhe, 2015).

To tackle with those challenges, Rwanda has established several institutions with specific goals and objectives; those are Rwanda Land Use and Management Authority, Rwanda Housing Authority, City of Kigali and Rwanda Environment Management and Districts. Those institutions have been established to provide master plans; guide and monitor their implementation and to solve challenges associated with its implementation although there are institutions but there is no study yet made indicating land use plan implementation and the associated impacts (Ali, Deininger, & Goldstein, 2014).

The urban design landscape strategy for the gateway hub is to have quality landscapes, which focuses on integrated green network, distinctive public open spaces for all ages, urban greenery (Kigali, 2013).

1.2. Problem Statement

In view of Rwanda's high population density, the continued direct dependence of the majority of the population on the land resource, the ambitious development path the country is embarked upon, the Government of Rwanda, through its long-term development instruments (specifically the EDPRS and NST) has made optimal, rational and sustainable utilization of land an absolute goal to be aimed at. To this effect, the National Land Use and Development Master Plan (NLUDMP) that guide spatial development in Rwanda was developed as provided in National Land Policy of 2004 and the Organic Land Law of 2005. While implementation of the NLUDMP is operational, there is much concern that land use in Rwanda is changing, but there is not much formal monitoring of what is changing, in what direction or what rate. Uncontrolled land use change will lead to further loss of Rwanda's unique natural and cultural heritage. Ultimately, optimal land use is not achieved, affecting Rwanda's development and growth potential (RNR, 2015). A monitoring system on basis of the commonly fixed indicators deemed necessary in

order to provide indicators of progress towards sustainable land use as far as Rwanda is making positive headway in addressing sound management of its most limited resource (RNR, 2015).

The natural setting of Kigali is characterized by steep forested hills and farmlands on the northern and western hilly regions. Rivers and wetlands dominate the landscape and provide easily accessible recreational opportunities. These unique landscapes contribute to the attractiveness of Kigali as a beautiful place to live and work for local residents and enjoyable place for tourists. Unlike other cities, which are working to reclaim and reinstate their natural features, the city of Kigali has the enviable opportunity to grow into a beautiful, balanced and sustainable city (RNR, 2015).

There are many environmental issues and challenges such as rapid depletion of biodiversity, forests and wetlands, urban encroachment on the steep slopes etc. Issues and challenges in Kigali, lakes, rivers, streams, wetlands, forests and steep slopes combined with the existing agriculture areas constitute to 83% of the city's land area. The environmental issues and challenges related to those nature areas are: (i) steep slopes greater than 20% occupy 35% city's land area. Kigali land area falls under medium to high risk erosion zone where more than 5% is susceptible to heavy erosion. (ii) The wetlands, watersheds and flood environmental issues and challenges plains are intensively used for settlement structures, cultivation and grazing, thus altering the watershed. This has resulted in soil erosion, depletion of the river, siltation, and reduced soil fertility, wetland habitats and vegetation. (iii) Rapid urbanization, extensive subsistence farming, large land clearance, over cultivation and burning of forest under traditional pastoral system is adding to the loss of natural vegetation and biodiversity (Kigali, 2013).

This study aims to investigate the environment impacts that are associated with Land use plan implementation in Nunga site, Gahanga sector, Kicukiro District to know well its status. Based on the landscape of Kigali and its associated challenges to the implementation of land use plan, the study will help in examining the impacts of land use plan implementation like soil erosion, loss of soil fertility, shortage of arable land, loss of natural vegetation and biodiversity, and relocation of residents in Nunga site and how monitoring of land use plan implementation is being practiced.

Nunga site was very green with agricultural fields and scattered houses. With urbanization rate and land use plan implementation, much of the area is being built up. However, the plan

envisions Nunga Cell, Gahanga Sector, Kicukiro District in general to still maintain its green identity with plenty of quality landscapes. All-natural open spaces, streetscapes (Scene of streets), public and private open spaces contribute to creating the quality of urban landscapes

1.3. Research Objectives

1.3.1. General objective

The general objective of the research is to assess the implementation of land use plan and its associated environmental impacts, specifically in Nunga site/Kicukiro District, in Kigali City.

1.3.2. Specific objectives

To attain the general objective, the specific objectives of this research have been formulated

- a. To assess the land use evolution in Nunga site
- b. Analysis of existing physical plan and the progress in the implementation
- c. Assessing the environmental impacts that resulted from implementation of land use plan

1.4. Research Questions

This research will attempt to respond to the following research questions as shown in Table1.2

Specific Objectives	Research Questions
1. To assess the land use evolution in Nunga site	How the land use in Nunga site changed through time?
2. Analysis of existing physical plan and the progress in implementation	What are the components of the current land use plan in Nunga site? What is the current status of physical plan implementation in Nunga site?
3. Assessing the environmental impact that resulted from implementation of land use plan	What are the major environmental impacts that results from Land use plan implementation? What was environmental protection status before putting into place and implementing detailed physical plan? At which rate do they manifest? What are their effects?

Table 2 .Specific research objectives and research questions

1.5. Research Hypothesis

Therefore, the following hypotheses was postulated; Both effective and efficient of land use and implementation plan grounded on the location situation may reduce the environmental degradation effects

1.6. Significance of the Study

This research is very crucial for the writer and the reader because it highlights the situation of the Nunga site before and after the implementation of the detailed physical plan as well as the impacts on the environment. It is also important as it will provide strategies and recommendation and give an opportunity for further research by individuals and organizations, involved in Land use plan implementation and Environmental protection.

1.7. Researcher Benefits

Personally, as urban planner this research helped me to increase my knowledge and skills about land use planning and its implementation mostly in urban areas and also its associate impacts including economic, social, particularly environmental impacts.

This also helped me to improve mode of thinking about the implementation of land use plan without undermining the social and environmental condition at high rate and looking for the solution for those impacts which have raised during the implementation of land use plan.

1.8. Social Benefits

The community will benefit from the research because the population will be aware of the interest found in land use plan and its implementation in Nunga Site. They will be informed through their local leaders about the contribution of land use planning to the implementation of Kigali city master plan and the general development of the city.

This research will help the population to understand that, the land use plan implementation will increase their living conditions referring to what Nunga Site community tells.

1.9. Research Motivation and Scope of the Study

1.9.1. Research Motivation

The selection of the topic and study area was based on personal interest and the orientation of the urban development of Rwanda especially in Nunga Site in Gahanga Sector, Kicukiro District, Kigali city where Rwanda is looking forward to develop land use plan and its implementation and respect the rules and regulation related to land use planning. The motivation came from my academic studies and curiosity where the target of an urban planner is to come up with a good

view of the city. The choice of the study area was taken because Nunga site is one of the sites where the trial of land use plan is being implemented and was successfully achieved.

1.9.2. Scope of the Study

This research is only aimed to analyze land use plan implementation in Nunga site located in Nunga cell, Gahanga sector, Kicukiro District in the city of Kigali as the case study and the research was looking on land use plan implementation and its environmental impacts in Nunga site.

1.10. Limitation

In the process of conducting this study, there are limitations where Orthophotos and Quick bird images to show the changes of land use are missing and the available ones are not updated and not visible sufficiently only topographic maps and aerial photos can be visible.

Chapter 2. Literature Review

2.1. Defining key concepts

2.1.1. Land Use

Land use involves the management and modification of natural environment or wilderness into built environment such as settlement and semi-natural habitats such as arable fields, pastures, and managed woods. It also has been defined as the total of arrangements, activities, and inputs that people undertake in a certain land cover type (Alonso, 1964).

2.1.2 Land use planning

Land use planning is the systematic assessment of land and water potential, alternatives for land use and economic and social conditions in order to select and adopt the best land use options. Its purpose is to select and put into practice those land uses that will best meet the needs of the people while safeguarding resources for the future (M. Metternicht, 2017).

Land use planning in the context of development cooperation is an iterative process based on the dialogue amongst all stakeholders aiming to define sustainable land uses in rural areas. It also implies the initiation and monitoring of measures to realize the agreed land uses. Land use planning creates the preconditions required to achieve a type of land use that is environmentally sustainable, socially just and desirable and economically sound.

It thereby activates social processes of decision making and consensus building concerning the utilization and protection of private communal or public area (Engel, 2011).

2.1.3. Land use Paradigm

Land use planning need the combination of policies, institutional settings, rules and regulations so as to protect the limited land and the human activities carried out on this land.

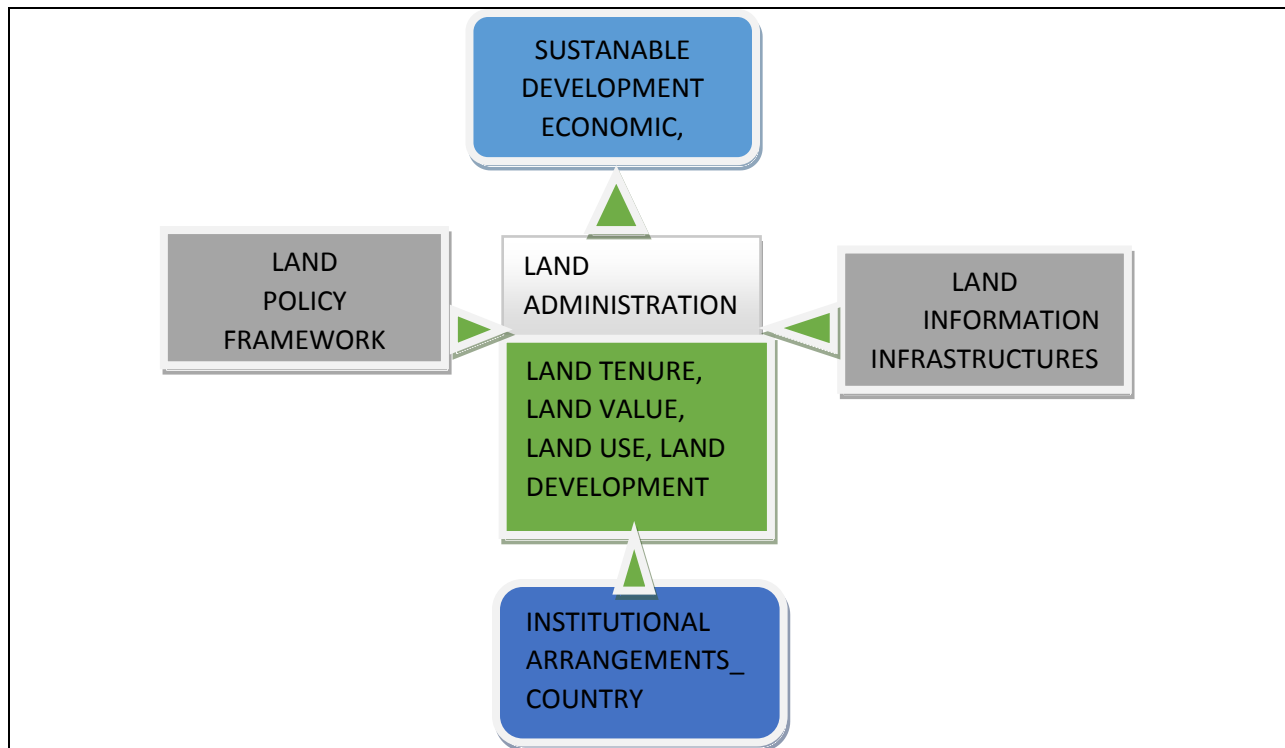


Figure 1: Land use Paradigm, Source: www.RLMA.RW

2.1.4. Principals of land use planning ;(Engel, 2011)

Based on the definition and the objective of land use planning, it should be based on different principles:

- *“Land use planning aims at sustainability balancing social, economic and environmental needs;*
- *Land use planning results in legally binding land use plan and/or legally binding land use rules. Formal recognition of the land use plan or land use is crucial for its implementation. Otherwise, key players such as sector ministries or private investors do not respect them;*
- *Land use planning is integrated into state institutions having the official mandate for inter-sector planning. This can be realized in different ways. The planning can be done by local or traditional chiefs and later formalized through the signing by regional or*

national officer. In the late case, the higher-level officers need, however, be involved from an early age on;

- *Land use planning is a dialogue: a central part of any land use planning is the initialization of a communication process that allows all stakeholders to express their interests and enables them to agree on future land uses that respect all positions in a fair and adequate way;*
- *Land use planning is an all-inclusive process: this requires that all stakeholders' groups are represented (local direct and indirect users, public authorities, private investors, NGOs and CBOs). Depending on the level on which land use planning is done, stakeholders' participation can be direct or indirect;*
- *Land use planning is based on stakeholder differentiation and gender sensitivity: to identify all relevant stakeholders, gender differentiated analysis of all actors should be done in advance;*
- *Land use planning promotes civic engagement: the population should actively participate in the land use planning. The results of planning and the implementation of measures can only be sustainable if plans are made with and by people, not behind or even against them. Planning is therefore not just a matter for experts, but should be carried out together with those affected by it;*
- *Land use planning is realistic and oriented to local conditions not only have the content of a land use planning to be adapted to local condition. The methods to have to fit the technical, economical and organizational capacities of the local population as well as administration;*
- *Land use planning is based on a light methodology avoiding unnecessary data collection resulting in data graveyards;*
- *Land use planning considers and valorizes local knowledge: rural societies or groups often possess a complex autochthonous knowledge of their natural environment. They can contribute valuable information and should, therefore be mobilized during the land use planning;*

- *Land use planning considers traditional strategies for solving problems and conflicts: traditional rural societies have their own way of approaching problems and setting conflicts concerning land use. In the process of land use planning, such mechanisms have to be recognized, understood and considered;*
- *Land use planning follow the idea of subsidiary: all functions from planning to decision making, implementation and monitoring are assigned to the lowest appropriate level of government in order to be responsive to the needs of citizens and to ensure effective control.*
- *Land use planning integrates bottom-up aspects with top-down aspects (vertical integration): land use planning needs to combine local needs and interests with provisions made by higher levels. This can be achieved in a sustainable way if stakeholders from all levels participate in the process and directly talk and listen to each other;*
- *Land use planning is based on inter-disciplinary cooperation and require sector coordination (horizontal integration): the diverse functions and potential uses of land make it necessary to apply an interdisciplinary approach involving all sectors that have a stake in that area. This generally requires a longer support in institution building and improving cooperation between different sector ministries/agencies;*
- *Land use planning is a process leading to an improvement in the capacity of stakeholders: the participation methods used in all steps of land use planning promote the technical and organizational capabilities of all participants, thereby improving their capacity to plan and act. In the medium term, this leads to an improvement in the capacity of local groups or administrative entities (such as municipalities, districts and provinces) for self-determination;*
- *Land use planning requires transparency: if there is no transparency on decisions about future land uses, risks are high that some people will be deprived of their rights and /or that future land used will not be sustainable;*

- *Land use planning is future-oriented: land use planning is not only about mapping the current land uses or land covers. Land use planning determines how the land will be used in the future. This may differ more or less from today's utilization of the land;*
- *Land use planning is an iterative process: land use planning is more than the preparation of planning document; it is an iterative process. Iteration is both the principle and method. New developments and findings are specifically observed and incorporated into the planning process. It may lead to the revision of decision and the repetition of steps taken.*
- *Land use planning is implementation oriented: land use planning has to consider how the negotiated decisions and the solutions identified are to be implemented. It does not end with the land use plan. The implementation of limited measures right at the beginning of the process or parallel to it plays an important role in establishing villages' confidence in the planning process;*
- *Land use planning is linked to financial planning: this is crucial for implementation. Land use planning needs to be aware of the designated uses of sector budgets as well as of the financial planning cycles of the relevant sector ministries. At the same time, land use planning should influence the composition and intended purposes of budgets and funds;*
- *Land use planning relates to spaces and places (spatial orientation): in most countries, many forms of planning and quite a number of plans exist. What most of them are lacking is the relation to space. Many development plans, for instance, state what has to be developed (mainly in terms of infrastructure) but do not indicate where. Land use planning puts the focus on spatial relations and differences. The spatial orientation of planning ensures the optimum distribution of investments and the most adequate use of any place and avoids land use conflicts (Engel, 2011)''.*

Rwanda National Land Use Planning proposed steps and guidelines that are adopted into the prescribed phases or tasks of the LUP Planning Process (RLMUA, 2017):

STEP 1: Working together with the LUP and identifying stakeholders: Needed resources for the surveying and planning activities until the implementation phase.

STEP 2: Setting the vision for the LUP: avoids double efforts and the risk of confusion among stakeholders and the general public.

STEP 3: Assessing the existing situation: answers the questions where we are? And need to be? Analysis and diagnostic in identifying issues, potentials and future development needs and spatial requirements of the city/nation. Assessment involves technical and participatory methods.

GIS is an essential tool for this as it makes the plan more clearly to the public. The Suitability Analysis Information Products will focus on the limitations and potentials originating from nature and manmade/ rules and regulations

STEP 4: The goals and objectives for the LUP: formulation of goals and objectives is following data gathering and analysis, to implement the plan effectively all sectors

STEP 5: Establishing the advance thrust and spatial strategies: future spatial development of the nation with the use of advanced GIS in a way of getting proper, practicable and possible ways through an examination of diverse land use alternatives or scenarios and start preparing the draft plan.

STEP 6: Public consultations on LUP: comprises a 3-stage process specifically: public display and information dissemination; conduct of hearings then consultations to update the general public and guarantee an objective and participatory review of the draft LUP and to encourage ownership of the plan and gain support for its implementation, in a PowerPoint presentation.

Conducting review meetings with local community, local authorities, the private sector and other local organizations. - Public display and circulation of the draft plan.

➤ Central Government (Binding Directives of Conflicts Resolution) verse Local Governments

➤ Draft LUP → District Council Presentation → Situation Analysis → Public Forum
→ Consultation Report → District Council Approval → ~~Final~~ Approved LUP

STEP 7: Preparation the detail draft LUP: this stage is where the location and details of the plan components are put into final draft.

STEP 8: Reviewing, adopting and approving the LUP: Review of the LUP, adoption, enactment and approval of LUP by the Client will take place at this stage.

- All stakeholders to be there in consultations since early stages of the planning proposal to ensure all aspects are ok
- Local authorities initiative
- All proposals to be submitted to concerned entities

STEP 9: Implementing the LUP: requires resources, institutional structures and procedures.

- A comprehensive land use plan to be included in the District Development Plans
- The proposed planning legislation should be flexible for the implementers to design and implement their own organizational structure and its vision, mission, goals and objectives as contained in the LUP and accountability to the country.

STEP 10: Monitoring, Reviewing & Evaluating the LUP: GIS assists the planner to readily extract data from the database and LUP project profile.

Ministries and agencies are concerned to manage/ implement projects, with stakeholders/contractors. Monitoring review and evaluation are performed at final stage, where GIS software is highly used in digitalizing the data and outcome

2.1.5. Importance of land use plan

A community is made up of individuals with different needs, interests and lifestyles. Some needs however are common to us all, such as sanitation, fresh air, clean water, and open space for recreation. The way a city or town develops can have a direct impact on these needs and therefore the quality of life of its citizens. Town planning and specifically control of land use is not tool for ensuring these common needs are met and for achieving sustainable cities and towns by controlling development so that: (i) important natural resources are preserved, (ii) urban settlement is contained to ensure that roads and other infrastructure such as water, sewage, power, and telecommunications are provided efficiently, (iii) the economy is supported by maintaining a hierarchy of business centers; (iv) community services, facilities and open space are fairly distributed; and (v) incompatible land uses are separated (van Lier, 1998).

Control of land use through town planning is necessary because the way individual land owners wish to develop and make use of their land may not match the needs or aspirations of the broader community. The planning system in each state and territory manages the use and development of land in the public interest by ensuring that most developments need development approval before it can proceed.

If land use were not controlled, we would almost certainly have seen even more extensive urbanization of the rural/urban edge of cities and lack of community infrastructure such as open space. The main way of controlling land use is through planning schemes that are prepared and implemented by local council under state or territory government laws. The use of regulation to control land use promotes compliance and certainty that would not exist if there were no statutory basis for these controls. There is an underlying tension for governments between easing the regulatory path for business to undertake development and ensuring an open and transparent opportunity for the community to have its say on these developments (van Lier, 1998).

2.1.6. Land Use Plan Implementation,

Implementation of land use plans is shared responsibility in the government. The government implements approved land use plans with conditions that future plan's vision and goals, and decision-making aligned with conditions in the plans. The government's roles and responsibilities in implementing land use plans include (Alterman and Hill, 1978):

1. An approval authority and land manager: once a plan is approved, the government will implement the plan when issuing rights and authorizations related to land, water, and resources. In addition, the government will make reasonable efforts to complete all actions directed to the government. However, that does not imply a commitment to additional outside funding. While conditions identified in land use plans are advisory in nature so, the government will consider implementing the recommendations wherever feasible and appropriate.
2. Issuer of rights and authorizations: four departments issue rights and authorizations in accordance with approved land use plans: department of lands; department of environment and natural resources; department of industry, tourism and investment; and department of transportation.

3. Inspection and enforcement of permits, licenses, and leases: post-devolution, the government enforces conditions set-out in land and water authorizations.
4. Authority referral for conformity: the government has the authority to refer a proposed activity to the planning board to determine whether a land use activity is in line with the approved land use plan.
5. Proponent applying for rights and authorizations: the government like any proponent, incorporates approved land use plans into project applications to ensure that proposed land use activities conform to the plan (Alterman & Hill, 1978).

2.1.7. Environmental Impacts of land use plan implementation

Land use plan implementation is arguably the most pervasive socioeconomic force driving changes and degradation of ecosystems. Deforestation, urban development, agriculture, and other human activities have substantially altered the Earth's landscape. Such disturbance of land affects important ecosystem processes and services, which can have wide ranging and long-term consequences. Farmland provides open space and valuable habitat for many wildlife species. However, intensive agriculture has potentially severe ecosystem consequences. For example, it has long been recognized that agricultural land use and practices can cause water pollution and the effect is influenced by the government policies. Runoff from agricultural land is a leading source of water pollution both in inland and coastal waters. Conversions of wetlands to crop production and irrigation water divisions have brought many wildlife species to the verge of extinction (Soriano & Christina, 2016).

Forests provide many ecosystem services. They support biodiversity, providing critical habitat for wildlife, remove carbon dioxide from the atmosphere, intercept precipitation, slow down surface runoff, and reduce soil erosion and flooding. These important ecosystem services will be reduced or destroyed when forests are converted to agriculture or urban development. For example, deforestation, along with urban sprawl, agriculture, and other human activities, has substantially altered and fragmented the earth's vegetative cover. Such disturbance can change the global atmospheric concentration of carbon dioxide, the principal heat trapping gas, as well as affect local, regional, and global climate by changing the energy balance on Earth's surface (Soriano & Christina, 2016).

Urban development has been linked to many environmental problems, including air pollution, water pollution, and loss of wildlife habitat. Urban runoff often contains nutrients, sediment and toxic contaminants and can cause not only water pollution but also large variation in stream flow and temperature. Habitat destruction, fragmentation and alternation associated with urban development have been identified as the leading causes of biodiversity decline and species extinctions. Urban development and intensive agriculture in coastal area and further inland are a major threat to the health, productivity, and biodiversity of the marine environment throughout the world (Soriano & Christina, 2016)

Chapter 3. Methodology

This part discusses different materials, methods, techniques, tools, and presents different scientific approaches that will be used to conduct this research in order to obtain the reliable result. Materials that will be used in this research will mostly base on the review of the existing documents, thesis, and various images of the study area. This section also highlights aspects for data collection, data preparation, data analysis, interpretation and presentation of the final results.

3.1. Research Design

The research design is the overall plan for connecting the conceptual research problems to the pertinent and achievable empirical research. In other words, the research design articulates what the data is required, what methods are going to be used to collect and analyze data (Lewis, 2015).

The research design will summarize within the chart, the arrangement and organization of the research document according to the sections namely: General Introduction, Literature Review, Methodology, Results and Discussion, Conclusion and Recommendations as illustrated on the figure 2.

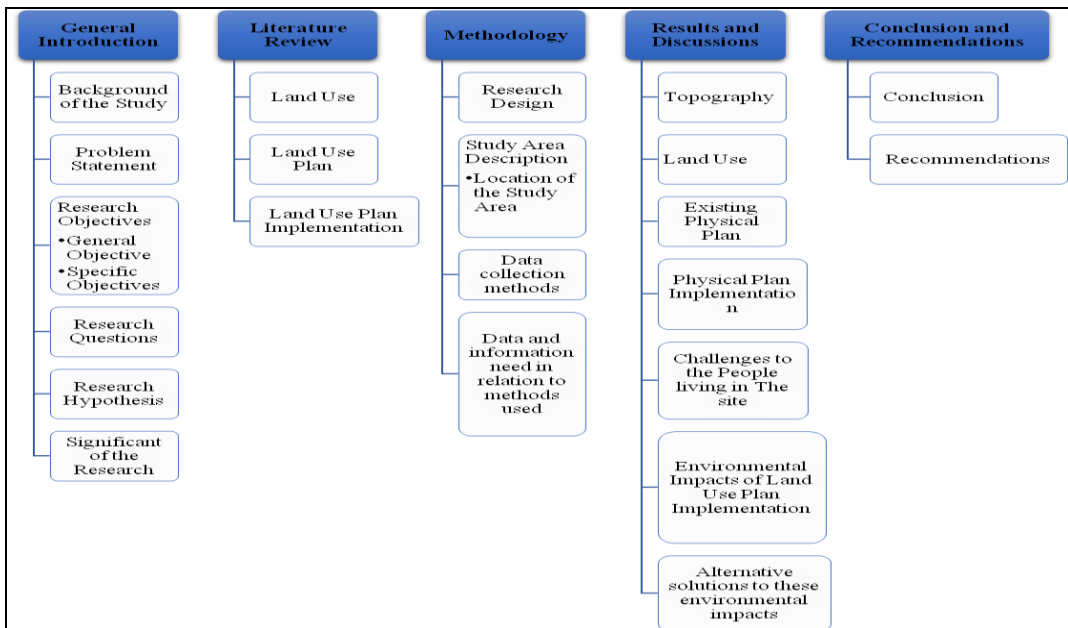


Figure 2: Research Design illustrated chart, Source: Designed by the author

3.2. Study Area Description

Nunga is one of the cells comprising Gahanga sector of Kicukiro District in the City of Kigali. Nunga cell is located in South West of Gahanga Sector and is bordered in North by Karembure Cell, North East by Gahanga Cell, South East by Murinja Cell and Nyarugenge District in West as illustrated on Fig. 3

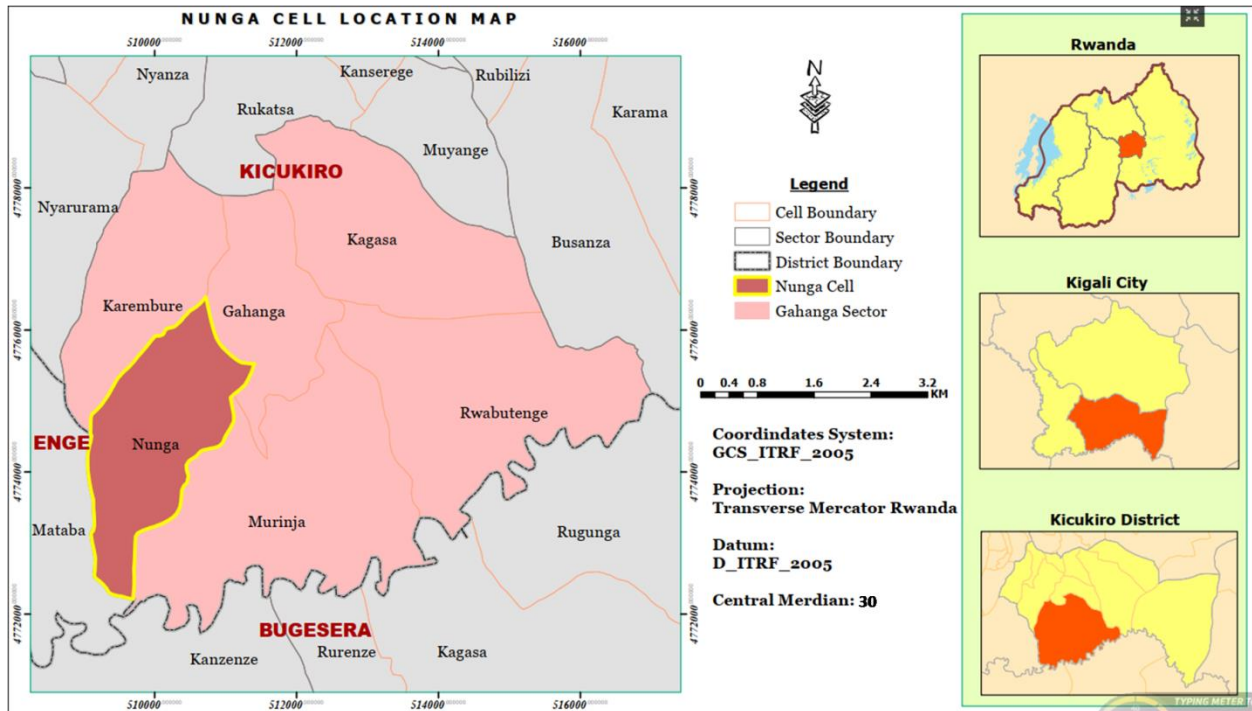


Figure 3: Nunga cell location map, Source : Data from RLMUA

This study will be carried out in Nunga Cell as one of the sites in the City of Kigali where land use plan was implemented and it was selected purposively as the study area, since the Cell is one of the sites located in the City of Kigali, which is the capital of Rwanda, whereby this City is developing in many aspects of development including land use planning and its associated implementations. Nunga Cell is also a place which is rapidly developing in terms of housing as the Kigali City is expanding towards Bugesera and other regions.

Nunga Cell covers a surface of 481 hectares with a total population of 4180 (749 households) and a density of 869 population per km² according to 2012 Rwandan population census (NISR, 2015). The Cell is further divided into six villages: Nunga 1, Nunga 2, Kigarama, Kinyana, Rugasa and Mugendo as illustrated on Fig. 3. 3.

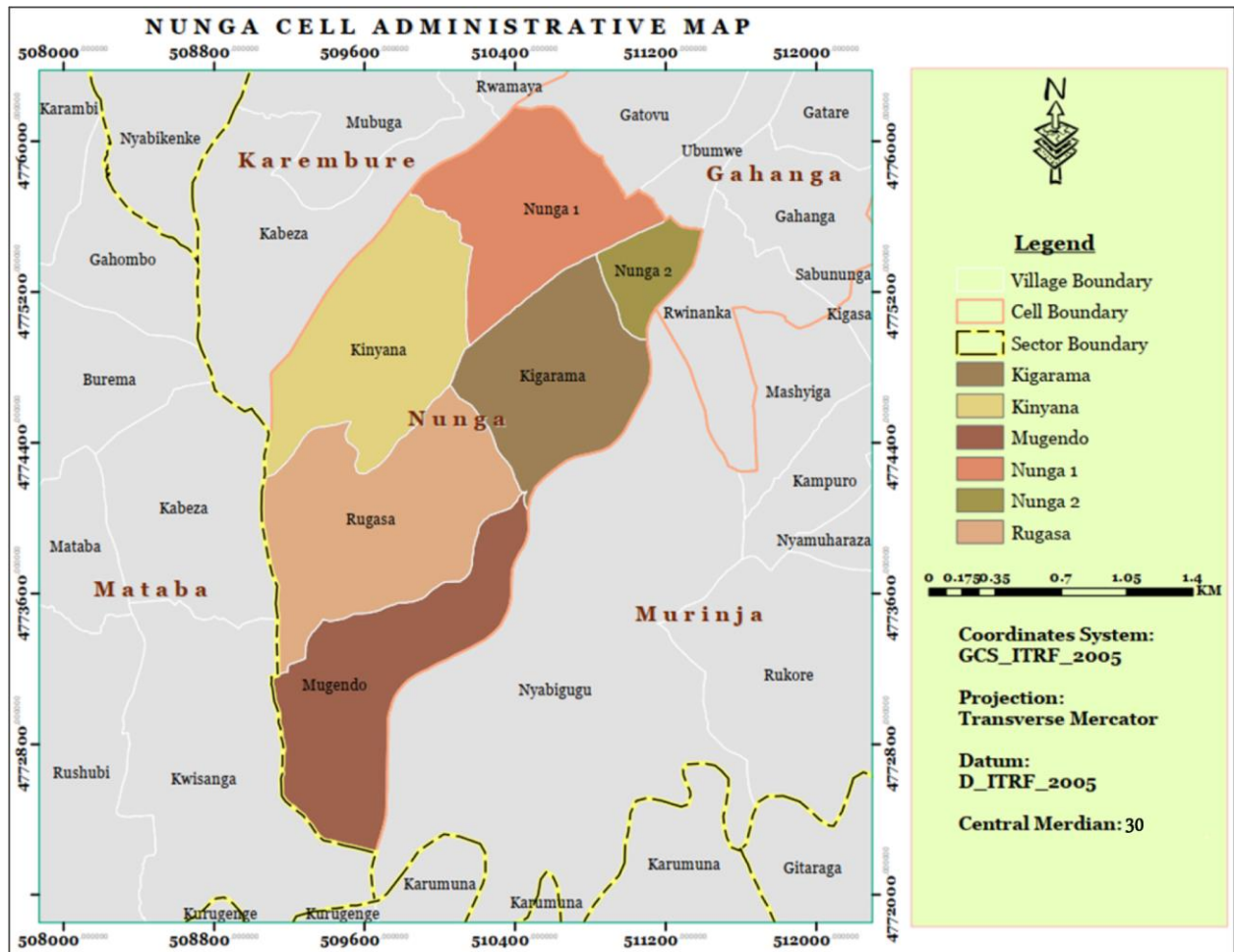


Figure 4: Nunga cell administration map, Source: Data from RLMUA

Nunga Site is not occupying the whole area of Nunga Cell. It is located in North-West of the Cell, in two villages which are Nunga 1 and Kinyana. Nunga site is covering an area of 59 ha which represents 12% of Nunga Cell total surface.

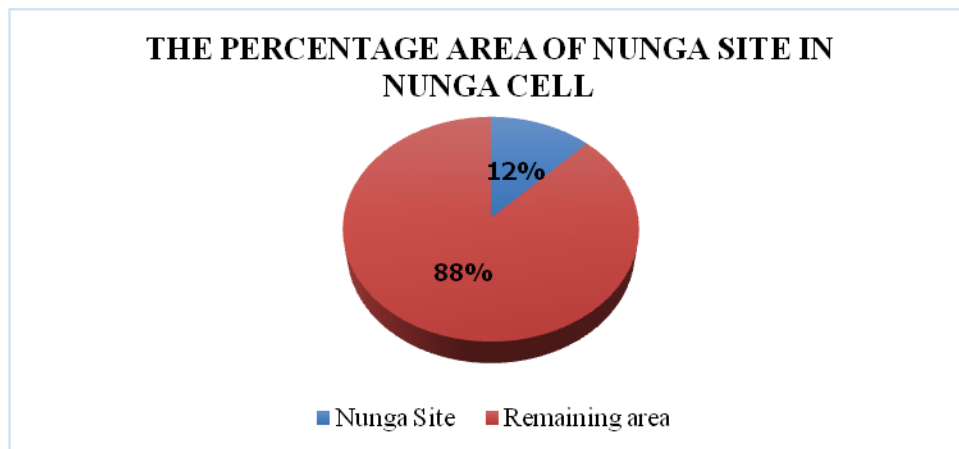


Figure 5 : The percentage area of Nunga site in Nunga Cell, Source: from field survey

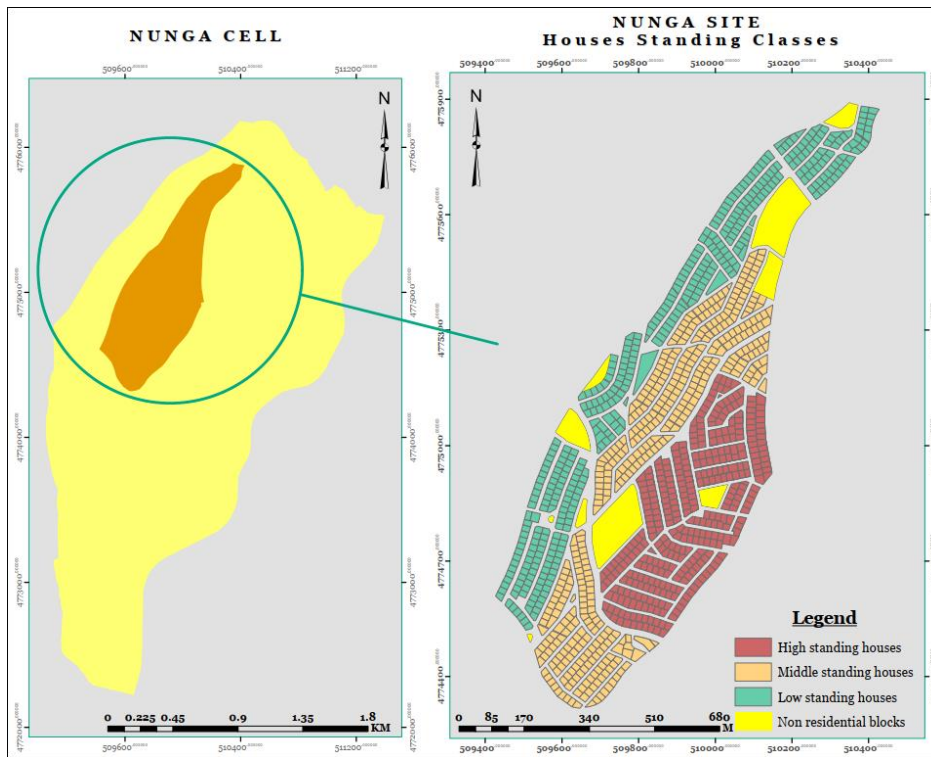


Figure 6: .Nunga site location in Nunga Cell and its associated house standing classes

Source: Data from Kicukiro District

3.3. Topography

A big part of Nunga site is located on the side of hill and has an elevation ranging from 1425 m to 1500 m of altitude. It is made of hill from West to East and it has a plateau surface for high standing houses in eastern part of the site. It is characterized by steep slope from North East and Central part to West. Topography has a critical role in the land use plan and its implementation, because the more inaccessible place, the less likely it is suitable implementation of land use plan. For instance, an area located on a steep slope, is open to challenges for implementing the land use plan due to the difficulties of providing the basic infrastructures like roads, electricity and water. While an area experienced on non-steep slope, it is simple to provide different infrastructures and services because it is not expensive as like providing them on steep slope surface. Nunga site has both steep slope in West part with low standing houses and plateau surface in East with high standing houses.

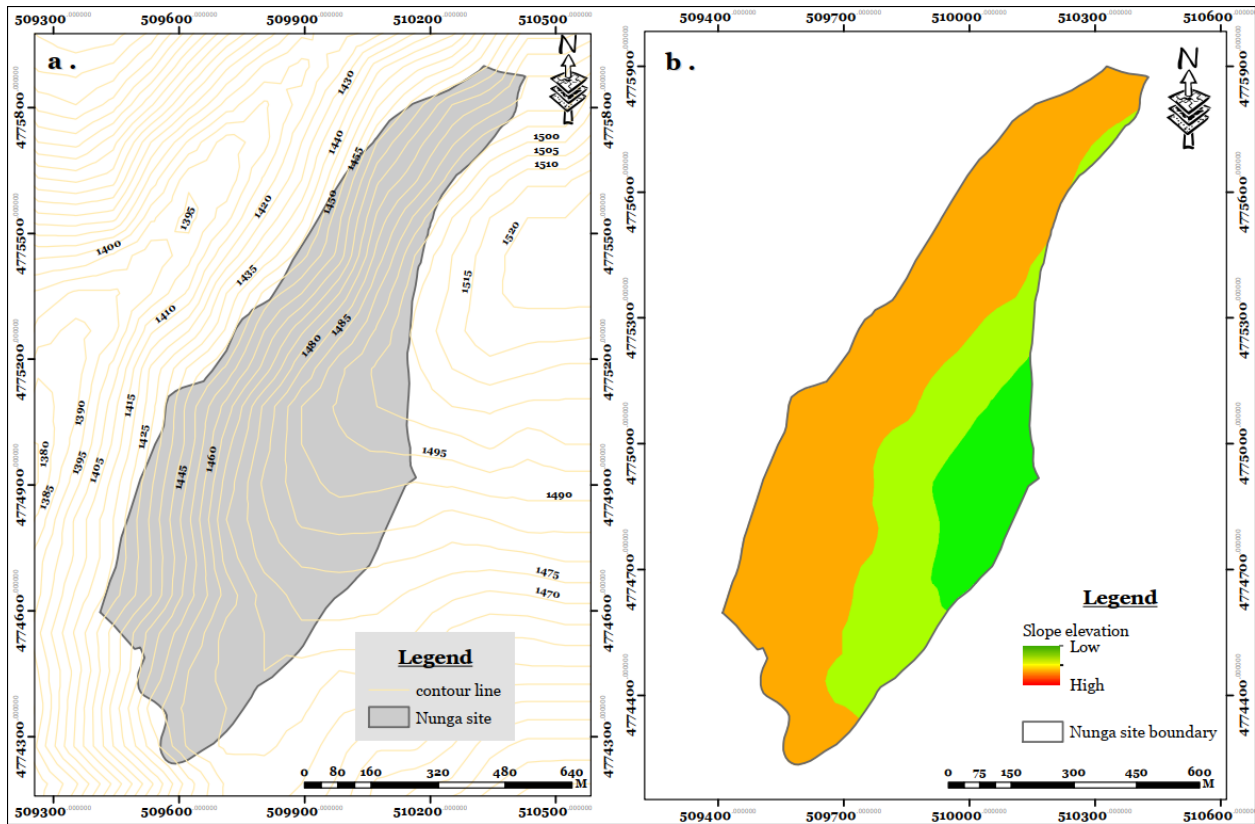


Figure 7: Nunga site elevation map with contour lines, Nunga site elevation map with slope

Source: Data from RLMA

3.3.1 Landscape of Nunga site

The following figures (Slope Map and Watershed Map) is the way the site is appearing from the top (where the slope is less than 5% and the water streams are less) to most down part (where it's in high risk zone with the slope greater than 20% and with much water streams that contributes to the accumulative impacts to down wetland).

The following Maps explain more:

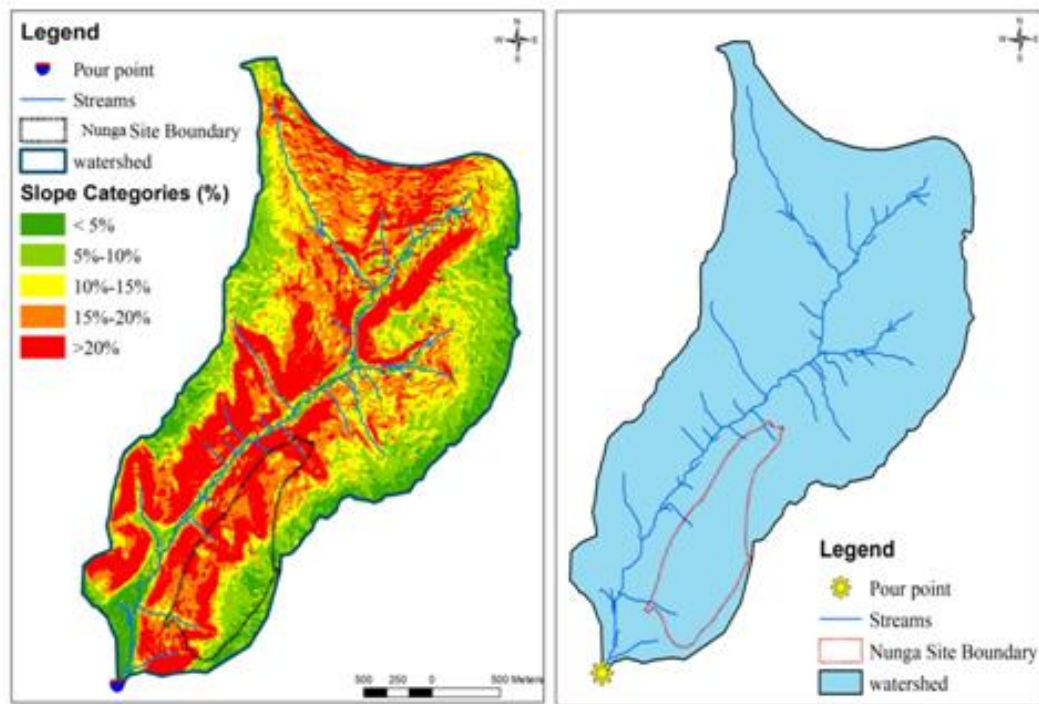


Figure 8 : Slope Map/Nunga site and Watershed Map/Nunga site

Source: data from Rwanda Housing Authority

From the above figures, some severe impacts revealed in high residential housing is severe surface erosion that continued to medium and low residential housing, from high to low contributions:

- Severe surface erosion
- Sealing of surface soil
- Landslides escarpments in medium standing goes directly to low area
- Zones of severely degraded vegetation
- Siltation/ pollution of water with particles dominated by silt or clay
- Salinisation due to natural cause/ increase of salt content
- Formation of ravines (deep or landform)(Gullies, erosion ditches)
- Zones with high water erosion

- Hence degradation of wetland bellow the site and destruction of agricultural activities in the outside of the site.

3.4. Data Collection Methods

Data collection was conducted through a methodological triangulation which consisted of the use of multiple methods to study a phenomenon or a single problem. Triangulation of data collection involves looking at an object from more than one stand point. In the context of the proposed study, the methods included interpretation of satellite imagery, questionnaire, interviews and field observations. As a strategy, these methods were put in one platform to gather information and facilitate the crosschecking of facts.

The data collected were qualitative and quantitative. In qualitative method, the researcher visits the site and gives the interview to the residents and local authorities while for the quantitative data method, the numerical and measurable information get collected.

3.4.1. Primary Data Collection

Primary data collection involves the process of gathering data directly from the original sources as opposed to collect information from research that others have done. Information have been obtained by scientific observation and field measurement, questionnaire, interviews and surveying (Roos, Nicol, & Cageorge, 1987). The primary data collection helps the researcher to obtain qualitative and quantitative data which help to analyze existing physical plan, to investigate the progress in the physical plan implementation, to assess the environmental impact that result from implementation of land use plan and come up with strategies and recommendation based on the findings.

3.4.1.1. Field Observation

This technique helped to look at the applicability of the required activities. The author managed to identify the existing land use of the matrix, topography and assessing methodologies to use in data collection. In case of Nunga Land use Plan Implementation; to examine people's natural settings and this reflected to the interview (face to face) and designed questionnaire (with open and multiple choice) used, Camera to take photos of the existing features on ground. All these helped to gather the empirical data and avoid errors and in getting all related information on Land Use Plan Implementation.

3.4.1.2. Questionnaire Survey

The Survey questionnaire; Gathering data method that is utilized to collect, analyze and interpret the different views of a group of people from a particular population, when designed and administered correctly ; should gather all the necessary information but avoid confusing the respondents because the data collected should reflect the opinions of the respondents. Mainly parts of the survey questionnaire is Self-completed questionnaires, Face-to –face interviews and Telephone survey (<https://www.examples.com/education/what-is-a-survey-questionnaire.html>)

3.4.2. Sampling Technique

Sampling is the technique of selecting the units from the population of your interest so that from it, you may generalize the results back to the population and assuming that your results are very accurate and have few confusions from mistakes (Lu & Yao, 1988). The case of land use plan implementation in Nunga site, the sample is taken from households. In Nunga site, the sample technique helped to determine the number of households that the interview and questionnaire have directed on.

In 1985, Javeau has established the following formula for calculating the sample size where n is the sample size, N is the universe or the total population within the study area and n_0 is the constant calculation from probability of two complementary events p and q where

$$p=q=0.5 \leftrightarrow p+q=1, n = \frac{N \cdot n_0}{N + n_0}$$

In 1963, Cochran has developed the equation which gives the value of n_0 as follow:

$n_0 = \frac{Z^2 \cdot p \cdot q}{e^2} = 100$. Where Z is the threshold of confidence which is estimated to be equal to 2 and e is the stroke of errors that is estimated to 10% or 0.1 . According to the formula, we determined the sample size from households in Nunga site as the population of our matrix and then we carried out the interview and provide questionnaire to use.

$$n = \frac{812 \cdot 100}{812 + 100} = 90 \text{ households}$$

3.4.2.1. Interview with key informants

Interview technique of data collection enabled to know the population view points by talking to them individually or in group discussion about Nunga land use plan implementation. It helps to obtain the detailed information about personal feelings, perception and opinion. It allows more detailed questionnaire to be asked. In my study, the interview helps to investigate the progress in the physical plan implementation, to assess the environmental impact that results from implementation of land use plan in Nunga site. My research interview has focused on mature people living in this site who know the situation of land use plan implementation and who are able to answer the raised questions. In my study, I contacted the local authorities who have participated in setting land use implementation at Nunga site. Two types of interviews (structured and semi-structured) were used in interview to make the easy understanding and collection of accurate information.

3.4.2.2. Questionnaire Distribution

Questionnaire is a research instrument consisting of a series of questions for the purpose of gathering information from respondents. After determining the sample size, the next step is to provide questionnaires related to the number of sample size (Suskie, 1992). In my research, questionnaire was not self-administrated; it was completed by the research. This reflects face to face completion model of administration where I have asked questions and subsequently recorded answer by myself. Questionnaire has enabled to get quick and efficient ways of obtaining large amount of information about environmental impact that result from implementation of land use plan in Nunga site.

3.4.3. Secondary Data Collection

Secondary data collection obtained by going through the existing documents such as scientific reports, websites, thesis related to land use planning and it allows keeping data from other sources and providing the stable qualitative and quantitative source of data (Hox & Boeijs, 2005). Secondary data helped in assessing the land use evolution in Nunga cell through time and helped in identifying the impacts associated with land use plan implementation through various documents exist

3.4.3.1. Library Research

In order to come up with information related to the implementation of land use plan, published materials were consulted. This includes various web documents and other ones found in libraries and documentation units of different public organizations like Rwanda Land Management and Use Authority (RLMUA), Rwanda Housing Authority (RHA), Ministry of Infrastructure (MININFRA), Kicukiro District, and the City of Kigali.

3.4.3.2. Spatial Data Analysis

The use of available spatial data set as administrative boundaries of Villages, Cells, Sectors, Districts and Provinces was used to produce different maps like delimitation and localization of Nunga Cell as the study area of the research. The spatial analysis helped to assess the evolution of land use in Nunga Cell by using different images of different years which was extracted from Google Earth.

Table below summarizes the information mentioned Earlier

<i>OBJECTIVES</i>	<i>RESEARCH QUESTIONS</i>	<i>DATA AND INFORMATION NEEDED</i>	<i>METHODS AND TECHNIQUES</i>
1. To assess the land use evolution in Nunga site	-How the land use in Nunga site changed through time?	-Land use change -Images and Orthophotos	-Google Earth images extraction -Spatial data analysis
2. Analysis of existing physical plan And progress in implementation	-What are the components of the current land use plan in Nunga site? -What is the current status of physical plan implementation in Nunga Site?	-The thoughts and feelings of residents and authorities about Nunga site physical plan -Households affected by physical plan implementation	-Questionnaire -Interview -Field observation
3. Assessing the environmental impact that result from implementation of land use plan	-What are the major environmental impacts that results from Land use plan implementation? -What was environmental protection status before putting place and implementing detailed physical plan? -At which rate do they manifest? What are their effects?	-Environmental impacts of land use plan implementation -Difficulties in implementation process -Solutions to mitigate the environmental impacts of land use plan and its implementation	-Questionnaire -Interview -Library research -Field observation

Table 3. Presenting Objectives, Research questions, Data and Information needed, Methods and Techniques used during data collection, source: designed by the author

3.5. Data Analysis

The primary data gathered through semi-structured questionnaire were analyzed statistically using the computer software (Statistical Package for the Social Sciences (SPSS) version 16.0) and GIS software also used in interpreting, analyzing and mapping. Percentages and frequencies were calculated to explain the statistics of respondents' characteristics. Regression analysis was employed to examine the relationship between a dependent variable and a set of independent

variables. The independent variables in this case were linked to respondents discussed in details in the next section.

3.5.1. Qualitative and Quantitative Data Analysis

Analysis of quantitative data involved descriptive frequency of certain characteristics like level of education and dominant environmental problems etc.

3.5.2. Data Quality

Validity; which refers to the appropriateness and the extent to which a measure accurately reflects the concept that is intended to measure, was enhanced by avoiding generalization. Questionnaires were designed to suit all respondents most especially use of open ended questionnaires for purposive respondents. The questionnaires were designed in a logical way and a pilot test with a few residents before actual fieldwork started was carried out.

Reliability; which involves consistency and the extent to which the same result is achieved when a measure is repeatedly applied to the same group was improved through, questionnaires that contain questions that relate well to the research objectives and seeking the supervisors guidance on the contents. Through acquisition of data from various sources, reliability of data and findings was easily enhanced.

Objectivity; which also involved expressing no particular opinion, neither for nor against a topic or issue was attained by avoiding leading questions, vague and suggestive questions when conducting interviews.

Chapter 4. Results and Discussions

The research focuses on land use plan implementation in Nunga site of Nunga Cell, Gahanga Sector in Kicukiro District. This chapter answers the question that the research posed. The major party of this section is to present the results of data gathered from the field and their analysis and interpretations. This was mainly done using questionnaire, field observation to understand the views of local population and the contribution of the authorities. It is important to be aware of the present state of land use plan in Nunga site and the present stage in the process of its implementation. This chapter provides the summary statistics for all data collected on field and identifies the issues that could affect the modeling process of land use plan implementation in Nunga site. It is also presenting the findings of the research as undertaken in section 4.

The field visit as the part of the research technique of data collection helped in realizing how infrastructure like sewage, drainage, water system, electricity in Nunga site are still insufficient but being upgraded. In this chapter, the spatial data present the land use change; evolution of housing, how the land use plan is being implemented and infrastructure are being provided in Nunga site. The interviews revealed that most of the residents in Nunga site are coming from different areas of Kigali city, while others come from neighboring regions where the majority of them are former migrants of casual workers

Characteristics		Frequency	Percent
Gender	Male	47	52.2%
	Female	43	47.7%
Age	Less than 20	10	11.1%
	20-30	20	22.2%
	30-40	20	22.2%
	40-50	35	38.8%
	50 and above	15	16.6%
Level of Education	No school	12	13.3%
	Primary	20	22.2%
	Secondary	15	16.6%
	University	43	47.7%
People's category (on the site)	Indigenous people in the site	20	22.2%
	Newcomers in the site	45	50%
	Indigenous people shifted to other places	25	27.7%

Table 4: Selected Descriptive Statistics of the Study Population, source: from field visit

A total of 90 respondents were considered for the interview. Table 4 shows various descriptive statistics for the study population. Table 4 also reveals that the vast majority had attained college education with 47.7% having achieved university education. 13.3% of survey respondents had no education. Nonetheless, 22.2% of respondents had completed primary education with 16.6% having gone up to secondary school. Surprisingly, the table also reveals that half of the respondents (50%) were newcomers in the site, however in the respondents there were 22.2% of Indigenous people who remained in the site where as 27.7% were Indigenous people shifted to other places.

4.1. Analysis on Nunga Site

Nunga Cell as it is located in fringe zone of the City of Kigali is mostly dominated by agriculture activities. However, the site of Nunga is 100% for residential and its associated activities like commercial, transport, education, religious, recreation and sports. Settlement in Nunga site is now subdivided into three categories according to the capacity or ability of the residents. The first category is for high standing houses in the Eastern part of the site which is the plateau surface on the top of the hill in this site and this category require more capacity to build the houses. The houses in the first category (high standing) might have one floor plus the upward levels. The second category is for middle standing houses in Central part of the site which is located on side of hill following the top plateau surface for high standing houses. The houses in middle standing category might have at least ground floor but with strong construction materials with concrete walls due to the nature of the slope there. The last category is for low standing houses in Western part of the site on steep slope. The houses in third category might have at least ground floor and here the mud bricks are mostly used during construction.

Here is a table with clear information.

No	Are (Ha)	Usage	Number of Plots
1	14.1	High Standing	384 residential plots, 4 commercial plots and 3 green areas. (Total = 391)
2	17.06	Medium Standing	450 residential plots, 5 commercial plots and 2 green areas. (Total = 457)
3	25.88	Low Standing	382 residential plots, 10 commercial plots and 15 green areas. (Total = 407)
4	1.51	Social	1
5	1.57	Social	1
6	0.32	Recreation	1
Total	60.44		1258 Plots

Table 5: Land use categories in the Nunga site, source: field observation

4.2. Land use evolution in Nunga site

4.2.1. Land use change in Nunga site from 2005 to 2010

During 2005, the current boundary of Nunga site was agriculture area and small surface was composed of vegetation cover like forest. During this time, there were 80 houses in the whole site and were scattered. By comparing to the current area of Nunga site with the number of its households in 2005, the density was about 7,375 m² per house.

As it is mentioned on the figure 9 through digitizing, a large part of Nunga site is occupied by clop land area which has changed in different years. In 2010, Nunga site was occupied by 117 houses that can be signified in calculation by taking the surface area of the site divided by the number of houses. This ended up with housing density of approximately 5,043 m² per house. The overall of those houses were not accessing to any infrastructure like roads, electricity, and water connection as well as they were informally established, that is why the land use plan of the site was needed to change the livelihood of the residents. In the couple of 8 years from 2002 to 2010, the number of houses in the site was increased from 80 to 117 houses and they were 37 more new houses established.

In this period, the land use within the site has not changed because since 2005, agriculture remained the dominant use of land and the surface of other vegetation cover was reduced. In this couple of 8 years, agriculture area shifted from 54.5 ha which is 92% of the total surface to 55.5

ha which is 94% of the total surface to the whole site, while the area of other vegetation cover reduced from 4.5 ha which is 8% of the total surface of the site to 3.5 ha which is 6% of the total area.

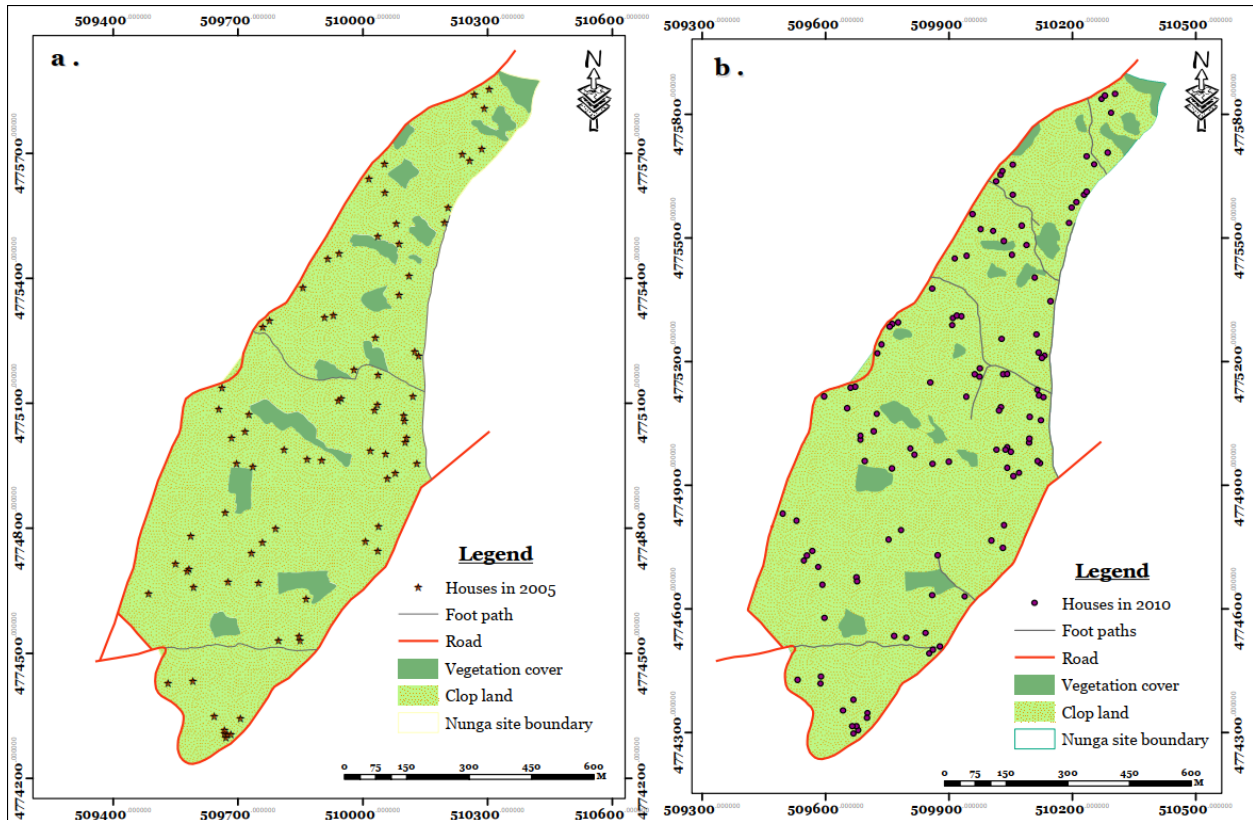


Figure 9 : Nunga site land use map in 2005 and Nunga site land use map in 2010/Source: www.rcmr.org

4.2.2. Land use change of Nunga site from 2010, 2015 to 2018

The change in land use in Nunga site continued but at a small rate until the physical plan was introduced. In 2015, eight-one houses (81 new houses) have been added to those in 2010. The average increase of the houses in the 5 years between 2010 and 2015 indicates that approximately 16 houses per year have been added. By comparing to the housing density of 5,043 m² per house in 2010, the housing density in 2015 is approximately 2,980 m² per house.

Since 2015 the aggregate of houses continued to increase where 291 houses have been added in the range of 3 years between 2015 and 2018. This increase indicates that approximately 97 houses have been added per year in Nunga site as the residential is dominating in the site. The

main cause of this increase shift of housing and residential area in relation to the decline of crop land area and other vegetation cover was the introduction of Nunga site physical plan.

In this period, agriculture area and other vegetation cover area were declining as the whole site is dominated by residential. The housing density in this range of 3 years from 2015 to 2018 compared to the total surface of the site is about 1,207 m² per one house.

According to the plan, the plot size should be 300 m² within the site for residential and this is excluding the land planned for non-residential uses. The plot is covered by 15 out of 20 meters as the regulations of Rwanda Land Management and Use Authority (RLMUA). The increase of the houses in Nunga site goes with the provision of infrastructure and basic services.

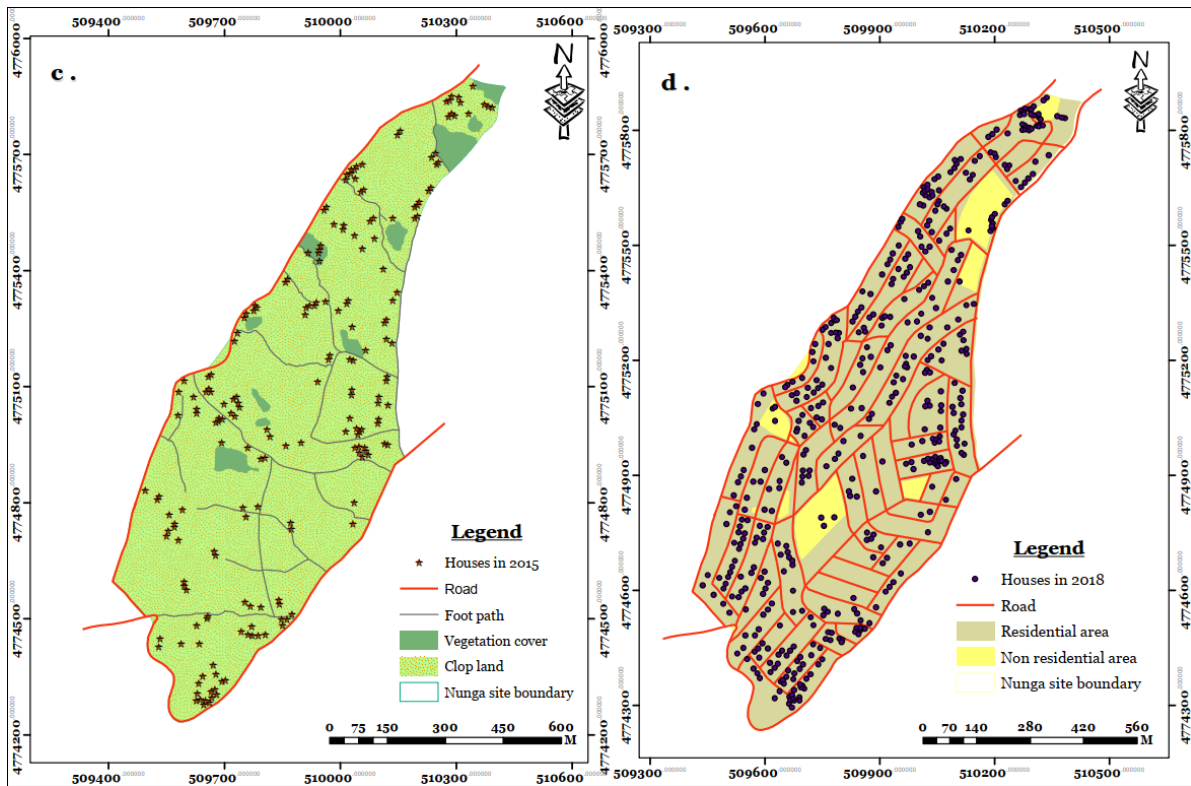


Figure 10 :Nunga land use map in 2015 and Nunga land use map in 2018/Source: www.rcmrd.org

Generally, the change in land use and the increase in houses and households in Nunga site imply the physical plan implementation by including local residents and other immigrating population from different locations with the availability of infrastructure. As the demand of shelter increases, the construction is tending to raise in the site.

4.3. Existing Physical Plan

Nunga site land use planning was done to identify the alternative solutions for land use and to adopt the best land use options for the local residents. The main target of land use planning in Nunga site was to allow the people to easily find the safeguarding place to live instead of moving to other regions outside the area. Nunga site land use plan was taken by allocating the land uses in helping the local residents to meet the economic and social needs. Nunga site physical plan was planned for (i) delivering infrastructure and services within the site, (ii) protecting environment, and (iii) constructing the well-designed houses.

The Nunga site was settled by diverse of people from different locations of Kigali and other areas of the country. Some of these people settled at Nunga before the introduction of Nunga land use plan while the others came after it is in the place. From the results of the field visit and data collection, 59% of the selected sample settled at Nunga after the introduction of land use plan while 41% settled in the site before the introduction of physical plan. The following chart indicates what attracted the people on the site.

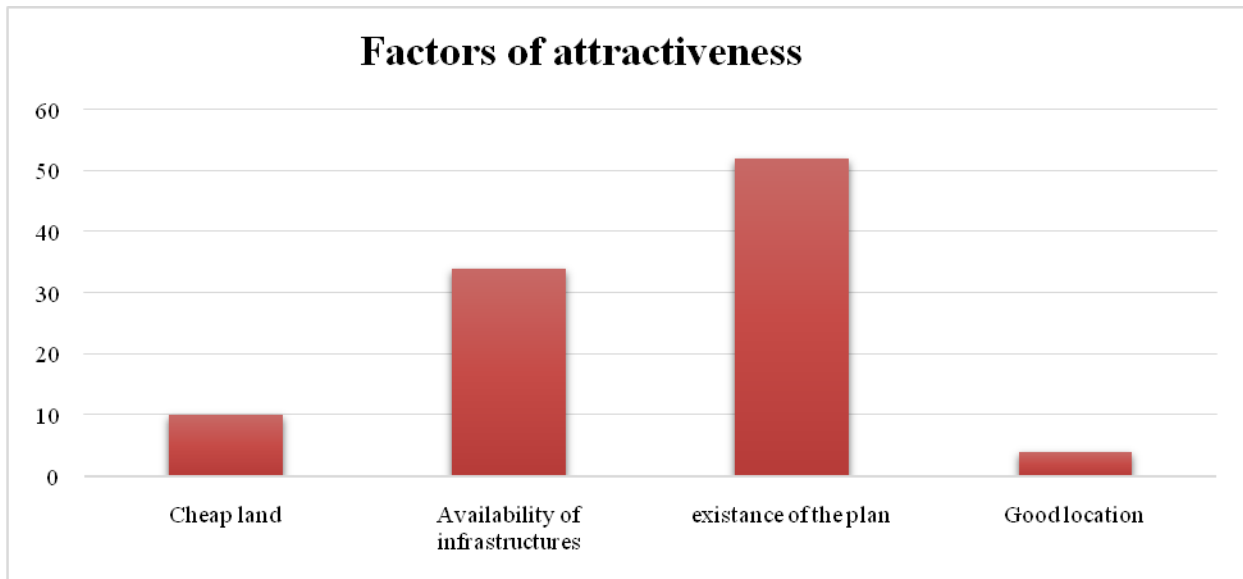


Figure 11: Factors that attract people in Nunga site, source: results from field

The new comers in the site were attracted by different factors like low prices of plots, availability of infrastructures that would be for a while, good location of Nunga site and the existence of the plan. As the results from the field indicating, 52% attracted by the existence of the plan, 34%

were attracted by the availability of infrastructures that would follow the site occupation, 10% of dwellers who came after the introduction of the physical plan were attracted by low prices of plots, while 4% were attracted by the location of the site.

In Nunga site, integration of residential and economic land uses are local-based businesses to help the community within the site. Ensure that neighborhood plans and housing designs provide adequate and appropriate space for these activities. A common tool for achieving this is mixed-use zoning that allows residential and certain commercial activities to be carried out within the site.

After the introduction of land use plan, the District of Kicukiro provides first the technical experts in making layout plan of the site where they made site roads and plots. After this stage, authorities communicated and presented the result to the population and District provided the site roads and contributed in providing the regulations that the people will follow during the construction of the houses within the site.

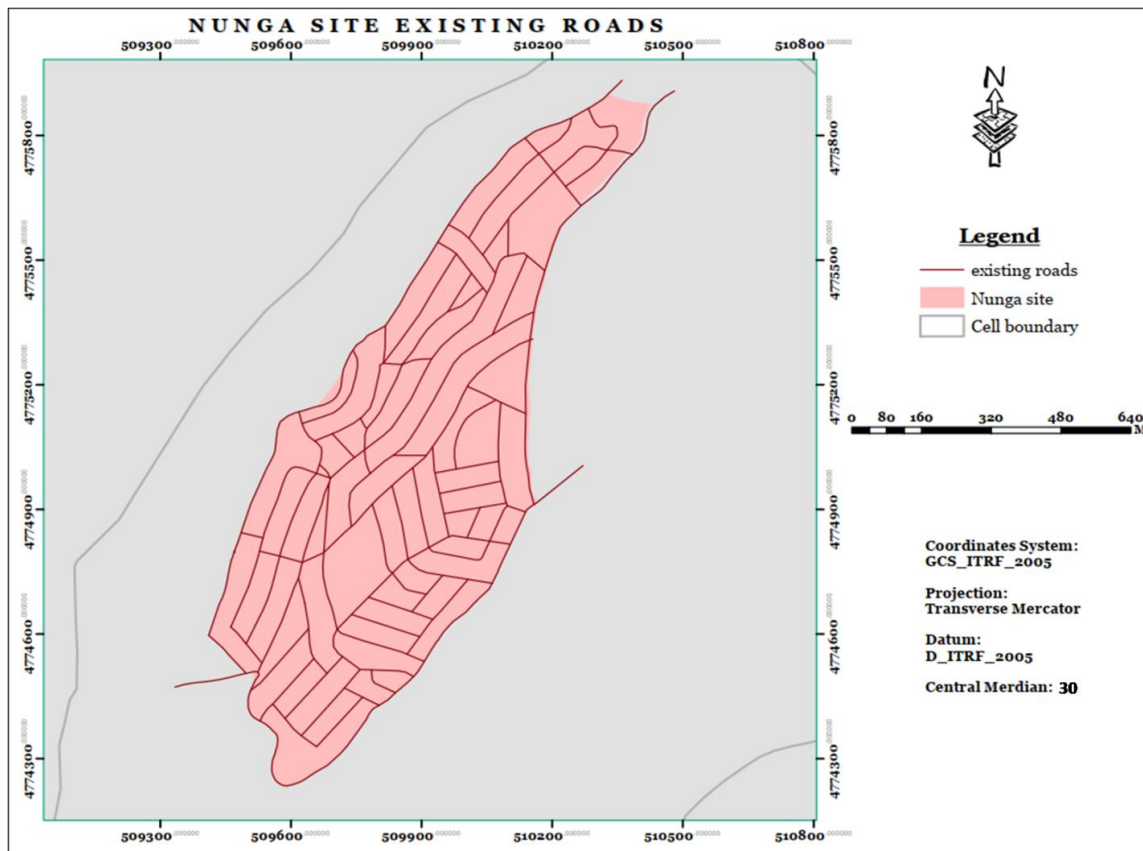


Figure 12 : Nunga site roads network/Source: Kicukiro District

The community is the main key actor of Nunga site land use plan and its associated implementation. The community participated in the land use, physical and strategic planning processes. The community developed a collective vision for the future of the residents; arrive at agreement on policy issues that cut across communities. The case study before 2016, describes how the community took the lead in requesting the government allow them to settle and build the residential houses in the site and the government provided land use plan to them and they took a first place in its implementation. The local government carried out the planning processes at the local community and created the structure to enable the meaningful community participation. The local leaders are committed with physical plan implementation and establish the regulatory framework for implementation process.

The local authorities carry out communications campaign to ensure compliance with plans. They review and approve building plans, enforce buildings codes and land use regulations, carry out inspections and administer sanctions with the committee in charge of managing and controlling the Nunga site land use plan. The City of Kigali and the District of Kicukiro mobilize the relevant government agencies, including regional entities, guide and support the implementation process. The District of Kicukiro provides technical expertise as required and creates the policy environment in which the plans are prepared.

Nunga site was divided into three categories. There is an area of high standard housing where the owner of the plot must build a house of one floor and additional of levels upwards. There is also an area of middle standard housing where the owner of the plot can build single floor houses but the construction materials must be everlasting materials while there is another area of low standard housing with single house floor but the difference of houses is the construction materials that compose the houses. The cost of the plot depends on the location. The plot for high standard housing cannot have the same value as the plot for the low standard housing. Nowadays, the cost of plot become expensive compared to the price of the plot at the beginning where the plot for high standard housing raised from six million up to ten million, the plot of middle standard housing from four million up to six million while the price of low standard housing came from two and half million up to three and half million.

The figure bellow is clearly indicating it;



Figure 13: The chart showing the average prices of plots according to their categories in Nunga site, source: results from field

This chart shows the price of plots according to their categories in two different periods. It is visible that from the beginning of selling the plots for housing, the price of the plot was not more expensive compared to the price of today where the price increased at least 1.5 times to the price of the beginning of selling the plots. According to the respondents, the increase of the price caused by the high demand of plots were due to the proposed infrastructures including paved roads, schools, market that would be in the site, many people were attracted by those infrastructures.

Let's refer to the map below;

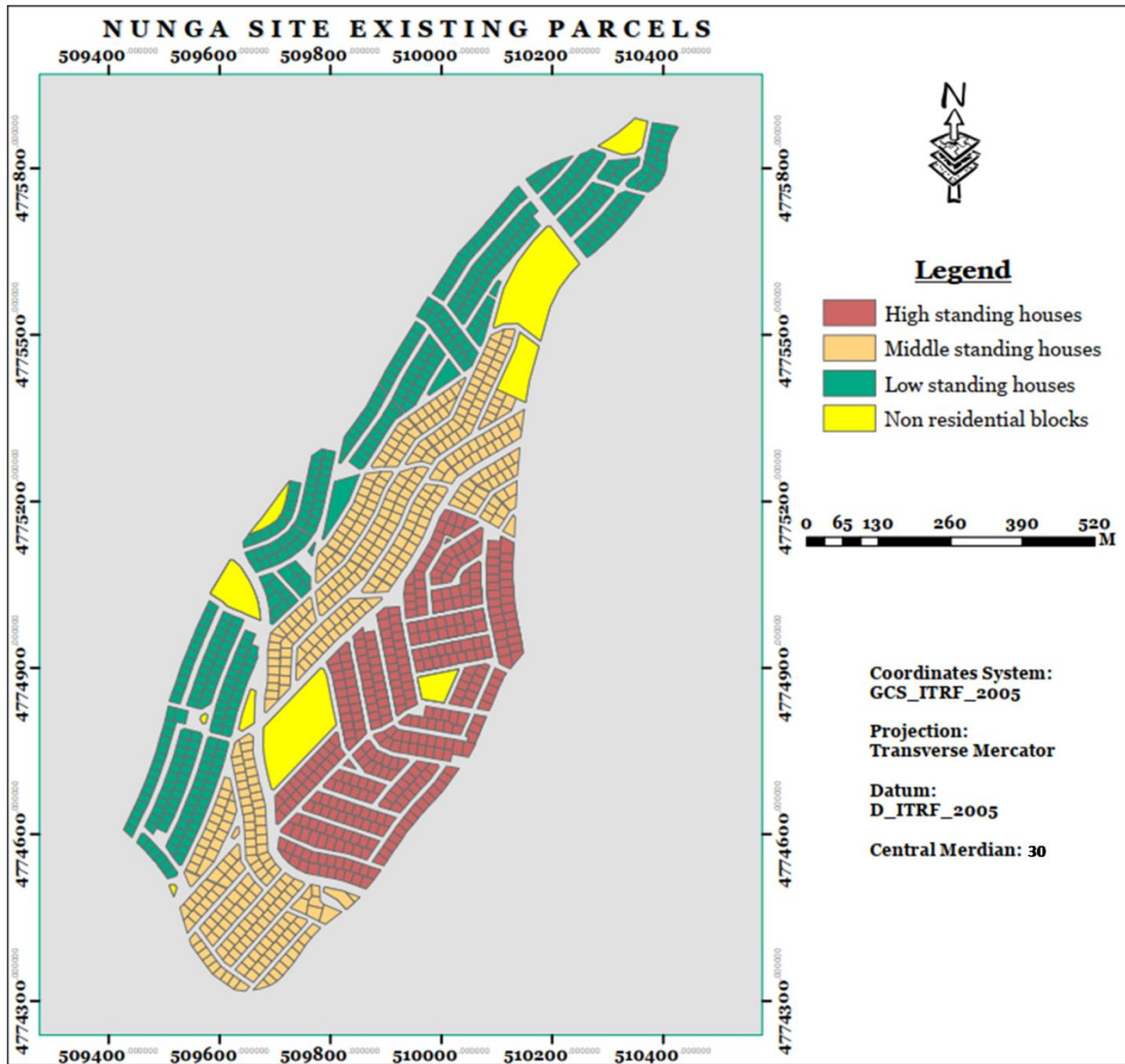


Figure 14: .Nunga site existing plots according to housing categories/ Source: Kicukiro District

The size of the plots in Nunga site both of low standard, middle standard and high standard housing most of them are equal, means the standard of plot size of 300m² is respected during the making layout plans of the site. The only difference occurs on the plots which were settled before the implementation of land use plan that occupy more than 300m² and those ones cannot be divided into fragments because the houses can be damaged. The plots for building were acquired in different ways mostly from the people who don't have the capacity of respecting

master plan regulations that have sold the plots to others. 59% of respondents have acquired the plots by purchasing from the property owners while 41% of the respondents resided at Nunga before the implementation of land use plan they bought the land before.

4.4. Physical Plan Implementation

The comprehensive physical plan provides a tangible vision for the future of any location that can be implemented flexibly as changing dictate circumstances. The plan provides accurate and detailed information on educational programs, space requirements, facilities conditions, construction costs, project phasing, sequencing, financing and much more. It is a high-resolution road map to the future.

As specified by the chairperson of Nunga site and Kicukiro District, Land use in Nunga site before the implementation of physical plan were occupied mostly by agriculture compared to the other use of land with few numbers of houses. Local authority in collaboration with local community, they decided together to change Nunga site into residential land use as the solution of several number young people who moved to the other locations for looking the area containing some basic infrastructures and choose to settle there. The local authority together with local community chose to take Nunga site as an area that can be developed by creating different infrastructures that can be attractive to different categories of people. The plan has designed with the support of District which showed up where different infrastructures will be located.

After getting the plan of the site, they were creating the road but with the agreement to people that no one would be compensated to his/her land which will be affected by the roads. The electricity was provided even if it is not enough and they started to install piped water in the site and the other infrastructures like construction of schools, market will follow step by step.

Nunga site land use plan implementation has different stakeholders. The powerful stakeholders are local citizens who accepted to use their land in roads formation without compensation. The other stakeholders including the local authority, District of Kicukiro, institution in charge of land use plan implementation, Police, Military and City of Kigali. The responsible of Nunga physical plan implementation are local citizens and Kicukiro District.

The site is near the main road (asphalt road) in 2.5 km. The first plot in the site has bought in January 2016 and there is a committee in charge of joining together the buyer and seller of the plots and that committee paid a big role in explaining people about the implementation of Nunga physical plan without compensation of their land for those who were affected by the roads. This committee is made up of seven people and they intervene in requesting for development money that has to be paid by everyone who buy and sell the plot. As the plots are located in different categories in the site, amount of money paid for the plots are also different.

The follow up of Nunga land use plan implementation is being conducted by Kicukiro District, City of Kigali and institution in charge of land use plan. They try to arrange everything as it was planned. Those who are in charge of following up are the ones that can take decision of upgrading the plan.

The following captured pictures, are taken photos while on field visit of this site and these photos are in three categories as mentioned earlier.



Figure 15: Houses in high standing area, source: taken from field



Figure 16: Houses in middle standing area, source: taken from field



Figure 17: Houses in low standing area, source: taken from field

The residents of Nunga Cell, especial those who reside in Nunga site are happy because of land use plan implementation in their site. 93% of respondents they appreciate the implementation of land use plan because everything in the site was planned, they really know everything which can take place on every plot that can help people to carry out their activities without fear of changing their plan in short term period.

4.5. Social and Economic situation

In comparison with the situations before the provisional of physical plan and after the plan, there were quiet improvements in the accessibility of the infrastructure available.

Effect	Before	After	Percentage
Water	Not available	Available in some categories	16.6
Electricity	Not available	Available	0
Roads	Not available	Available	0
Trading centers	Available but few	Available but many	50 Available
Sewage	Not available	Not available	33
Market	Not available	Not available	
Schools	Not available	Not available	

Table 6: Infrastructure and service accessibility: source: field survey

In the site before the plan; there were no development at all, market, trading centers, schools, and health facilities were from Gahanga Center, in 2.5 km from the site to the tarmac road, to reach there only bicycles and motorbikes are used so as to get buses or any means of transport. There were no electricity, no roads, and no water and so on. Today roads have been improved, electricity is available, insufficient water in the whole site, trading centers were extremely few but today they have multiplied, and the value of land has increased which led to the improvement of wellbeing of these people that born in the site, some remained others left to new places around.

The implementation of land use plan in Nunga site made in the collaboration between the local population and the local authority. This situation means that, there were no expropriated people

from the site. The only people who were moved from the site are those who did not have the capacity of building required houses in the site. They sold their plots to others and moved to cheaper areas. Other families left in Nunga site are those whose land was highly affected by the construction of some infrastructures like roads. As specified by the coordinator of the committee in charge of plots selling, six families were compensated for the affected land due to the construction of roads.

4.5. Environmental Impacts of Land Use Plan Implementation

Land-use change is arguably the most pervasive socioeconomic force driving changes and degradation of ecosystems. Deforestation, urban development, agriculture, and other human activities have substantially altered the Earth's landscape. Such disturbance of the land affects important ecosystem processes and services, which can have wide-ranging and long-term consequences.

The use of land has considerable impact on the natural and human environment. Conversion of natural and productive lands to human use, sprawling pattern and inappropriate location of development; building construction and land use practices after development; all have broad impact on human environmental health and the natural environment. Land use and its implementation plan's decisions can exacerbate and destroy wildlife habitat, pollute surface ground and cause air pollution, which affect community character and quality of life. The environment risks to humans are increased by poor location or design of land use developments.

Previously, mainly agricultural land and some small forest area covered Nunga site but today it has changed into residential land use. There are many environmental impacts that have been raised during the implementation of physical plan in Nunga site, the removal of those small portions of forest (deforestation) that catalyze the soil erosion and declining soil fertility due to unsustainable land use practices as the topography of the area is quiet sloppy and there would be soil conservation measures, the air pollution also take place due to the increase of dust in the atmosphere during the creation of roads and houses construction

Generally, contrasting views are reflected by households regarding the current Land-Use towards environmental effect. For those people who settled in the site, 18.8% of them did not get the capacity of collecting rainwater from the roof, iron sheets are so much and no planned measures

yet to avoid this runoff; this increased the problem of soil erosion in the site.14.4% of respondents were strongly agree on the increasing of land fragmentation especially in the neighboring areas where these indigenous people shifted from Nunga as result of this plan occupied and hence urban sprawl and much slums example in people went to Nyarugenge , Eastern Province and Bugesera because most of them are depending on agriculture.

Effect	Frequency	Percent
Inadequate/insufficient water	15	16.6
Surface runoff/erosion	30	33.33
Poor Hygiene	5	5.55
Other(environmental implications)	10	11.11
Lack of water tanks	17	18.88
Land fragmentation	13	14.44

Table 7: Different challenges on environment, from respondents, source: field survey

From the study, majority, 33.3% of respondents believed that land cover changes led to increased erosion, 5.5% of the respondents left in the site have poor hygiene and sanitation due to lack of jobs , 16.6 of respondents indicating surface insufficient of water because the whole site is not having water, 11.11% indicated other environmental implications like noise and air or atmospheric pollution, reduced soil fertility and consequently decline in agricultural productivity, reduced grazing fields and others.

Many land uses lead to significant disturbance on land surface thus interfering with natural erosion rate. The higher rate of erosion reported in this study may be attributed to the fact that most land use activities expose land to various erosion agents. In other words, land use is the single most important factor affecting soil erosion strongly enhanced by the human activities mentioned in the previous chapters. Lowering of water quality may be attributed to both solid and liquid waste both from domestic uses and industries.

Land use decisions can exacerbate natural hazards and soil erosion, alter the hydraulic balance, pollute surface and ground water, destroy wildlife habitats, increase energy use and air pollution.

This lead to the disturbance off some components like precipitation, evaporation, transpiration infiltration, and ground water flow.

4.6. Challenges to the people living in the site

From table 7 as the other new sites, Nunga site face different problems including water scarcity, insufficiency of electricity, poor sewage system, lack of market, schools , hospital and lack of drainage system. 16.6% of the respondents are facing the problem of water scarcity while 33% are facing both, problem of sewage system, lack of market and schools. Even though they are facing those problems, they desire that many of them will be resolved because the process of resolving water and electricity problem have started since on master plan the area for market, schools, and sewage system were also planned. The other problem related to land title especially for those people whose land were fragmented into many plots and they are waiting for new land titles have clear way of following up.

With the problem of water scarcity, people spend too much time, energy and money to fetch water in the swamp located in West of the site. The water from this swamp is not well filtered. The photo bellow is indicating it



Figure 18: Fetching water from the swamp, source: taken from field

4.7. Alternative Solutions to Environmental Impacts

The role of land use planning is vital to determine the future land use pattern and development. The main purpose of land use planning is to ensure the sustainability of three major societal

attributes. These attributes are: (1) infrastructure (jobs, roads, schools, firehouses, etc.), (2) environmental resources (open spaces, parks, watersheds, natural areas, wetlands, etc.), and (3) public health and safety (avoidance of flood plains, unstable soils, fire hazards, etc.). Although all three attributes are important and should be considered in land use planning, the priority must be given to the protection and sustainable use of environmental resources. It is because the (a) security and viability of infrastructures and assurance of public health and safety are greatly determined by the availability and quality of environmental resources, (b) land use decisions of last few decades have already caused major long term damage to our natural environment, most of these damages intensify with time and have no prospect of recovery, and (c) the continuation of the same old land use decisions would damage more resources causing imbalance to our ecosystem, costing billions of money to our economy, and posing threat to human civilization.

In order to avoid or at least minimize damage to our valuable environmental resources from future land use decisions, I am proposing two major strategies in land use planning and decision making process: (1) “Where to” strategy, and (2) “How to” strategy. These two strategies are based on the premise that population and economic growth must be accommodated by smart and wise development where environment comes first. To put this premise we need to incorporate ecological vision into our future development guided by the principles of “make nature visible” and “design with nature”. Environmental damage of urban growth can be averted by protecting environmental resources of our ecosystem. Protection of environmental resources can be achieved through the kind of land use decisions and plans that ensure “where to” develop and “how to” develop without jeopardizing environment.

Nunga site is a place that can bring more impacts to environments as its topography is high steep sloped, but due to the implementation of the physical plan, the environmental impacts are increasing day after day and the solutions should be taken in order to mitigate them. The strategy that has been taken for the rain water from the houses is that everyone has to control rain water from his/her house by installing water tanks, they also planned the way of drains of both flowing rain water and the waste water from the houses. The green space must be implemented in order to keep good air condition in the site, monitoring and assessing development programs to ensure compliance with the laws on the environment during the preparation and implementation of any

activity in the site related to the implementation of land use plan, and monitoring and supervising environmental impact assessments in the site.

The residents in Nunga site are encouraged to collect the rainwater to the water storage, fosses and the tanks in order to avoid the dangerous running water of runoff in destroying the properties or eroding the soil. The people of Nunga site are invigorated to explore water efficient irrigation system to protect their gardens against soil erosion. Another solution to be taken is to put an effort in building the water drainage system within the site in order to conduct rainwater or waste water from the site without damaging environment.

In Nunga site, the people will always need good air in respirations and in everyday activities. In this case the people are encouraged to plant local species of trees, flowers, vegetables and shrubs that will contribute in the provision of fresh air and attract variety of animals like birds in keeping the beauty of the site and its greening.

The people could make a compost pit to turn organic waste from the kitchens and gardens to soil enriching manure and this can be used in mechanization of agriculture.

In the site, it is not good to use intensively chemicals products as they will eventually end up in water systems and upset the delicate balance of lifecycles. The organic and environmentally friendly fertilizers and pesticides are available and organic gardening reduces pollution and is better for the life within the site.

Public meetings, and of ensuring a participation process that takes full advantage of the tools available to society in this area. A land-management division will be entrusted with managing the planning process as well as negotiating planning policies in the context of sector area plans. A legal division will be entrusted with defining, applying, and proposing reforms of the legal instruments necessary to create levers that will change the market. Finally, a division that provides geographic information, cadaster, and land-value assessment will ensure the accessibility.

Chapter 5. Conclusion and Recommendations

5.1. Conclusion

Land use plan implementation is an essential, yet neglected field of planning. This research aims to assess land use plan implementation and its environmental impacts in Nunga site, Gahanga Sector, Kicukiro District in the City of Kigali. One of the key findings of this study is that a collaborative planning process that engages stakeholders in the development and implementation of plans is required for successful implementation. In Nunga site, a big collaboration made between the local community and local authority to take decision about what are more needed in the site.

Land use plan implementation in Nunga site will yield more for the local population due to different infrastructures will be maintained including roads, electricity, water connection, schools, market and trading centers as well as raising concerns over lack of drainage system within the site. The electricity and water will be highly provided and increase in service provision in the site. Apart from the benefits from the implementation of land use plan in the site, there are some few environmental impacts that were happening including soil erosion which is highly increased due to the uncontrolled water from the ceilings of some houses, air pollution from the increase of dust in the atmosphere and also some species of plant have disappeared in the site due to the change of land use from the agriculture use to residential use of land.

Strategic Environmental Assessment (SEA) or Sustainable Assessment (SA) must be used for assessing the cumulative environmental impacts of land use plan implementation in Nunga site. This can be mainly including general discussion on the environmental issues and possible adverse impacts and emphasizes to prepare detailed environmental management plan of major development projects that can be done in the site.

5.2 Recommendations

Planning process of land use plan implementation should be done in close contact with the population, especially with the respect to the expressed aspirations of the poor and their potential for self-determination.

The residents should be informed before the implementation of land use plan and they should be informed on what is going on about the physical plan implementation process in order to reduce the opposition.

The government and the City of Kigali should find more external investors to fund the project of implementing Nunga site physical plan. This case will contribute to decreasing of the project delaying and will help the residents to be satisfied with the compensation fee for their expropriated properties. This funding should also help the poor people to reconstruct their houses without delaying and try to set up the strategic ways of negotiation while in compensation of destroyed assets.

Legislative, institutional and financial measures should be oriented to facilitate people's involvement in meeting their own needs for social services.

Standards for infrastructure and facilities should be based on the felt needs and priorities of the residents.

The government, the city and the district follow up should be done during the implementation process of Nunga site physical plan to reduce the problems and challenges that can happen from the disagreements on how the process is carried out and try to keep the indigenous people because the land use plan provision force these people to move to other surrounding places hence continue development of slums and informal settlements.

It is difficult to relocate the poor residents from the site as the community is a main actor in implementing Nunga site physical plan. In this case, order to protect the poor residents residing within the site, the government should at least provide the cheapest houses for renting or selling to them.

The communications about Nunga site physical plan should be done in whole country in order to encourage and attract more people to move to Nunga site. This case will help in accumulating the variety of different development from different locations in Rwanda as different people move to resettle in the site.

Nunga site before the introduction of its physical plan was the land for cultivation and other agriculture related activities. In this case, the government should contribute in protecting land for cultivation and promote mechanization in or around the site.

Continuous researches: Researchers, Universities, RLMUA, RHA, CoK and other relevant institutions are recommended to conduct more researches in the field of land use planning, its implementation and associated environmental impacts in sensitive areas like Nunga site in order to identify more challenges or issues that the actors or residents are facing. The results could have significant impacts on developments of the residents and the country in general.

The people in Nunga site, is now struggling with lack of water, insufficient electricity, lack of drainage channels, sewage lines and storages. So as recommendations, it is better to quickly provide these basic infrastructures in order to facilitate the people who are now settled in the site to meet their needs and to overcome the challenges related to lack of well elaborated infrastructure within the site. Once the basic infrastructures are well established within the site, people and different investors should be attracted to bring their business there.

An environmental impact assessment should also be part of the practice while implementing the plan as it contributes in achieving environmental protection, and it evaluates the environmental impact to be expected during the development, use and disposal of those exposed products.

References

- Ali, D. A., Deininger, K., & Goldstein, M. (2014). Environmental and gender impacts of land tenure regularization in Africa: Pilot evidence from Rwanda. *Journal of Development Economics*, 110, 262-275.
- Alonso, W. (1964). Location and Land Use, Toward a General Theory of Land Rent.
- Alterman, R., & Hill, M. (1978). Implementation of Urban Land Use Plans. *Journal of the American Institute of Planners*, 44(3), 274-285. doi: 10.1080/01944367808976905
- Beattie, L. (d.). Plan Implementation: The Reality of Land Use Planning in Auckland, New Zealand. Auckland Mail Centre, New Zealand: University of Auckland, School of Architecture and Planning.
- Bertolini, L., le Clercq, F., & Kapoen, L. (2005). Sustainable accessibility: a conceptual framework to integrate transport and land use plan-making. Two test-applications in the Netherlands and a reflection on the way forward. *Transport Policy*, 12(3), 207-220. doi: <https://doi.org/10.1016/j.tranpol.2005.01.006>
- Biraro. (2015). Performance audit report of the implementation of City of kigali master plan - period 01 october 2013 to 30 november 2015.
- Burby, R. J., & Dalton, L. C. (1994). Plans can matter! The role of land use plans and state planning mandates in limiting the development of hazardous areas. *Public Administration Review*, 229-238.
- Campbell, S. (1996). Green cities, growing cities, just cities?: Urban planning and the contradictions of sustainable development. *Journal of the American Planning Association*, 62(3), 296-312.
- County, A. (2006). Land Use Final.
- Engel, A. (2011). Land Use Planning. from <https://www.giz.de/fachexpertise/downloads/Fachexpertise/giz2012-en-land-use-planning-manual.pdf>
- Groot, J. C., Rossing, W. A., Jellema, A., Stobbelaar, D. J., Renting, H., & Van Ittersum, M. K. (2007). Exploring multi-scale trade-offs between nature conservation, agricultural profits and landscape quality—a methodology to support discussions on land-use perspectives. *Agriculture, Ecosystems & Environment*, 120(1), 58-69.

- Hameed, R., & Nadeem, O. (2008). Challenges of Implementing Urban Master Plans: The Lahore Experience. *International Journal of Humanities and Social Sciences*, 2.
- Hox, J. J., & Boeije, H. R. (2005). Data collection, primary versus secondary.
- INES. (2015). Land market values, Urban land policies and the impacts in urban centers of Rwanda. Kigali.
- Jie, L., Jing, Y., Wang, Y., & Shu-xia, Y. (2010). Environmental Impact Assessment of Land Use Planning in Wuhan City Based on Ecological Suitability Analysis. *Procedia Environmental Sciences*, 2, 185-191. doi: <https://doi.org/10.1016/j.proenv.2010.10.022>
- Kaswamila, A. (2006). evaluation of land use plan in protected areas bionetworks in notheastern Tanzania. Tanzania.
- Kaswamila, A. (2012). An Analysis of the Contribution of Community Wildlife Management Areas on Livelihood in Tanzania Sustainable natural resources management: InTech.
- Kigali, C. o. (2013). Kigali City Master Plan Report. Rwanda / Kigali City: City of Kigali.
- Lewis, S. (2015). Qualitative inquiry and research design: Choosing among five approaches. *Health promotion practice*, 16(4), 473-475.
- Lombard, M. (2016). Land conflict in peri-urban areas: Exploring the effects of land reform on informal settlement in Mexico. *Urban studies*, 53(Urban land and conflict in the Global South), 21. doi: 10.1177/0042098015603569
- Lu, D., & Yao, K. (1988). Improved importance sampling technique for efficient simulation of digital communication systems. *IEEE Journal on Selected Areas in Communications*, 6(1), 67-75.
- Martínez, M., F.G. (2015). Social Sustainability in the Land Use Planning Process of Bogotá. (Master's Degree Programme in Creative Sustainability), Aalto University, Bogota, Colombia.
- McCall, M. K., & Dunn, C. E. (2012). Geo-information tools for participatory spatial planning: Fulfilling the criteria for 'good' governance? *Geoforum*, 43(1), 81-94.
- Merriam, S. B. (1998). *Qualitative Research and Case Study Applications in Education. Revised and Expanded from " Case Study Research in Education."*: ERIC.
- Metternicht, G. (2017). Land use planning.
https://static1.squarespace.com/static/5694c48bd82d5e9597570999/t/593a42d7197aea88458703df/1496990441721/Land+Use+Planning+__G_Metternicht.pdf

- Metternicht, M. (2017). LAND USE PLANNING. from https://static1.squarespace.com/static/5694c48bd82d5e9597570999/t/593a42d7197aea88458703df/1496990441721/Land+Use+Planning+__G_Metternicht.pdf
- MINIRENA. (2004). National Land use Policy.
- MINIRENA. (2013). National Land Use Development Master Plan to improve the land use and management. Retrieved June 27, 2018, from http://www.minirena.gov.rw/index.php?id=61&tx_ttnews%5Btt_news%5D=182&cHash=83e58f1a5f0daba584733e8d69be3182
- Nadeem, O., Haydar, S., Sarwar, S., & Ali, M. (2013). Consideration of environmental impacts in the integrated master plan for Lahore-2021 (Vol. 65).
- Nadeem, O., Haydar, S., Sarwar, S., & Ali, M. (2013). Consideration of Environmental Impacts in the integrated master Plan for Lahore-2021. *Pakistan Journal of Science*, 65.
- NISR. (2015). Fourth Population and Housing Census, Rwanda, 2012 District profile, Nyarugenge.
- Orhe, C. (2015). Implementation of the pilot SEA of the Orhei Town Master Plan: Strategic Environmental Assessment (SEA) of the Master Plan of the Municipality of Orhei.
- RNR. (2015). Indicators for sustainable land use in Rwanda
- Roos, L. L., Nicol, J. P., & Cageorge, S. M. (1987). Using administrative data for longitudinal research: comparisons with primary data collection. *Journal of Clinical Epidemiology*, 40(1), 41-49.
- Soriano, Q., & Christina, C. (2016). Impacts of land use change on ecosystem services and implications for human well-being in Spanish drylands. *Land Use Policy*, 54, 534-548. doi: <https://doi.org/10.1016/j.landusepol.2016.03.011>
- Suskie, L. A. (1992). Questionnaire Survey Research: What Works. *Resources for Institutional Research*, Number Six.
- Tao, T., Tan, Z., & He, X. (2007). Integrating environment into land-use planning through strategic environmental assessment in China: towards legal frameworks and operational procedures. *Environmental Impact Assessment Review*, 27(3), 243-265.
- Ullah, M. (2014). Urban Land Use Planning using Geographical Information System and Analytical Hierarchy process:
- Case study DHAKA CITY. (Master degree), Lund University, Lund, Sweden. (35)

USAID. (2015). An Assessment of Land Use Planning in Rwanda. Kigali, Rwanda: USAID.

van Lier, H. N. (1998). The role of land use planning in sustainable rural systems. *Landscape and Urban Planning*, 41(2), 83-91. doi: [https://doi.org/10.1016/S0169-2046\(97\)00061-3](https://doi.org/10.1016/S0169-2046(97)00061-3)

Wapwera, S., & Egbu, C. (2013). Master Planning System: Constraints for Planning Authorities in Jos Metropolis, Nigeria (Vol. 6).

RLMUA,(2017): Rwanda National Land Use Planning Guidelines.

<https://www.examples.com/education/what-is-a-survey-questionnaire.html>

Appendices

Appendix 1. Questionnaire for household survey

SECTION A. QUESTIONS TO THE PEOPLE LIVING IN THE SITE

1. Are you native or immigrant person?

- a. Yes
- b. No

If you are immigrants, which factors that attracted you to choose this place?

- a. Cheap land
- b. Availability of infrastructure (facilities)
- c. Good location
- d. Existing of the plan
- e. Other (Specify).....

2. What is your profession?

- a. Working in public institution
- b. Working in private institution
- c. Own business
- d. Others (Specify)

3. What is the value of your plot today? If you need to sell it?.....

4. How much tax do you pay on your plot?

5. How do you consider land use plan and its implementation?

6. What are the environmental impacts occurred during and after the implementation of land use plan?

.....
.....
.....

7. Are there any strategies designed to overcome these environmental impacts?

- a. Yes
- b. No

If yes, what are they?

.....
.....
.....

8. How much is the size of your plot? By Length (m), Width (m) and Surface area (m²).

	Low standard of housing			Middle standard of housing			High standard of housing		
	L	W	S.A	L	W	S.A	L	W	S.A
Surface of the plot									
Size of the house									

9. How did you acquire the plots for building?

Purchase from government

Purchase by expropriation

Land/Property purchase

Others (specify).....

10. Which problems do you face in this site?

.....

.....

.....

.....

11. Does people have access to the following services? (Tick where appropriate)

No	Utility	Yes	No	Estimated Distances/Km
1	Electricity			
2	Piped water			
3	Sewer line			
5	Land line telephone			
6	Water tank			
7	Paved roads			
8	Roads in neighborhood			
9	Hospital			
10	Schools			
11	Churches			
12	Market			
13	Trading Centers			

Thank you for taking your time to answer this questionnaire!!

SECTION B. QUESTIONS FOR PEOPLE EXPROPRIATED FROM NUNGA

1. Why did you choose to move from Nunga site instead of staying there as your resident place?
.....
.....

2. Are you happy with compensation?

Yes

No

3. How long time did you took for moving to new resident place?

a.5 months

b. 1 year

c.2 years

d. 3 years

e.4 years and above

4. How did you consider the infrastructure accessibility in Nunga site before the implementation of land use plan?

a. Insufficient

b. Moderate

c. Sufficient

5. Are there any consequences you meet based on the situation of Nunga site land use plan implementation?

Yes

No

If yes, what are they?

.....
.....
.....

6. What positive impacts did you get from expropriation?

.....
.....
.....

7. What negative impacts did you get from expropriation?

.....
.....
.....

8. Has the land become expensive after announcing the implementation of land use plan in Nunga site?

Yes

No

9. How do you consider the conditions of living before and after the implementation of land use plan?

.....
.....
.....

Thank you for taking your time to answer this questionnaire!!

Appendix 2. Interview guide:

Questions to the local authorities

1. Would you please give us a brief history on how land use plan implementation started in Nunga site?
2. How many people living in Nunga Cell? And in Nunga Site?
3. What type of land use before physical plan implementation?
4. What kind of current land use in Nunga site?
5. What caused the land use to change over time?
6. When does this land use change started?
7. What are the characteristics of physical plan of Nunga site?
8. What is the guarantee of this site?
9. Who are stakeholders in the land use plan?
10. What time does the plan take to be implemented?
11. Who implements the plan?
12. Who is in charge of making follow up while implementation of land use plan?
13. Is there any upgrade/Validation or any other follow up after implementation?
14. What are the challenges in the implementation?
15. What are environmental impacts mostly frequent in this site?
16. What criteria in setting up protecting measures on environment?
17. What time line in implementation?
18. How long does the process of land use plan take? Since the submission of project to the District till implementation?
19. What criteria were considered to choose the site?

20. How do you determine what goes where? If people disagree on how land should be used what happens?
21. What is the number of households to be partly affected by land use plan implementation in Nunga site?
22. How do you compensate the affected households?
23. What are the infrastructures and services provided during the implementation of land use plan?
24. Did you hold community meetings about land use plan and its implementation?

Thank you