The impact of a road infrastructure project on socio-spatial interaction and quality of life of planned and unplanned fragments in Kisumu City

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February, 2019

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ABSTRACT

Studies have shown that as cities urbanize in the Global South, spatial planning projects like road construction are increasingly becoming popular in transforming landscapes and leading to both social and spatial inequalities. They lead to various land use changes in most cities which coexist as planned and unplanned, legal and illegal, formal and informal urban fragments, with limited or no interaction and varying quality of life (QoL) conditions between them. Attempt of scale-up infrastructure projects in cities to make them competitive sometimes fail to carefully consider the needs of the affected citizens. Earlier studies have shown that road infrastructure projects may aggravate processes of urban fragmentation resulting in limited interaction between fragments which is likely to have an effect on residents' quality of life.

This study sought to investigate how the bypass road in Kisumu city influences socio-spatial interaction between and within urban fragments, and how change in interaction may affect the subjective quality of life of the residents. The research employed a case study-approach, using qualitative, quantitative and spatial methods to understand the socio-spatial interaction dynamics and subjective QoL of the residents in planned and unplanned residential fragments of Tom Mboya and Obunga neighbourhoods respectively. Both secondary and primary data was used to understand the categorization of residential fragments, socio-economic status and potential impacts of road infrastructure project. Primary data was obtained through in-depth interviews, household questionnaires and walking interviews. A total of 239 questionnaires were administered in the study area and statistically processed to examine the perceived interaction and subjective QoL in the two fragments.

The study found that respondents in the two residential fragments perceived improved accessibility to facilities and services between and within fragments after road expansion. Enhanced accessibility facilitated both social and spatial interaction within and between fragments. Respondents in the two fragments perceived strong social interaction within fragments as compared to between fragments. Cumulatively, 90% and 86% of the respondents in planned and unplanned fragments respectively, were feeling at home in their fragment. Whereas, cumulatively 60% and 69% of the respondents in planned and unplanned fragments respectively agreed that they could rely on help from their neighbours. Regarding subjective QoL, there was improved perceived QoL within fragments across the five dimensions of QoL conditions. According to the coefficient of variation, the variability of subjective QoL decreased in the two fragments after road expansion, as QoL conditions increased across the five dimensions of QoL. Many respondents who experienced a change in perceived social interaction, also experienced a change in perceived QoL after road expansion. This implies that there could be an association between perceived interaction and subjective QoL, but it is not necessarily a cause-effect relationship, as there could be other factors like county government interventions, NGOs and development agencies contributing to change, other than road expansion.

The major findings of this study show that perceived interaction and subjective QoL improved in the two fragments after road expansion. The present study does not bring out the issue of more fragmentation between neighbourhoods as a result of road expansion as had been initially expected based on earlier studies on road infrastructure and fragmentation. However, to further accommodate this, the study recommends safe ways of crossing the road to connect the two fragments which will enhance the sharing of facilities and services. This will encourage co-existence that urban communities need to have in sustainable cities. Future research on understanding the relationship between interaction and QoL is needed for better planning and policy formulation that will promote interaction and sustainable urbanization.

Key words: Kisumu city; Kenya; Planned and Unplanned; Residential fragmentation; Road infrastructure; Socio-Spatial interaction; Subjective Quality of life

Dedication

To my late mom Peris Tabitha Nakholi, late sister in-law Melvyne Keli, David Odanga, Vincent Wandera, Candy, Paula, Rebecca and Maureen. I would not have been where I am today, if it were not for your love, prayer and encouragement. I am forever grateful!

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ABBREVIATIONS

AFD	Agence Française de Développement
CBD	Central Business District
CBS	Central Bureau Statistics
CDF	Constituency Development Fund
CRDC	County Research and Development Consultants
CSV	Comma Separated Values
GoK	Government of Kenya
KeNHA	Kenya National Highways Authority
KNBS	Kenya National Bureau of Statistics
KPHC	Kenya Population and Housing Census
MoRPW&H	Ministry of Roads, Public Works & Housing
NEMA	National Environment Management Authority
NGO	Non-governmental Organization
OSM	Open Street Map
QoL	Quality of Life
SPSS	Statistical Package for the Social Sciences
TTCA-NC	Northern Corridor Transit Transport Coordination Authority

1. INTRODUCTION

In rapidly urbanizing cities of the Global South, road infrastructure is increasingly becoming popular in transforming landscapes and leading to both social and spatial inequalities (Oviedo Hernandez & Dávila, 2016). This means that as cities grow economically and strive to become competitive, a need for structuring and in some cases re-structuring of road networks may emerge. The attempt of scaling-up the city and making it competitive sometimes fails to carefully consider the needs of the affected citizens during the infrastructural development (Brussel, Zuidgeest, Pfeffer, & Maarseveen, 2019; Aoun, 2016). Construction of a road, whether new or upgrading of an existing one, is presumed to have a range of impacts on both the population and the urban form (Mackett & Edwards, 1998). However, the impacts may be positive or negative. Positive impacts are that road construction will lead to job opportunities, travel-related businesses, increase in economic activities like setting up of road side businesses, retail shops, supermarkets among others. On the contrary, the negative impacts can be seen regarding road safety issues especially on road crossing due to high speed from vehicles (Zuidgeest, 2018; Gichaga, 2017). Security issues, noise and atmospheric pollution are other negative impacts. Road infrastructure development is likely to aggravate segregation, gentrification, polarization and other social-spatial differentiations among social groups (Bocarejo, Portilla, & Meléndez, 2015).

Furthermore, spatial planning projects in urban areas like road infrastructure lead to active land use changes in most Global North and South cities. These have often been characterised as the coexistence of planned and unplanned, legal and illegal and formal and informal urban fragmentation as stated by Follmann (2015) cited in Follmann, Hartmann and Dannenberg (2018). These cities also show spatial patterns of disintegrated urban form which are often defined as urban fragments (Balbo & Navez-Bouchanine, 1995). Urban fragments arise from urban fragmentation which refers to the breaking up or disintegration of the urban environment into fragments (Landman, 2011). These fragments may interact both socially and spatially or fail to interact with the other. Theoretically, interaction bring people together in neighbourhoods and create bonds between residents (Buonfino & Hilder, 2006). As such, interaction is likely to contribute positively to one's subjective Quality of Life (QoL). It can enhance social cohesion, provide strong institutions where residents can share facilities and even care for each other in neighbourhoods (Farahani, 2016). Additionally, interaction is capable of facilitating crime reduction within neighbourhoods because residents develop strong bonds which act as protective barriers that keep them close and out danger (Hoogerbrugge & Burger, 2018). Interaction also encourages residents to perform certain social activities together like walking, thus promote well-being and physical fitness as suggested by Brown and Lombard (2016). However, these fragments may also fail to interact.

1.1. Background and justification

Studies on the analysis of urban fragmentation have gained prominence in the recent past. This follows differences in the socio-economic status in cities in both the Global North and South (Michelutti, 2010). Despite urban fragmentation having been studied in both Global North and South, it is the South that has rapidly urbanizing cities characterised by planned and unplanned residential fragments. In Global South countries, urban fragmentation also referred to as segregation, has a long history originating from the colonial era towards neo-liberal models (Dupont & Houssay-Holzschuch, 2005). Overall, urban fragmentation is perceived to be a societal problem in most cities of the Global South. It leads to increased inequalities in accessing spatial opportunities and services, thus reducing interaction between

people and the urban space which affects their quality of life (Balbo & Navez-Bouchanine, 1995; Manderscheid & Bergman, 2008).

As such, fragmentation in Global South cities can be perceived in two ways: first as a product of colonialism and secondly, as a result of urbanization and globalization characterised by inequalities (Balbo, 1993; Landman, 2011). For instance, cities in Latin America which were compact during the colonial era show fragmented urban areas, often because of urban development projects (Borsdorf, Hidalgo, & Sá Nchez, 2007). Indian cities like Mumbai are also experiencing urban fragmentation as a result of rapid urban growth accompanied by political influence (Gandy, 2008). The spatial composition of Cape Town in South Africa shows a great deal of fragmentation, and the city has sprawled to the sandy plains away from the peninsula; this is attributed to apartheid or social segregation as noted by Dupont and Houssay-Holzschuch (2005). Emrah and Hüseyin (2008) explain spatial fragmentation and social exclusion in the city of Istanbul in Turkey which resulted from the process of globalization. Jimmy (2018) discussed residential fragmentation and Quality of Life in Nairobi city, Kenya. The author analyses the relationship between residential fragmentation and Quality of Life (QoL) using different categories of residential fragments; slum, planned non-gated and gated community in Nairobi city. Jimmy found that studying residential fragmentation and QoL was vital in understanding of urban matters in a multidimensional way.

Spatial planning projects like road infrastructure are based on master plans and a set of building standards and regulations aimed at handling problems that come with urbanization (UN-Habitat, 1995). The projects sometimes target place rather than people because of the pressure of economic development. It is assumed that there would be trickle-down effects from the new development to benefit the people either through policies of social inclusion or sometimes just naturally (Swyngedouw, Moulaert, & Arantxa, 2002). The assumption of trickle-down effect may not apply in some context coupled with the differences in income levels among the population. The differences are due to the socio-spatial inequalities between urban fragments and so allows exclusion and expels what was once considered the same territory (Nardelli & Szupiany, 2017). Studies have noted that some cities in Latin America show patterns of isolation based on socio-economic or class status resulting from urban expansion processes like road infrastructure and other functions (Nardelli & Szupiany, 2017). Road infrastructure development may have effects on land value and accessibility to services like healthcare facilities, schools among others thus leading to mushrooming of deprived areas as argued by Bocarejo et al. (2015). The analysis of the implementation of a Bus Rapid Transit System (BRT) in Bogota city looking at different social groups revealed the possible contribution of road infrastructure projects towards the aggravating process of urban fragmentation; this in return affects Quality of Life (QoL) of certain social groups because of limited interaction between them (Bocarejo et al., 2015).

Earlier studies allude to some attempts that have been done to address urban fragmentation. According to Emrah and Hüseyin (2008), these attempts have been in the direction of re-integrating cities by emphasizing participatory approaches to empower and enable inclusion for all. Subsequently, it is assumed that this can reduce the inequalities between social groups and improve interaction. However, this approach has not had much impact as stated by Coy (2006) because only a few examples exist, and may be attributed to the utopian idea. Another attempt being encouraged according to Cervero (2013), is the integration of infrastructure projects and land-use planning to mitigate unintended consequences in cities of Global South.

Kenya, being one of the Global South countries, is not an exception of the growing challenges related to spatial planning projects and their consequences on the urban form in its major cities. These include growing inequalities, exclusion, housing, safety and security (UN-Habitat, 2016). The rapid rate of urbanization in Kenya has exacerbated the ability of both national and county governments to manage urban growth. This has revealed itself in the presence of urban sprawl which is reflected in the growth of

unplanned settlements (Wagah, Mwehe, Obange, Teyie, & Nystrom, 2017). This is present in Kenya's major cities, such as Nairobi, Mombasa, Kisumu and Nakuru. Rapid urbanization has made Kisumu city to continue attracting investments and large-scale projects with the most recent one being road infrastructure development. Although the city is experiencing rapid urbanization, the unplanned settlements are facing peripheralization leading to low-income people being forced to move out of the city centre to the peri-urban areas, revealing different patterns of residential fragments in the area (Frediani & Monson, 2016).

1.2. Research gap Identification

Previous studies have shown that conceptualization of urban fragmentation has not been explored fully despite its existence in the urban field (Michelutti, 2010). Michelutti attribute partial conceptualisation of fragmentation to the weakness in the explanation of the phenomenon based on its complexity and inconsistency in definition. This may also explain the limited researches in this field of urban fragmentation. Study conducted in Bogota city on different social groups revealed the possible contribution of road infrastructure projects to exacerbation of urban fragmentation process (Bocarejo et al., 2015). In Kenya, studies related to road infrastructure and urban fragmentation have largely focused on the effects of road expansion on biodiversity and conservation (Seto, Güneralp, & Hutyra 2012; Mugendi, 2014)) and on the active exclusion of modes used by the poor from the newly created road spaces (Alando, 2017). Other studies that closely relate to the present one have focused on improving the mapping of the socially disadvantaged in the slum settlements (Wagah et al., 2017; Kohli, 2015; Pereira, 2011; & Karanja, 2010). There is also an existing study that focuses on the implications of the Kisumu bypass road before implementation (Lefever & Wouters, 2007). This existing body of literature, however, does not reveal much on how road expansion influences the interaction between urban fragments and the likely effects of this interaction on the Quality of Life of residents at a neighbourhood level. The present study thus expands the scientific knowledge on urban fragmentation, from the angle of the influence of road infrastructure projects on the interaction of urban fragments, and even paves way for further researches in this field. Study findings can inform interested stakeholders such as the Physical Planning office of Kisumu County and Kenya National Highways Authority (KeNHA) with regard to area-based interventions.

Looking at urbanization process in Kisumu city, it is essential to understand the kind of changes that have taken place in the social and spatial interaction of the urban fragments and determine the extent to which road expansion may be influencing the interaction between the residential fragments and how this interaction may affect subjective QoL of the residents. Secondly, it is also important to assess change in fragmentation between the two residential fragments by considering two moments in time of before and after road expansion (2012-2018)[1].

1.3. Research Objective

The main objective of this study was to investigate how the bypass road in Kisumu influences social-spatial interaction between and within urban fragments and how change in interaction may affect subjective Quality of Life of the residents.

[1] The period under review in this study is 2012-2018. Generally, this is because the construction of the bypass commenced in 2013 and the road was ready for use in 2016. Therefore, 2012-2018 takes care of the two moments in time being addressed in this study (before and after road expansion).

1.4. Specific objectives

1. To analyse categories of residential fragmentation and characteristics of interaction between these categories
2. To find out how road expansion influences the social-spatial interaction between urban fragments
3. To understand from the residents of the two residential fragments how they perceive interaction between fragments and likely effects on subjective Quality of Life before and after road expansion

Research questions

Specific Objective 1:
To analyse categories of residential fragmentation and characteristics of interaction between these categories

1a). What are the common categories of residential fragments and their spatial distribution in Kisumu city and how has this been shaped by the physical planning?

1b). What are the socio-economic and spatial characteristics of the categorised residential fragments?

1c). What are the relevant indicators to measure the interaction between these categories?

Specific Objective 2:
To find out how road expansion influences the social-spatial interaction between urban fragments

2a). What were the anticipated social and spatial impacts of the road infrastructure project in the study area?

2b). What are the actual social and spatial impacts accruing from road expansion according to the residents of the two fragments?

Specific Objective 3:
To understand from the residents of the two residential fragments how they perceive interaction between fragments and likely effects on subjective Quality of Life before and after road expansion

3a). To what extent does subjective Quality of Life of the residents vary in the two fragments, before and after road expansion?

3b). How does change in interaction between residential fragments affect subjective Quality of Life of the residents in the two fragments?

1.5. Thesis structure

This thesis consists of six chapters briefly discussed below:
Chapter one: *Introduction,* this chapter introduces the research topic and gives the background information in line with the study and justifies the research problem, objectives and research questions.

Chapter Two: *Literature Review,* the chapter examines relevant literature based on the discussion of concepts of urban fragmentation, road infrastructure development, interaction and Quality of Life. The chapter also discusses the conceptual framework and the indicators to measure interaction and subjective QoL between and within fragments based on earlier studies.

Chapter Three: *Methods and Data,* this chapter provides information on the case study area and justifies case study selection, gives an overview of residential fragmentation and land use patterns in Kisumu city. It describes anticipated impacts of the road infrastructure project, research design matrix, selected indicators, data collection methods and research process of the study. An overview of characteristics of respondents and ethical considerations that were adhered to during data collection phase are also presented.

Chapter Four: *Results,* the chapter discusses the results and findings of the study in regard to the research questions. Findings on categories of residential fragments and their characteristics together with impacts of the road are reported. Possible changes in the social and spatial interaction of residential fragments, the perception of the residents on subjective QoL and variations within fragments, together with the association between interaction and subjective QoL in the study area are presented here.

Chapter Five: *Discussion of results,* this chapter interprets the study findings as per the objectives of the study and the conceptual framework in relation to earlier studies.

Chapter Six: *Conclusion and recommendations,* this chapter presents a summary of major study findings and gives conclusions, limitations, followed by recommendations and proposes areas for further research.

2. LITERATURE REVIEW

This chapter of the study elaborates on the key concepts and their definitions; urban fragmentation, road infrastructure development, interaction, and Quality of Life. It discusses the conceptual framework and the relevant indicators to measure interaction and subjective QoL within urban fragments based on the available literature from the previous studies.

2.1. An overview of urban fragmentation

Different authors have offered various definitions of urban fragmentation: Landman (2011) and Al Shawish (2015) defines urban fragmentation as the breaking up or disintegration of the urban environment into fragments. This disintegration leads to the formation of smaller fragments with limited or no interaction between them as further defined by Bocarejo et al. (2015). It is often a disconnection of urban form, leading to disconnection of linkages in the functions of the landscape, hence does not allow the city to perform as one entity (Bocarejo et al., 2015). The concept of fragmentation is explained by the fact that the city is no longer a unit but divided into fragments which are not linked and have no relationship that permits cohesion and coherence. Many scholars like Graham and Marvin (2001) have discussed urban fragmentation concerning causes and consequences, making urban fragmentation a "slippery concept" (Landman, 2011). This study adopts Landman (2011) and Bocarejo et al. (2015) definition of urban fragmentation which emphasizes on the disintegration of the urban environment into urban fragments, *"as the breaking up or disintegration of the urban environment into fragments*," discussed in section 2.1.1.

2.1.1. Dimensions of urban fragmentation

Regarding the complex and multidimensional nature of urban fragmentation, recent studies have identified the following six dimensions; social, spatial (physical), economic, environmental, political and cultural (Bocarejo et al., 2015). *The social dimension of fragmentation* refers to differences between social groups, the inequalities between them concerning access to opportunities, public facilities and services, loss of social networks and links between fragments. Borsdorf et al. (2007) define *spatial dimension of fragmentation* as the division of different population groups and different land uses which include residential, commercial, industrial, social facilities and services, employment and recreation among others. Spatial differences in many of the Global South cities results from different household income levels and different ability to secure land. Borsdorf and Hidalgo (2009) further explain how weak physical relationships between fragments and public space bring about exclusions in the community, such as gated communities and thus the absence of cohesion and coherence. *The economic dimension of fragmentation,* on the one hand, refers to a disparity in access to the labour market between the rich and the poor (Kempen, 1994). On the other hand, it may also refer to inequalities in investments and access to other resources within the city. *The environmental dimension of fragmentation* refers to lack of accessibility to green space and public space by the public for recreation or other functions (Borsdorf et al., 2007). *The cultural dimension of fragmentation* is the presence of different identities among people in isolation in the city, and this influences their residential patterns and thus a sign of segregation (Coy, 2006). *The political dimension of fragmentation* is associated with the gap in urban policies and lack of political goodwill (Balbo & Navez-Bouchanine, 1995).

This study employs a planning perspective of development projects, and therefore consider social, economic and spatial dimensions of urban fragmentation. The socio-spatial phenomenon is more about morphology and its relationship with the social structures. Furthermore, studies have shown that social,

economic and spatial dimensions of urban fragmentation bring out inequalities that exist between groups as discussed by Chakravorty (1996) and Bocarejo et al. (2015).

2.2. Urban fragmentation and road infrastructure

Road infrastructure refers to "road facilities and equipment, including the network, parking spaces, stopping places, draining system, bridges and footpaths" (WHO, 2004). The definition suggests that road infrastructure is a land use project (spatial project) that takes a lot of space because it is expandable. Regarding urban fragmentation and road infrastructure development, earlier studies have shown that road infrastructure may exacerbate the already existing gap between the wealthy groups and the poor leading to increased social inequalities (Oviedo Hernandez & Dávila, 2016). In addition to the context of spatial concentration, the wealthier groups segregate themselves based on income levels, purchasing power and accessibility (Cervero, 2013; Oviedo Hernandez & Dávila, 2016). Inequality reveals ranked relationship of inclusion and exclusion, privileges and deprivation, and thus brings out differentiation by class and status of social groups (Marcuse, 1993). This affects the QoL of people and may even influence population distribution between the fragments. However, road infrastructure has also been associated with economic development (UN-Habitat, 2009).

2.3. The interaction between residential fragments

Interaction in this study is twofold, on the one hand, refers to activity between two or more people between and within fragments (social interaction). On the other hand, it refers to the activity between people and access to facilities between and within fragments (spatial interaction). This is then looked at as internal interaction, which occurs between residents of the same neighbourhood (within fragments) and external interaction, which occurs between residential fragments.

2.3.1. Social interaction

According to Hickman (2010), social interaction refers to regular interaction between friends, family or community among other groups. It describes the way people talk or chat and even visit those around them. Social interaction at the neighbourhood level can be viewed in different ways through;

- Social networks within a neighbourhood (Bridge, 2002)
- Family and kinship
- Neighbouring- positive interaction between residents living close to each other, Buonfino and Hilder (2006) discuss the same.
- Relations between ethnic groups
- Social capital

To analyse social interaction, the study looked at the key places like churches, mosques, markets, educational facilities, health facilities, social institutions and recreational facilities among others as places where social interaction can happen. These are valued places of interaction as they bring people together in neighbourhoods and create bonds between residents (Buonfino & Hilder, 2006). The strong bond between residents forms a protective barrier that keeps them out of danger, culminating into safe and caring neighbourhoods with reduced crime rate.

2.3.2. Spatial interaction

Spatial interaction in this study refers to access to facilities and services between and within neighbourhoods. Residents are likely to have access to facilities that are close to them regarding distance and how to get there. Presence of accessibility to facilities facilitates spatial interaction of residents within and outside their neighbourhoods. Earlier studies show that an increase in social inequality and polarization translates to spatial divisions within cities especially in the Global South (Krugman, 1999).

However, spatial interaction also enhances spatial integration of isolated cities through the sharing of facilities or certain functions and structures as suggested by Tan, Zhou, He, and Xu (2016). The authors further argue that spatial interaction between fragments may have a positive contribution to regional development and urban growth.

2.4. Quality of Life

QoL is a broad concept which has been defined differently by different authors. Tonon (2015) defines QoL as the perception that each person has about his or her life in a cultural context coupled with expectations and achievements in life. According to Senlier, Yildiz, and Aktas (2008), Quality of life (QoL) refers to the relationship between individuals' perceptions, feelings of people and experiences within the environment that they live in. QoL is seen as a way that makes an individual's life to be desirable or undesirable following the satisfaction levels of life and contentment. According to the literature, there is no single, universally accepted definition for QoL. The study defines QoL as *"people's feeling of well-being and satisfaction from the surrounding environment."* The concern about QoL in urban areas has resulted in researchers gaining interest to measure QoL in such areas (Oktay, Rüstemli, & W. Marans, 2009). QoL being a complex concept is investigated using two perspectives of objective and subjective conditions of life (Berhe, Martinez, & Verplanke, 2014). This implies that QoL can be assessed using both quantitative and qualitative methods, thus mixed method for measuring both tangible and intangible dimensions of QoL. In this regard, spatial differentials of neighbourhoods and patterns of inequalities can be traced and analysed based on QoL characteristics (Martinez, 2018).

This study analyses subjective QoL. In subjective QoL perspective, satisfaction or dissatisfaction levels of people with different domains of life is expressed giving information about people's perception or opinion with their living conditions (Royuela, Moreno, & Vayá, 2010). In this study, the use of questionnaires as a research tool gives residents perception about their QoL before and after road expansion in the two neighbourhoods.

2.5. Interaction and Quality of Life

Quality of Life is determined by one's overall feelings about the environment or neighbourhood satisfaction (Ghani Salleh & Badarulzaman, 2012). The level of satisfaction or dissatisfaction with an area is shaped by several factors including social and physical attributes of the neighbourhood. However, factors such as level of integration (interaction), individual expectation, attitude to the society in general and people's traditions may affect neighbourhood satisfaction as suggested by Pacione (2003). Society is key in determining QoL of people through behaviour, and attitude, since it influences perception, values and expectations of individuals. On the one hand, earlier studies have shown that social interaction is important in improving the QoL of individuals especially through social support (Datta, Datta, & Majumdar, 2015). On the other hand, spatial interaction, which refers to how people access facilities, is key in reducing the inequalities that exist between neighbourhoods, and so contribute to QoL of the people. Therefore, interaction has a pivotal role in improving the QoL of individuals in residential areas.

2.6. Residential fragmentation and Quality of Life

Urban space is becoming more fragmented and with less connection between neighbourhoods which in most cases, has an effect on access to amenities, hence affecting residents' QoL (Wang, Shaw, & Yuan, 2018). Quality of Life, in general, may refer to conditions in which people live. Urban transformations encourage privatization of amenities, which reduce the government control in managing urban space through planning guidelines and standards by providing public amenities which are reachable and affordable to residents. Furthermore, in some cases, important facilities like educational, commercial, health and even recreational areas which are key to residents' daily life may end up missing within the

vicinity, which is likely to have effect on neighbourhood life and resident's QoL as well (Wang et al., 2018). Studies have shown that amenities play an important role in building sustainable neighbourhoods and promotion of social interaction as they provide a connection between residents and enhance their neighbourhood identity and the overall QoL (Brown & Barber, 2012). However, it is also assumed that residents living in different fragments experience different QoL conditions following their socio-economic status. This explains the socio-spatial differences that exist between residential fragments and the varying QoL (Pacione, 2003).

2.7. Conceptual framework

The concepts of this study are urban fragmentation, road infrastructure project, interaction, and subjective QoL. The conceptual framework in *Figure 2-1* explains the relationship between the concepts in which the road infrastructure (bypass) is being investigated to see if it influences the social-spatial interaction and the likely effects on subjective Quality of Life of the residents, in the adjacent neighbourhoods. This study discusses social and spatial interaction between and within residential fragments, and analyses possible changes in the interaction. The interaction and satisfaction levels of residents within fragments is analysed through dimensions and indicators of Quality of Life, discussed in *Table 2-1*. Association between interaction and subjective QoL is also analysed to see if a relationship exist between the two. QoL indicators measure the conditions of life and, this implies that they reveal both social and spatial inequalities that exist at the neighbourhood level (Noll, 2002). Subsequently, this also informs the subjective QoL of residents within the residential fragments. This study uses residents, especially household heads, as a unit of data collection (cases) and residential fragments as a unit of analysis in determining the interaction between and within the two fragments.

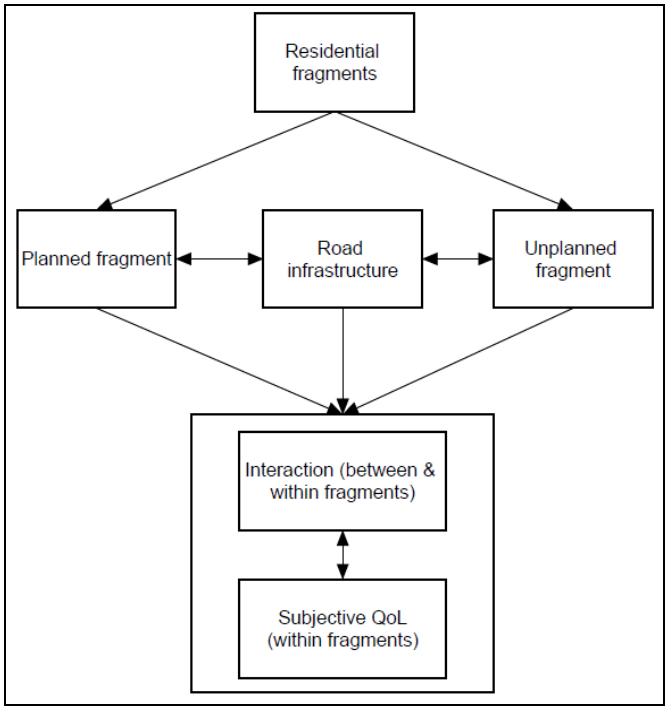

Figure 2-1: Conceptual framework
Source: Author, 2018

2.7.1. Selection of indicators to measure the interaction

Indicators are defined as direct or indirect measures of anticipated outcome which are in most cases flawed measures of intangible constructs or impression of complex reality (Sirgy, Rahtz, & Swain, 2006). Quality of Life is a complex concept as already mentioned, that has been studied from varied perspective,

and so different indicators have been used to measure subjective QoL conditions. Therefore, there is no specific method for selection of QoL indicators (Diener, 1995). In this study, to select relevant and reliable indicators, literature was reviewed with regard to the study area. This enabled identification of six dimensions from different dimensions of life to measure the interaction between residents of the two neighbourhoods which may inform subjective QoL *(Refer to Table 2-2)*. Therefore, indicators represent the operationalization of what is important in the interaction of the residents of the two neighbourhoods.

Table 2-1: Indicators to measure interaction and subjective QoL

Dimensions	**Indicators**	**Attributes**	**Supporting literature**
Social Networks	Welfare groups, religious groups, Associations & friends	Support from friends, neighbours and relatives	(Farahani, 2016; Lusher, Robins, & Kremer, 2010; Lowe et al., 2015)
Employment	Job opportunities	Access to jobs in neighbourhoods	(Sirgy et al., 2006)
Education	Access and attendance in schools	Access to schools	(Sirgy et al., 2006)
Health	Access to health facilities & services	Access to healthcare services for healthy and liveable neighbourhoods	(Lowe et al., 2015; Sirgy et al., 2006; Bentivegna et al., 2002)
Recreational areas	Access to parks, open & green spaces and playground	Availability and access to parks, open spaces and playgrounds	(Sirgy et al., 2006)
Housing		Housing access	(Sirgy et al., 2006)

3. CASE STUDY AREA, METHODS AND DATA

This chapter gives a description of the study area and the case study approach. It also describes the processes carried out before data collection, during and after field work. It describes anticipated impacts of the road infrastructure project, research design matrix and selected indicators. An overview of the characteristics of respondents and ethical considerations that were adhered to during data collection phase are also presented.

3.1. An overview of Kisumu city

Kisumu is the third largest city after Nairobi and Mombasa on the shores of Lake Victoria, Western part of Kenya. It is also the headquarters of Kisumu County and a former landing point for British passengers' flying boats and mail route. Kisumu city has an estimated population of 500,000 as per the 2009 population and housing census[2] (Nodalis Conseil, 2013), and an approximate area of 417 square Kilometres, where 297 square kilometres is dryland and 120 square kilometres under water as stated in Kola, Onyango and Oindo (2015) and CRDC (2016). The population of Kisumu city has grown in the recent past resulting in informal settlements around the Central Business District (CBD). More than 50% of the city population lives in peri-urban areas which are informal settlements and depend on the informal sector for basic needs (Steyn, 2012). The current city typology comprises of the colonial city with the original layout and the unplanned neighbourhoods around the colonial city, and beyond these, the peri-urban areas which are transforming very first as the city expands (CRDC, 2016).

Kisumu, is also an administrative and commercial centre for the Western region. The city was declared by the United Nations to be a millennium city in 2006, owing to the number of development projects that were coming up and its growing state of the urban centre for the region (Steyn, 2012). Administratively, Kisumu city falls in Winam Division, and some of the land use include residential, commercial, industrial and recreation (Alexander, Benjamin, & Grephas, 2012). Kisumu City covers two Sub-counties; Kisumu Central and Kisumu East Sub-Counties. Kisumu city connects to major cities like Nairobi, Mombasa, Nakuru and Eldoret. For this reason, the government launched a road project for a significant upgrade of Kisumu roads in 2009, and this is still ongoing in some sections of the city. A section of the Northern corridor road network which is the Kisumu bypass is one of the infrastructure projects that has been implemented in the city.

3.1.1. History of Residential fragmentation in Kisumu city

The emergence and development of residential fragmentation in Kisumu dates back to 1901 with the arrival of the railway line in the city which saw many people migrate into Kisumu town. In 1908, the town of Kisumu was struck by a bubonic plague which resulted in the zoning of residential areas (CRDC, 2016). The British colonial Township board designed Kisumu with the centre in well-drained areas away from the lake shore (Anderson, 2016).

The board zoned the residential areas of the city into three blocks; Block A-C (Letema, Van Vliet, & Van Lier, 2014). European and Asians were zoned in Block A, this is the current Milimani, Kibuye and Tom

[2] Kenya population and housing census (KPHC) is conducted after every 10 years and it is a comprehensive head count where every household in the country is visited. The last population census took place in 2009, the next census is to be carried out this year, 2019.

Mboya neighbourhoods. This block was planned and had formal housing alongside better facilities. Block B formed the undeveloped buffer zone, which constitutes the current informal areas (slum belt) of Kisumu (Letema et al., 2014). This zone includes the current Manyatta "A" and "B", Nyalenda and Obunga neighbourhoods. The final Block C was African residential areas and included Nyamasaria, Migosi, Dunga, Nanga among others and were peri-urban areas with communal plots *(Figure 3-1)*. This zoning was meant to exclude Africans from certain areas and curb the spread of diseases, thus causing fragmentation. The social divisions of the city during colonialism were therefore reflected in the racial location of residential quarters as indicated by the distinctive boundaries between the European and the Asian communities, Arabs and other urban Africans.

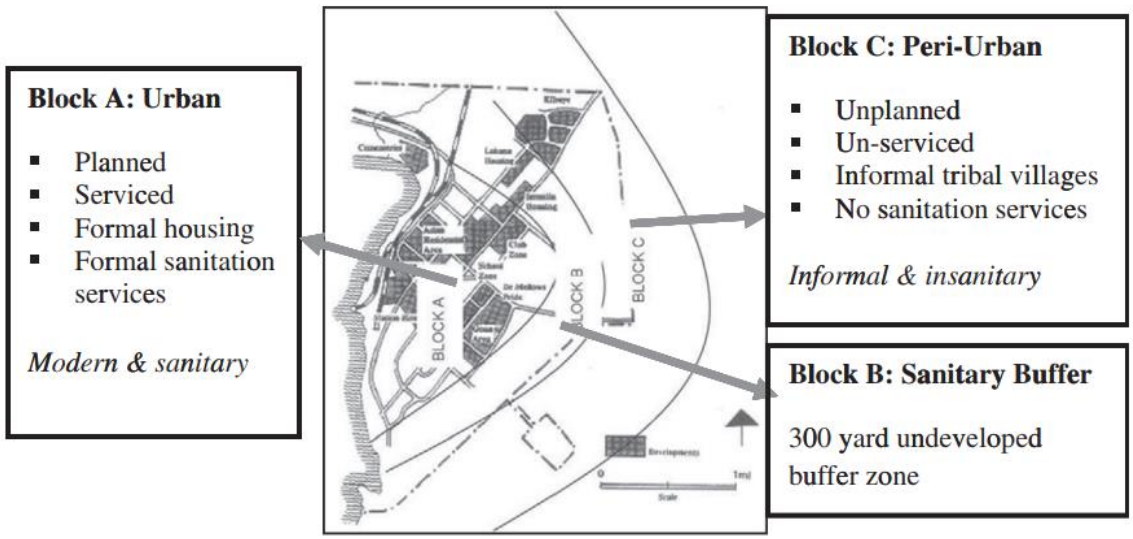

Figure 3-1: Blocks designated by the British colonial Township board for Kisumu
Source**:** Letema et al. (2014)

Major cities in Kenya are spatially zoned using old colonial zoning plans, which perpetuate this residential fragmentation on the basis of social-economic differentiation, rather than racial differentiation as it was during the colonial time. There exist cases of both formally planned developments and impulsive privately developed informal settlements in most of the major urban centres in Kenya (Olima, 2001). However, for Kisumu City when the colonialists first settled here, they encouraged a segregated city plan. Though this is changing, the traits of the order remain. Traditionally, when the city developed during the colonial period, areas like Obunga, Manyatta, Nyalenda among others were actually outside the colonial city boundary (Anyumba, 1995). However, the period marked the beginning of residential fragmentation as these areas housed poor workers who were outside the city as was recognised but yet part of the city. The old city included Tom Mboya, Arina, Russian quarters, Nubian, Makasembo, Ondiek, Milimani, Lower railways among others (Anyumba, 1995).

3.1.2. Land use patterns of Kisumu city

Urban land use of the contemporary cities both in the Global North and South according to Landman (2011) is seen to be more fragmented now than before, and the reason could be attributed to urban sprawl. For instance, the fragmentation of natural areas through the encroachment of development projects. Landman further explains that new residential or agricultural areas could be divided by the construction of new roads thus leading to spatial fragmentation, which is perceived negatively both in the North and South countries (Coy, 2006).

Literature review shows that Kisumu city has based its planning approaches on the initial 1984 structure plan for a long time, which has not been effective in guiding land use development especially for the peri-urban areas (Kola et al., 2015). There has also been no approved development plan for the peri-urban areas as further noted by Kola et al. (2015). *Figure 3-2* and *Table 3-1*, show Land use distribution in Kisumu city as presented in the Kisumu Integrated Strategic Urban Development Plan (KISUD-Plan) of 2013. Land use distribution shows the activities within the city with highest percentage of land use being under informal settlements 38.61% (Nodalis Conseil, 2013). This may mean that the majority of the city residents live in the informal settlements which are also unplanned. This reveal that the city is developing informally because the planned areas are not able to contain the housing demand. However, planned residential areas occupy 11.68% of the city area which is slightly lower than the industrial area which is 12.6%. The area under green spaces is the least regarding coverage with 0.9% (Nodalis Conseil, 2013). Institutional or government land is owned by Kenya Government or the County Government and stands at 4.25%, it is earmarked for infrastructure, administrative and social facilities (Bard & Lennmalm, 2015). Land for commercial purposes has not evolved for a long time, and just like industrial land use, it has no room for expansion. Area coverage in percentage for the different main land uses in Kisumu city is shown in *Table 3-1*.

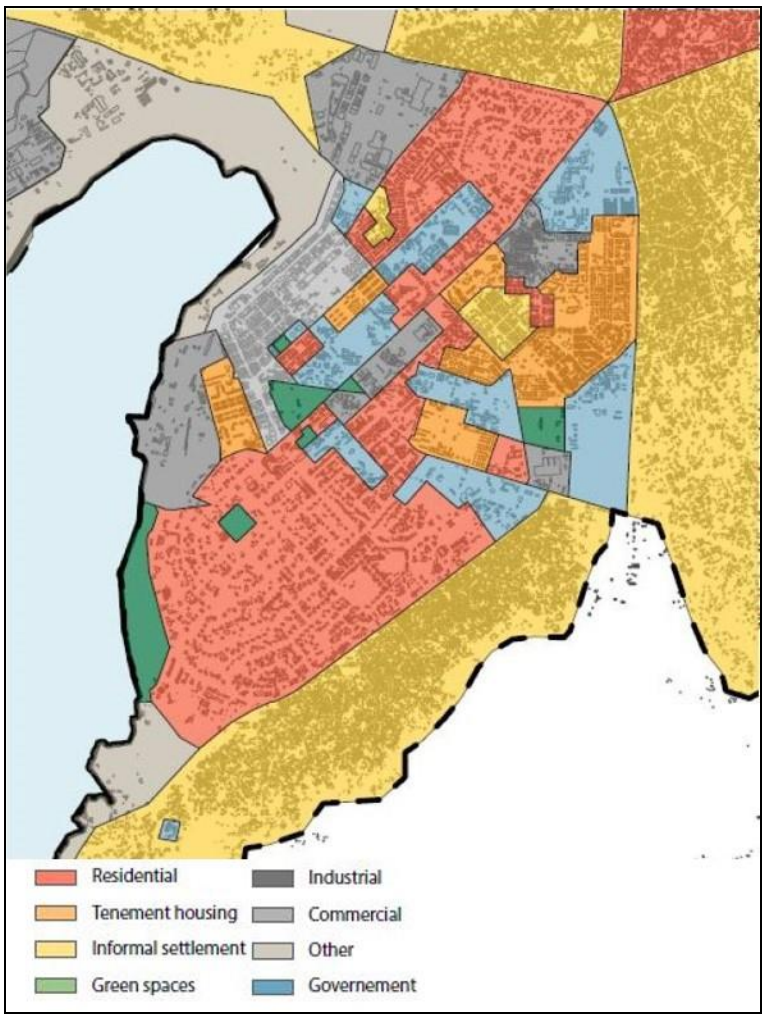

Figure 3-2: Land use distribution in Kisumu city.
Source: Adopted from KISUD-Plan (Nodalis Conseil, 2013)

Table 3-1: Land use distribution in Kisumu city as presented in Figure 3-2

Land uses	Area coverage in Percentage (%)
Informal settlement (Unplanned)	38.61
Tenement housing	2.4
Planned residential	11.68
Institutional/government	4.25
Industrial	12.6
Commercial	2.15
Green Spaces	0.9
Others	27.35
Total	**99.94**

3.2. Case study selection

The study employs a case study approach because it helps in studying the complex phenomena within their context and can be applied in project evaluation (Baxter & Jack, 2008). Yin and Hollweck (2015), define the case study as *"an empirical inquiry that investigates a contemporary phenomenon (the case) in depth and within its real-world context."* In this study, road expansion is a case related to other cases in the neighbourhoods of Kisumu city. Two residential fragments along the expanded road[3] are being used to analyse the case which can be related to other fragments with similar characteristics. In this respect, a case study design helps in the analysis of the urban fragments using their characteristics to find out how road expansion influences the interaction between and within fragments, and how change in interaction may have effect on the subjective QoL using the case of Obunga and Tom Mboya residential fragments in Kisumu city *(Figure 3-3).*

Selection of the study area (criteria)

The study analysed two residential fragments of planned and unplanned characteristics. The planned fragment is Tom Mboya neighbourhood and the unplanned fragment is Obunga neighbourhood. Three reasons guided the selection of the study area; first, being a comparative study, it was essential to select an area with different characteristics of planned and unplanned neighbourhoods to understand how the road influences the interaction and subjective QoL. This may imply that the effects of the expanded road affect the two neighbourhoods differently. Secondly, the neighbourhoods had clear different characteristics of QoL conditions, for instance considering housing quality. The third reason was that the two neighbourhoods were adjacent to the bypass road which is the main focus of this study and opposite each other assessment of interaction.

[3] Expanded road in this study refer to the bypass road which initially was a narrow road and not tarmacked in some sections, but it got expanded and upgraded at the same.

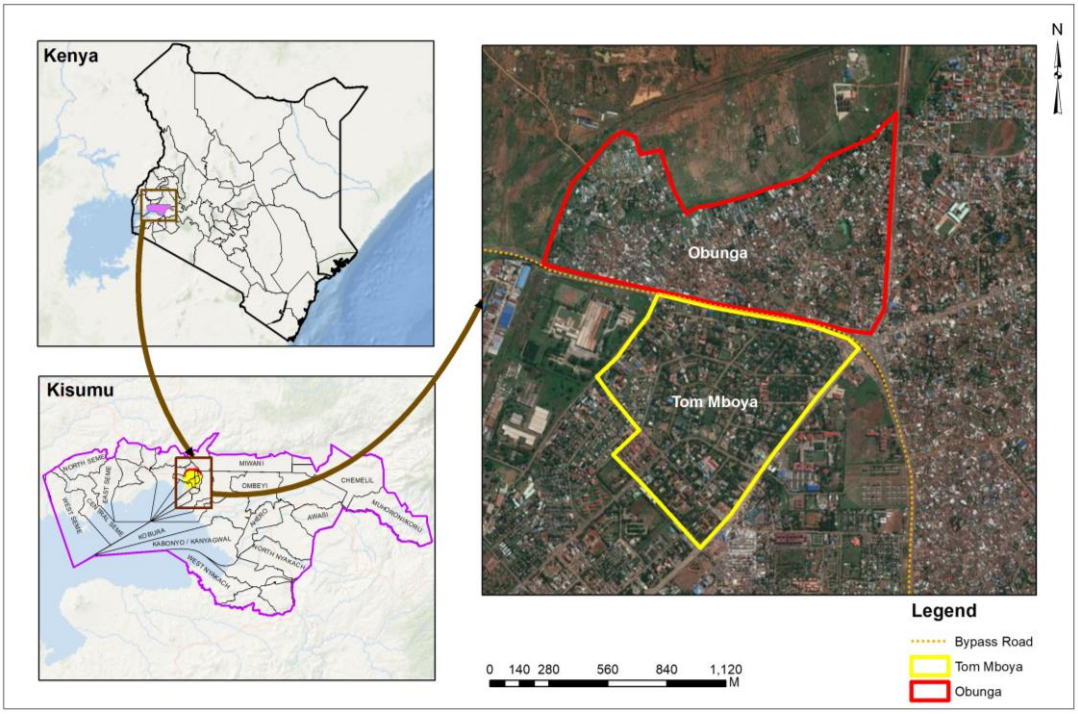

Figure 3-3: Contextual Location of the Study Area in Kisumu city
Source: World ocean base & Google Earth, 2018 and Author, 2018
Boundary data: ArcGIS online (Kisumu ward boundaries, 2016)

3.2.1. Why planned and unplanned urban fragments

Graham and Marvin (2001) when talking about breaking-up of the urban form (splintering urbanism), argue that urban planning sometimes support the development of social fragmentation of the urban space and exclusion leading to polarization and even privatization of public services. This then brings out the inequalities that come with urban fragmentation. Studies in Kisumu distinguished two types of urban fragments based on the differences in characteristics and their relevance to planning perspective; that is Planned and Unplanned fragments. Planned fragments on the one hand develop under government regulatory framework and as per the contextual urban planning guidelines (Kola et al., 2015). Unplanned neighbourhoods on the other hand, develop with no proper planning, and they are not directed by any governing framework, and so buildings are done haphazardly giving it irregular boundaries as discussed by Wagah et al. (2017). Unplanned neighbourhoods are areas where the populace is characterised as people with inadequate housing and infrastructural services, and in most cases not recognised by the public authorities and the government as vital part of the city (Maoulidi, 2012).

Different characteristics between planned and unplanned neighbourhoods may reveal the inequalities that exist with regard to access to facilities which is used to measure the spatial interaction between and within fragments. The neighbourhoods of planned and unplanned fragments have residents of different income levels, and this defines their social status which is key to analysing social interaction. Therefore, the two fragments have clear morphological differences especially looking at the housing typology, and they are adjacent to the bypass which is the case under investigation and opposite each other.

Impacts from the expanded road are presumed to affect the two fragments differently, with regard to social and spatial interaction. The social-spatial variations that exist between the two fragments and which are mirrored in the QoL of the residents may determine their living conditions and interaction (Sabatini, 2006). Subsequently, subjective QoL of the residents may also inform the degree of fragmentation between the residential fragments.

3.2.2. Northern corridor road Network (Kisumu bypass)

Northern Corridor Transport Improvement Project (NCTIP) links the Democratic Republic of Congo, Burundi, Rwanda and Uganda also referred to as the Great Lakes Countries. The corridor starts from Mombasa and runs through major cities of Nairobi, Nakuru, Kisumu to Busia on the border of Uganda *(Figure 3-4)*. It runs more than 2000 Kilometres and also serves Southern Sudan, Ethiopia and Northern Tanzania (Gichaga, 2017). The Northern corridor serves basically as a transit route for goods from the port of Mombasa to the inland countries. The Kenyan section of the Northern Corridor was jointly funded by the Kenya Government and the World Bank, with the aim of achieving economic recovery in determination to alleviate poverty (MoRPW&H, 2004) and also to increase the efficiency of road transport (Gichaga, 2017). It is worth noting that, 40% of the Northern corridor Road Network is within Kenya with Kisumu being a vital transport node, and it is said to have contributed to improved traffic flow and road safety (The World Bank, 2016).

The Kisumu bypass[4] is part of Northern corridor transport project. It is an international pass-through for transit goods from Mombasa to the neighbouring countries mentioned earlier. The reason for the bypass road in Kisumu was to have traffic go around the city and ease congestion in the city centre (Bard & Lennmalm, 2015). It forms part of the ring road that marks the old city boundary. The bypass road connects Nairobi highway with Busia highway. The road stretches from Nyamasaria to Kisumu Airport junction (section of the Northern corridor) and passes between planned and unplanned residential fragments. In this study, Tom Mboya represent the planned while Obunga represent the unplanned fragment *Figure 3-3*.

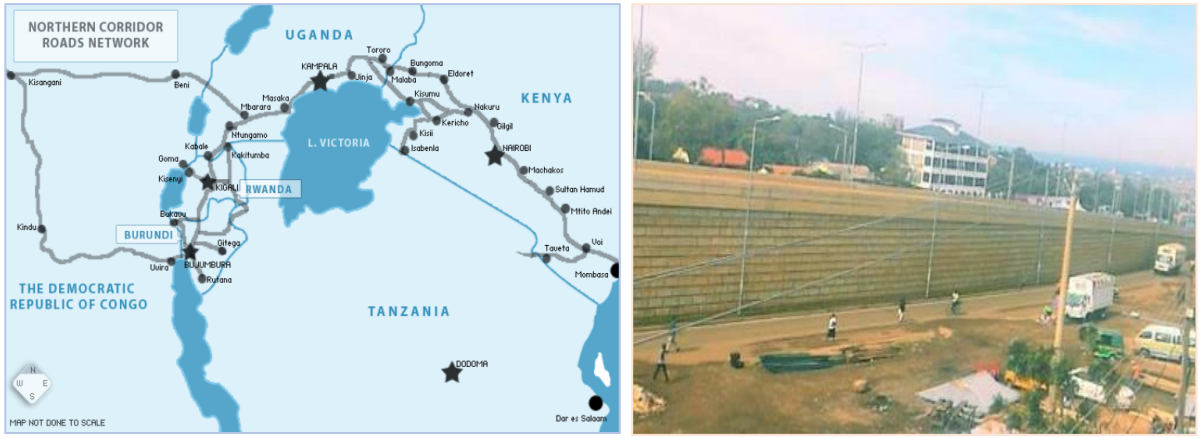

Figure 3-4: Northern corridor road network (left) and part of Kisumu Bypass in the study area (right)
Source: Adopted from TTCA-NC (Nodalis Conseil, 2013) and Author, 2018.

3.2.3. Anticipated impacts of the road infrastructure project (Kisumu bypass)

According to Environmental Laws of Kenya, Section 58 of the Environmental Management and Coordination Act (EMCA) of 1999, all projects listed under the second schedule which include transportation thematic area are subject to Environmental and Social Impact Assessment (ESIA). In fulfilment of this requirement, ESIA was conducted by the Ministry of Roads, Public Works and Housing[5] in February 2004, for the section of the Northern corridor that covers the Kisumu bypass road. The objective of the ESIA study was to identify significant environmental and social impacts of the road infrastructure project, and the important mitigation measures to minimize the adverse effects (MoRPW&H, 2004). The ESIA was also supposed to give guidance on the implementation of

[4] Also known as Nyamasaria-Airport bypass

[5] Ministry of Roads, Public Works and Housing and Ministry of Transport and Communications merged and became Ministry of Transport and Infrastructure (MOTI), it has State Department of Transport and State Department of Infrastructure (The World Bank, 2016).

environmentally sustainable decisions, and ensure sound preparation of Environmental Management Plan (EMP) to implement and monitor mitigation measures.

Identification of environmental and social impacts

During the identification of the possible impacts in the study area, the ESIA study team ensured that relevant stakeholders were involved in the exercise. This made the assessment process participatory, and it involved relevant government departments like National Environmental Management Authority (NEMA), Kenya National Highways Authority (KeNHA), Physical Planning, Lands, Water Resources Management Authority (WRMA), Public Works; Local leaders, Community Based Organizations (CBOs) and members of the public among others. Project information disclosure meetings were held to sensitize the communities on the nature of the project that was coming in their midst. Discussions were made and key environmental issues relating to the road infrastructure project identified under two categories; bio-physical (natural) and socio-economic environments. The experts used the check list in *Table 3-2* to analyse and identify the potential impacts as contained in the Kenyan EIA draft guidelines for road sector (MoRPW&H, 2004).

Table 3-2: Process of identifying potential impacts of the road project and environmental parameters

PROJECT ACTIVITY	**ENVIRONMENTAL PARAMETERS**						
	Bio-physical				**Socio-economic**		
During construction	**Soil**	**Water**	**Plant**	**Animal**	**Economy**	**Employment**	**Health**
Site clearance within the road reserve	l	l	h+ h-	h+ h-	h+	m- h+	h+
Culverting according to specifications	h+ m-	h+	l	l	h+	m+	m+
Excavation of material sites	h-	h-	h-	h+	h+	h+	h-
Bridges, box culverts & drifts	h+	l	l	l	h+	h+	None
Drains and ditches	l+	l+	l+	l	m+	h+	h+
Protection works, gabions, stone pitching & scour checks	h+	h+	h+ m-	h-	h+	h+	h+
Routine maintenance (After construction)							
Bush clearing	l	l	h-	l	h+	h+	h+
Culvert cleaning & head wall repair	m+	l+	l	l	h+	h-	l+
Drainage or ditch de-siltation	m+	m+	l	l	m+	l	m+
Installation of access culverts	m+	m+	l	l	m+	l	m+
Pothole patching	l	l	None	None	h+	l	h+
Encroachment control	h+	l+	m+	None	None	l	m+
Fast driving	l	l	l		h+	h+	h-

The identified potential impacts were rated as positive (+) or negative (-) depending on their renowned benefit or loss to natural or socio-economic environments. The impacts were then subjectively quantified as high (h), medium (m) or low (l). *Source*: ESIA report, 2004

High positive (h+) impact on both economy and employment was envisioned during the excavation of materials sites in the construction phase (*Table 3-2).* This can be attributed to the availability of job opportunities in the material sites especially casual labour for the residents. However, the same period of excavation of material, was also anticipated to have high negative (h-) impacts on health. This could be attributed to the presence of open quarry pits or sites which act as breeding places for mosquitoes thus causing diseases like malaria and other water-borne diseases. Similarly, dust emanating during excavation of materials can also lead to upper respiratory tract infections. During routine maintenance, it was anticipated that there would be high positive (h+) impact on the economy, employment and health especially during bush clearing period. This may be attributed to job opportunities for those who will be engaged in clearing the bushes. The clean environment will then have a positive effect on residents' health following reduced disease incidences.

Identified possible positive and negative impacts as per the ESIA report, 2004 from the Nyamasaria-Airport road which is a section of the Northern Corridor are highlighted below and discussed in details in section 4.4.

Positive impacts

1. Easier access to social amenities
2. Enhanced accessibility
3. Enhanced security
4. Landscaped road environment
5. Positive foreign cultural values
6. Enhanced non-motorist traffic safety (wider Pedestrian and cyclist paths)
7. Generated employment opportunities
8. Heavy vehicle parking bays at the Weigh bridge and in abutting urban centres
9. Increased commerce
10. Reduced vehicle operating costs, commuter travel time and costs

Negative impacts

1. Disturbance of fauna and flora in their natural ecosystem
2. Displacement of human settlement
3. Operational hazards of road workers (danger posed by careless motorists)
4. Landscape disturbance
5. Negative cultural influence (Resultant increase in promiscuity in the local community)
6. Traffic disruption and accidents
7. Noise, Gaseous and Dust pollution
8. Water pollution by oil spillages and contamination from raw concrete and fragments of demolished structures
9. Encroachment by upcoming generated infrastructure such as markets and other business premises
10. Pollution by waste materials from drains clearing and pavement reconstruction discharged into the rivers

Proposed Environmental mitigation measures

Environmental mitigation measures come in handy to minimise the identified adverse impacts of road infrastructure project. The mitigation measures to be actioned parallel with road project. Most of the adverse effects (negative impacts) caused by the road infrastructure project were seen to be on a magnitude that could be mitigated *(Table 3*-3).

Table 3-3: Environmental mitigation measures

Negative impacts	Mitigation measures
Disturbance of fauna and flora in their natural ecosystem	Create awareness of the importance of bio-diversity amongst road maintenance workers. Discourage site clearance beyond road reserve
Displacement of human settlement	Resettlement Action Plan (RAP) for Project Affect Persons (PAP)
Traffic disruption and accidents	Provision of proper road safety elements like adequate shoulders and road signs Sensitize drivers on road safety
Noise, Gaseous and Dust pollution	Regular watering of the diversion roads Encourage use of dust masks Road side tree planting to minimize noise Enforcement of standards
Encroachment along road reserve	Awareness campaigns Enforcement of section 91 of the traffic Act[6]
Displacement of business locations, customers and income	Cash for compensation of structures (businesses and farms) to be affected by the acquisition of land for road expansion

Source: ESIA report, 2004 (MoRPW&H, 2004)

EIA was conducted with the aim of identifying significant environmental and social impacts accruing from the road project, and prepare a workable environmental management plan that would reduce and minimise any adverse impacts during and after rehabilitation of the road (MoRPW&H, 2004). EIA is a vital tool that facilitates decision-making, and therefore key in determining the implementation of environmentally friendly development projects.

3.3. Research design matrix

Research design of this study entailed a logical plan for data collection, methods of data collection and ways of analysing the collected data. It was developed consistently to guide the study process and ensure that research questions are answered. In this study, different methods and techniques were employed to measure interaction and subjective QoL in the two residential fragments. Data was analysed in different ways; content analysis, statistical analysis and spatial analysis. See *Table 3-4* for details.

[6] Section 91 of the traffic Act (CAP. 403) of the laws of Kenya talks about encroachment on and damage to roads. It states that every person who, without the written permission of the highway authority-encroaches on a road or on any land reserved therefore at the side or sides thereof by making or erecting any building, fence, ditch, advertisement sign or other obstacles, shall be guilty of an offence.

Table 3-4: Research design matrix

Objective 1: To analyse categories of residential fragmentation and characteristics of interaction between these categories			
Research questions	**Data collection method**	**Data Sources**	**Methods of data analysis**
1a). What are the common categories of residential fragments and their spatial distribution in Kisumu city and how has this been shaped by the physical planning?	Literature review Key informant interviews GIS data	Physical Planning Department & Academic researcher OSM & Dymling (2006)	-Qualitative analysis (Content analysis) -Spatial analysis
1b). What are the socio-economic and spatial characteristics of the categorised residential fragments?	Literature review Current census data -Key informant interviews -Questionnaire	(KNBS, 2009) Pamoja Trust (NGO) Physical Planning Department & Academic researcher	-Content analysis -Descriptive statistics
1c). What are the relevant indicators to measure the interaction between these categories?	Literature review Key informant interviews	Physical Planning Department & Academic researcher	Qualitative analysis
Objective 2: To find out how road expansion influences the social-spatial interaction between urban fragments			
2a). What were the anticipated social and spatial impacts of the road infrastructure project in the study area?	Key informant interviews Reports (Planning, ESIA reports)	KeNHA office, Physical Planning Department, & NEMA	Content analysis
2b). What are the actual social and spatial impacts accruing from road expansion according to the residents of the two fragments?	Key informant interviews -Walking interviews -GIS data	Residents, KeNHA, NEMA & Physical Planning Department -ArcGIS online data for schools & health facilities	Content analysis (Atlas.ti 8) -Spatial analysis
Objective 3: To understand from the residents of the two residential fragments how they perceive interaction between fragments and likely effects on Quality of Life before and after road expansion			
3a). To what extent does Quality of Life of the residents vary in the two fragments, before and after road expansion?	Household questionnaire Walking interviews	Residents (Household heads)	-Statistical analysis (descriptive and Coefficient of variance) -Content analysis
3b). How does change in interaction between residential fragments affect Quality of Life of the residents in the two fragments?			Content analysis

3.3.1. Selected relevant indicators for measuring socio-spatial interaction

It was important to identify relevant indicators for measuring socio-spatial interaction between and within fragments. However, there are no universal identified indicators to measure interaction and QoL as earlier mentioned in section 2.7.1. Quality of Life indicators which are key in understanding people's perception about the environment they live in and their expectations and experiences in life, were selected to measure subjective QoL of the residents in the two neighbourhoods. The pre-selected indicators were validated during fieldwork through Key Informant interviews, and the final list of indicators relevant to the study area context prepared *(See Table 3-5).*

The indicators were selected based on their purpose, importance and linkages as per the selection guidelines suggested by Sirgy et al. (2006). Considering purpose and importance, the indicators provided useful information about changing trends in the interaction between residents and accessibility to facilities within neighbourhoods, thus informed subjective QoL. The indicators revealed relationship with each other over time and some of the linkages may reinforce one another. For instance, improved access to education over time may lead to improved employment rates thus change in QoL. QoL indicators are capable of revealing if a community is improving, deteriorating or remain stagnant or sometimes maybe a mixture, regarding inequalities. Therefore, QoL indicators can be used to show patterns of change in general community or neighbourhood life as noted by Martinez (2018) and Phillips (2015). The study looked at two moments in time of before and after road expansion to monitor the changing trends in interaction between and within fragments, and subjective QoL by assessing the inequalities that exist.

Table 3-5: Selected dimensions and indicators to measure the interaction and subjective QoL condition

Dimensions	**Attributes**
Social Networks	Feeling at home in the neighbourhood (sense of belonging) Support received from friends, neighbours & relatives Chat and discuss personal matters with neighbours Member of women group, self-help or youth groups; religious group & community associations Access to churches/ mosque, within neighbourhoods Availability and access to cultural institutions (social halls/resource centres) within neighbourhoods
Employment	Access to job opportunities within neighbourhoods Employment status of the household heads Adequacy with family income
Educational facilities	Access to pre-primary, primary and secondary schools
Health	Access to health facilities & services
Recreational areas	Availability and access to parks, open spaces and playgrounds
Housing	Access to housing within neighbourhoods

Social Networks

Social networks may augment the interaction between teams or even residents as far as social life is concerned (Lusher et al., 2010). It also refers to material help, which is borrowing or lending of money or other items together with emotional support to seal the gap of isolation (Farahani, 2016). This makes one to have a sense of belonging and attachment to people around, thus improve social interaction between residents. Other relevant indicators for measuring social networks include welfare groups and support from friends. Religious facilities like churches that bring different social groups together enhance social interaction between people and their environment as suggested by Bocarejo et al. (2015). Access to religious places like church and mosque impact on both spiritual and social well-being of people (Sirgy, Gao, & Young, 2008).

Employment

Employment in this study refers to access to job opportunities in neighbourhoods, employment status of households and family income. A diversified mix of economic activities in neighbourhoods offers plenty of opportunities for employment, a strong consumer market base and high standards of living among a wide range of residents. This creates a good platform for interaction in neighbourhoods. Access to job opportunities lead to an increase in satisfaction with financial, work and family life, which eventually translates to better QoL and interaction (Sirgy et al., 2008). Families with adequate income are expected to have better QoL.

Education

Access to education is a ladder to better employment opportunities and could lead to improved Quality of Life (Sirgy et al., 2006). Residents who have access to learning opportunities are likely to interact more, and in return aim for higher education which will earn them better job opportunities and of course good QoL. Subsequently, if people learn they share the knowledge with their social networks, this sharing enhances the social bonds and strengthens social interaction (Sirgy et al., 2008). The indicator of access to educational facilities within neighbourhoods is a good example that could bring inequalities to the fore between and within neighbourhoods (Martinez, 2018). Inequalities in education are measured using access to schools which include pre-primary, primary and secondary schools.

Health

Access to healthcare and mental well-being of a person may facilitate active interaction in the neighbourhood. Inequalities in health in this study are measured using access to health facilities and services. On the one hand, according to (Lowe et al., 2015) healthy and liveable neighbourhoods give a positive impact on residents' behaviour and perceptions on QoL thus spur interaction process. Furthermore, well-being promotes the principle of equity and reduces social deprivation (Bentivegna et al., 2002).

Recreational areas

Access to parks and open spaces are vital to the lives of urban dwellers, they provide resources like play grounds for all age groups, resting and relaxing areas, thus meeting point for people and interaction platforms (Sirgy et al., 2006). These recreation places also influence greatly the QoL and liveability of residents in a community or neighbourhood. Open spaces provide quiet places within the urban fabric and allow open-air activities for the urban dwellers and contribute to air quality which is essential for the well-being of residents. According to KISUD-Plan, neighbourhoods open spaces or parks need to be well distributed for ease of accessibility by residents. Therefore, open spaces are key in facilitating interaction between and within neighbourhoods.

Housing

Inequalities in housing is measured using access to housing, thus an indicator for both spatial and social inequalities (Chakravorty, 1996). Indicator of housing employed in this study is about how one can get housing (house). This could be through social networks of family or friends, thus offering a platform for interaction. Access to housing is one of the basic human needs whose satisfaction contribute positively to QoL domains like social life, environmental life and family life (Sirgy et al., 2008). People pay visits to their friends, relatives or neighbours in their houses to socialize, this makes housing a medium of social interaction between residents.

The selected dimensions and indicators were used to measure the interaction of residents between and within neighbourhoods, accessibility to facilities and services and satisfaction level of their subjective QoL. This was in pursuit of getting to understand residents' perception on interaction and QoL (Subjective measurement of QoL).

3.4. Pre-fieldwork phase

Pre-fieldwork phase entailed preparation of research instruments which included a household questionnaire, interview guides for key informant interviews and walking interviews based on the research questions. The questionnaire was designed based on the selected indicators of QoL, to measure the interaction and QoL in the two residential fragments. The questionnaire form was uploaded to the Open Data Kit (ODK) platform which is a free and open source application that allows users to build a survey form in XLS Form for large datasets. It also allows the user to collect data on a mobile device and send it

to the server (https://opendatakit.org). The XLS form allows integration of all possible structures of questions; closed, open-ended and even multiple responses. It also enables picking of geographical coordinates of where data is being collected from, for instance, household location. Map of Kisumu was downloaded and used during walking interviews for recording tracks followed.

3.5. Data collection methods and sources

The study employed a mixed method approach, combining qualitative and quantitative techniques. A quantitative method was used in collecting data to depict spatial interaction, whereas qualitative was used to reveal in-depth social interaction between and within the residential fragments. Primary data was collected through Key Informant Interviews (KII) by the use of key informant interview guide (Appendix 5), household surveys by use of a questionnaire *(Appendix 6)* and walking interviews by use of walking interview guide *(Appendix 7)*. The participants for walking interviews were identified during the household survey since it was a follow up of the questionnaire based on their responses. Secondary data on household socio-economic characteristics like education and income levels among others was obtained from the field and offices of Kenya National Bureau of Statistics (KNBS) and Pamoja Trust (NGO).

Additionally, the study sought for secondary data from Kisumu County offices from departments of physical planning office, Kenya National Highways Authority (KeNHA), National Environment Management Authority (NEMA) and Social services. Secondary data was in the form of documents, reports and maps. Details are provided in *Table 3-6*.

Table 3-6: Datasets and their sources

Data collected	Acquisition dates	Sources
Aerial image	2018	Google maps
Kisumu County & ward boundaries	2016	ArcGIS online (shape file)
Kisumu schools & health facilities	2016	ArcGIS online (shapefile)
Kisumu secondary roads		Physical Planning office
Purpose for data collection		
Socio-economic characteristics	August, 2014 Census data, 2009 Field (October, 2018)	Pamoja Trust KNBS KII
Anticipated impacts of road infrastructure project	February, 20004 Field (October, 2018)	Ministry of Roads, Public Works & Housing (ESIA Report) NEMA and KeNHA (Interviews)
Categorised residential fragments and indicators to measure interaction	Field (October, 2018)	Academic Researcher Physical Planning Department (Interviews)
Actual impacts	Field (October, 2018)	Household heads (Walking interviews) KII
Interaction between & within fragments	Field (October, 2018)	Household heads (Questionnaire) Community Development Officer (KII)
Quality of life	Field (October, 2018)	Household heads (Questionnaire)

3.6. Fieldwork phase

Reconnaissance survey of the study area was conducted on 5th and 6th October, 2018 for Obunga and Tom Mboya neighbourhoods respectively. This entailed a brief survey of the study area where valuable information that could help during the actual data collection was obtained and contact with the

neighbourhood gate keepers established (Residents association officials). This part of the field work phase was important as also noted by Pido (2014), it enabled meetings with the local leaders of the two neighbourhoods. The reconnaissance survey paved the way for the actual field work which was on collection of both primary and secondary data in the study area. The activities executed during the fieldwork phase included: key informant interviews, training of research assistant and testing of the questionnaire, household survey and walking interviews.

3.6.1. Key Informant Interviews

Key Informant Interviews (KII) were conducted to provide a further understanding of the study area and aid in revision and validation of the household questionnaire and indicators to measure both interaction and subjective QoL. The interviews were conducted between 8th to 23rd October, 2018. The informants were selected based on their knowledge about the topic or information they hold about the study area (purposive sampling). A total of nine Key informant interviews were conducted which included participants from diverse fields such as academic scholars, residents and County and Ministry officials *(Refer to Table 3-7)*. The selection of the participants always took into account the research questions to be answered. The interviews were conducted using a semi-structured interview guide with a set of questions to allow probing, this made the process more flexible as also suggested by Bryman (2012). Voice recording was incorporated in the interview sessions, but only after obtaining informed consent from the informants. KII aimed at obtaining expertise knowledge as well as perceptions on the impacts of the bypass road project, both envisioned and actual, that show interaction between and within neighbourhoods together with the common categories of residential fragments in Kisumu city and their characteristics.

Table 3-7: Summary of characteristics of participants in Key Informant Interviews

Interview Type	Gender	Position/Title	Organization/Institution
Key Informant 1	Male	Residents Association official	Tom Mboya Neighbourhood
Key Informant 2	Male	Residents Association official	Obunga Neighbourhood
Key Informant 3	Male	Senior Physical Planner	Ministry of Lands & Physical Planning
Key Informant 4	Male	Academic Researcher/Spatial Planning lecturer	Maseno University
Key Informant 5	Male	Dean, School of Planning and Architecture/Private Planner	Maseno University
Key Informant 6	Female	Regional Director, Environments	NEMA
Key Informant 7	Female	Community Development Officer	Kisumu Central Sub-County
Key Informants 8	Male	Consulting Engineer & Land Surveyor	KeNHA
Key Informant 9	Male	County Field Coordinator	Kisumu County

3.7. Sampling of participants for interviews and questionnaire

The sampling strategy for household surveys entailed clustering of the study area as per the administrative units for Obunga and estates for Tom Mboya neighbourhood. On the one hand, Obunga has five smaller administrative units namely Obunga Central one (1), Obunga Central two (2), Kamakowa, Sega-Sega and Kasarani as highlighted in CRDC (2016) report. Tom Mboya on the other hand has Robert Ouko Senior and Junior, USAID Scheme and Tom Mboya estates *(Figure 3-5)*. Random sampling was employed in identifying eligible household heads to give responses to the questionnaires. Both women and men who had lived in the neighbourhoods for at least five years or longer participated in the household survey. Respondents were selected from each administrative unit for Obunga, and each estate for Tom Mboya neighbourhood. For Tom Mboya, the survey was undertaken both on weekends and evenings on week

days to interview those who go to work during the day and only where access was given. Kenya government defines *"household as a person or group of persons who reside in the same homestead or compound but not necessarily in the same dwelling unit, have same cooking arrangements, and are answerable to the same household head*" as also stated in Alando (2017). For qualitative data, the selection of the Key Informant participants was done purposively depending on their expert knowledge or the information they hold about the study area.

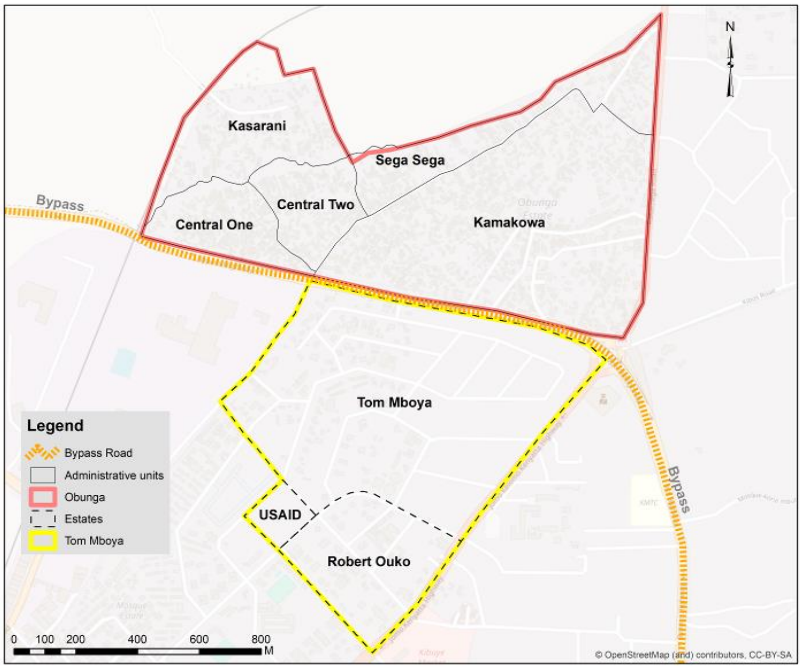

Figure 3-5: Administrative units of Obunga and Estates of Tom Mboya neighbourhood
Source: Author, 2018

3.7.1. Training of Research Assistants

Training of the research assistants was conducted on 13th October, 2018 immediately after carrying out some key informant interviews and revising the household questionnaire. The researcher was assisted by three assistants drawn from the community (Obunga neighbourhood) with the help of Obunga Residents Association officials. These were youths with previous experience in data collection, at least college certificate level of education and also local knowledge about the study area. This was a way of building their capacities and also of gaining trust from the community. The research assistants were taken through the entire questionnaire, and use of Open Data Kit (ODK) collect application to ensure a common understanding of the questions *(Refer to Figure 3-6)*. They were also briefed on the research ethics which are key in data collection. The questionnaire was then tested on the same day in Obunga neighbourhood and any necessary adjustments made before getting into force with the actual survey. This also enabled estimation of the required time for a respondent to answer the questions.

Figure 3-6: Training research assistants and administering questionnaire in Tom Mboya

3.7.2. Household Survey

Household surveys were conducted in the two neighbourhoods of Obunga and Tom Mboya between 15th to 30th October 2018, using structured questionnaires for collection of both qualitative and quantitative data. The questionnaire was used as a tool to gain insights on the interaction between and within neighbourhoods, accessibility to facilities and the perception of the residents on subjective QoL, before and after road expansion. The household questionnaire had both closed and open-ended questions totalling to 46 questions *(Refer to Appendix 6)*. The open-ended questions aimed at asking the respondents to clarify more on their responses thus generating qualitative data to be analysed. Most of the closed questions were on Likert scale of 1-5 with 1 being the least preferred choice, and 5 being the most preferred choice/response especially for measuring subjective QoL perceptions of the residents as also discussed by Bryman (2012) on the use of Likert scale. The questionnaire was divided into four sections;

1. *Section one focused on finding out the neighbourhood and residential history of the household head.* It was important to establish the number of years one had lived in the neighbourhood because only those who had lived there for five years or longer, that is when the construction of the Bypass started (2013), were eligible to participate in the survey. This section also had questions on whether the resident knew someone when they moved into the neighbourhood and this was to assess interaction through social networks.
2. *Social-spatial interaction between and within neighbourhoods was captured in section two of the questionnaire.* This entailed questions on social and spatial interaction within one's neighbourhood and with the neighbourhood across the bypass road, using the QoL indicators to measure the interaction before and after road expansion. Spatial interaction was more on the spatial accessibility to facilities. This was geared towards getting responses on both internal and external interaction between residents and assess kinds of change in the interaction.
3. *The third section was on Quality of Life perceptions of the residents.* This part of the questionnaire had questions on satisfaction levels of residents with their subjective QoL conditions and access to facilities and services between and within neighbourhoods before and after road expansion.
4. *Personal information of the respondents.* Socio-economic characteristics of the respondents which included gender, age, education level and employment status were asked in this last part of the questionnaire.

A total of 239 questionnaires were administered in the two neighbourhoods; Tom Mboya had 111 while Obunga 128 questionnaires. The interviewed households were geocoded, and visualization of their locations is shown in *Figure 3-7*.

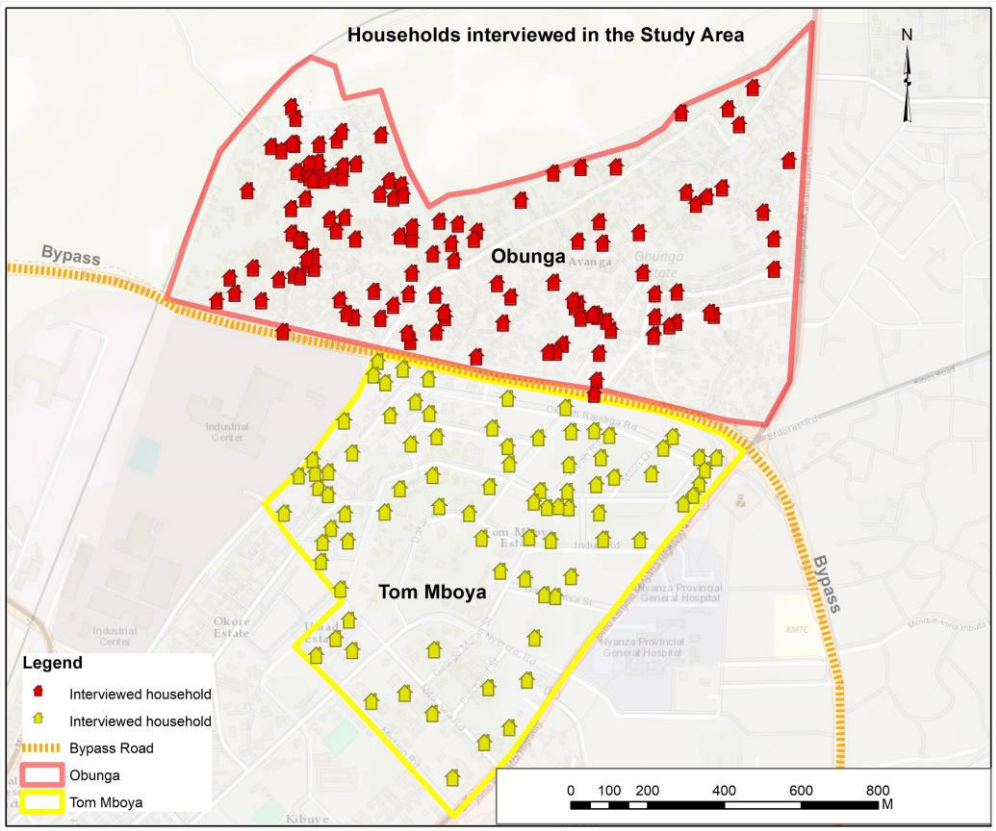

Figure 3-7: Spatial location of households interviewed in the study area during the household survey
Source: Fieldwork data, Author, 2018 and Open Street Map data (OSM)

3.7.3. Walking Interviews

Walking Interviews were carried out to verify the perceived changes in the neighbourhoods. Walking interview is a method where the researcher walks together with the participant to gain an in-depth understanding of the association between people and their spatial environment (Evans & Jones, 2011). The aim of Walking Interviews was to get the in-depth understanding of the resident's perception of impacts coming up as a result of road expansion. Participants who had answered the questionnaire were identified to voluntarily participate in the walking interviews, and their questionnaires were used for further probing. It was also a way of observing what had changed on the ground and capture pictures of the changes like facilities. Walking-interviews also offered the participant ample time to explain what had changed in the neighbourhood following the expansion of the road, and was able to recall memories (Evans & Jones, 2011). Participants decided on the routes (participant driven) and walked along with the researcher pointing out what had changed after road expansion. Therefore, walking interviews assisted in checking for both positive and negative impacts that could be influencing interaction and resident's subjective Quality of Life (QoL).

Walking interviews give both text data and geographical cordinates which can be useful in examining the relationship between location and speech thus gives place-specific data (Evans & Jones, 2011). Four Walking interviews were conducted in each neighbourhood; Tom Mboya and Obunga. Both men and women participated in the Walking Interviews. The tracks followed were recorded together with the interviews. *Table 3-8* gives a summary of interviews conducted.

Table 3-8: Summary of interviews conducted in the study area

Type of interview	Role	No. Respondents	Remarks
Key Informants	Different experts	9	Different categories
Household survey	Residents	239	Interviewed Household Heads (Tom Mboya 111 & Obunga 128)
Walking-interviews	Residents	8	Four respondents per neighbourhood

3.7.4. Characteristics of respondents

Gender composition

The respondents were household heads aged 18 years and above. Both men and women participated in the survey and interviews. For household surveys, eligible respondents to participate in the survey were household heads who had lived in the neighbourhood for at least five years or longer. A total of 239 responses were realized in the two fragments through answering questionnaires. The majority of the respondents in planned fragment (Tom Mboya) were men 53.2% (N[7]=111:59), and 46.8% were women (N=111: 52). Contrary, the majority of the respondents in unplanned fragment (Obunga) were women 60.2% (N=128: 77), and 39.8 % men (N= 128: 51).

Age of respondents

Considering age cohorts, the majority of the respondents in the two neighbourhoods were between 25 to 44 years, which is the economically active population as per the labour force framework (KNBS, 2009). It is worth noting that the majority of the respondents in the planned fragment were in the age cohort of 35 to 39 years (N=111:28), unlike in unplanned fragment where respondents were between 25 to 29 years (N=128: 29). This may suggest that they were ready to participate in the survey and could comfortably respond to the questions. Respondents in age cohorts of 55-59 years were the least among the respondents in the two neighbourhoods with planned fragment having 2 (N=111:2) and unplanned fragment (N=128:1). Refer to *Figure 3-8*.

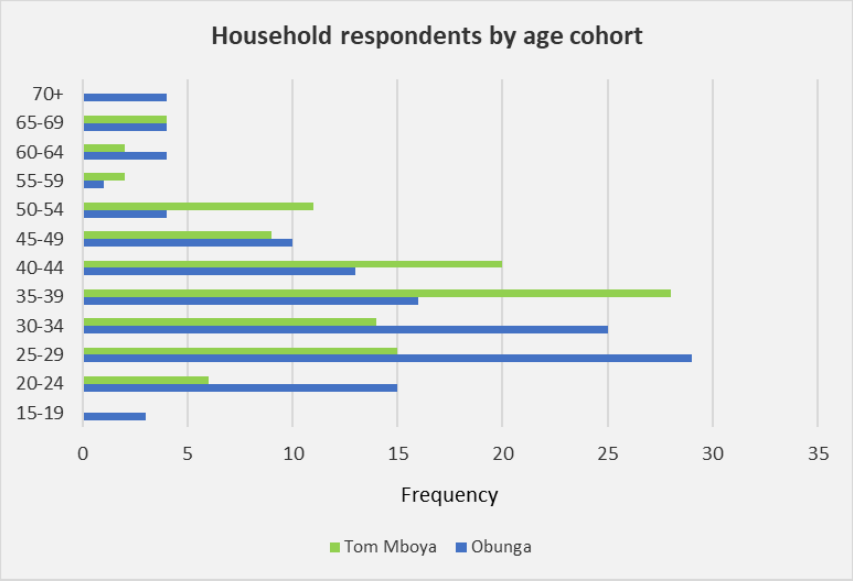

Figure 3-8: Household respondents by age cohorts as per demographic classification

Respondents level of education, primary occupation (employment) and satisfaction with household income is discussed in section 4.3.

[7] N refers to the number of respondents interviewed during the household survey

3.8. Data Analysis (Post-Fieldwork Phase)

This phase of the study entailed checking, processing and analysing both primary and secondary data collected to answer the research questions. Data collected was quantified and visualised in the form of graphs, tables and maps. A total of 239 questionnaires were administered in the two neighbourhoods. The respondents participated voluntarily and at their convenience in the two neighbourhoods. For quantitative data, the responses to the questionnaires were collected using Open Data Kit platform (ODK). They were checked for completeness and consistency to ensure quality before being uploaded to the ODK server. The data was extracted in CSV format and exported to SPSS for statistical analysis. Subjective QoL perception of the residents in the two fragments was analysed on a Likert scale of one (1) to five (5) as presented in the questionnaire (*Refer to Appendix 6*). Descriptive statistics such as frequencies, cumulative percentages, coefficient of variance together with mean scores and standard deviations were used to analyse the interaction between and within neighbourhoods and subjective QoL perceptions of the residents following road expansion. Perceived access to facilities between neighbourhoods was also spatially analysed.

Qualitative data involved the transcription of the recorded interviews from key informants and walking interviews. The transcription was done in Microsoft-word and analysed using both content analysis and Atlas.ti 8 software. Main themes were identified and coded; similar themes were grouped through networking and emerging themes identified for analysis. The analysis was used for discussion of the physical planning and residential fragmentation in Kisumu city, categories of residential fragments and impacts accruing from the Kisumu bypass.

3.9. Ethical consideration

Ethical consideration which entails ensuring the protection of the respondents and which is vital in any research was adhered to during data collection (fieldwork phase). Both the researcher and the assistants observed confidentiality of the information provided, seeking for consent and maintained honesty. In this study, the outlined guidelines were adhered to during interviews with key informants and walking interviews with the residents, and also during the administering of a questionnaire to the household heads. The researcher gained entry into the community by meeting the residents association officials for the two neighbourhoods, Area chiefs for Kanyakwar and Nyawita Sub-locations and Area politician (Ward Administrator for Railway ward). Introductions were done to the leaders and the permission to research in the area was sought before commencement of the fieldwork. The Researcher was assisted by three youths drawn from the community, this was a way of empowering them and gaining trust from the community. Research assistants were trained on the guidelines governing ethical consideration. The University of Twente gave the researcher an introductory letter stating the purpose of the research to present to the relevant participants' authorities. In the case of voice recording, consent was sought and consent forms were also signed by the informants. Arrangements for meetings were made in advance and a venue fixed beforehand.

4. RESULTS

This chapter presents the results and findings of the study with regard to the specific research objectives defined in section 1.4. The chapter begins with an overview of physical planning and its contribution to residential fragmentation in Kisumu city. Secondly, the findings on common categories of residential fragments and their characteristics are discussed, followed by socio-economic status of the categorised residential fragments. This is then followed by the findings on both the anticipated and potential impacts of the expanded road as perceived by the respondents. Variation in subjective QoL in the two fragments and the relationship between perceived interaction and subjective QoL is also discussed.

4.1. The history of physical planning in Kisumu city

Physical planning and regulatory frameworks are important in any urban area because they provide controlled and organized development and facilitate efficient land use (Ngetich, Opata, & Mulongo, 2016). The aim of planning, therefore, is to have controlled development and reduce inequalities that exist in residential areas, and this underscores the need for effective standards and guidelines for planning. The physical layout of Kisumu City has majorly been the result of the 1984 Structure Plan, Physical planning Act of 1996, Urban areas and Cities Act of 2011 and Kisumu Integrated Strategic Urban Development Plan (KISUD-Plan) for 2013-2030 (Nodalis Conseil, 2013), and a number of Urban Development Plans that the state has prepared from time to time. The preparation of these plans are guided by the Constitution of Kenya (2010), the Physical Planning Act (1996), Urban Areas and Cities Act (2011), national level policy priorities such as those set by the Kenya Vision 2030, and a range of Municipal By-Laws that have been in force up to the year 2013 and even during the transition period.

Literature review and interviews revealed that Kisumu City for a long time had relied on the 1984 structure plan, which was replaced with Kisumu Integrated Strategic Urban Development Plan (KISUD-Plan) in 2013 (after 29 years). The 1984 plan was directing the growth of the city around the lake, but this could not be actualised on the ground because of lack of political goodwill and resources for development (Nodalis Conseil, 2013; Kola, Onyango, & Oindo, 2015). Considering what was supposed to be implemented under the 1984 structure plan, it can be deduced that the city has grown naturally without consideration of the plan. The current extensive slum belt had been designated for upgrading through site and service schemes, but this has not been achieved except for a section of Manyatta "B" neighbourhood. Therefore, it is worth noting that the growth of Kisumu city in the last four decades has been informal, growing without proper planning hence leading to fragmentation of residential areas. However, the County Government of Kisumu has a proposed Kisumu Integrated Strategic Urban Development Plan (KISUD-Plan) for the years 2013-2030, to replace the 1984 plan which is now obsolete and ineffective (Kola et al., 2015). In the Kisumu ISUD-Plan, needs-based zoning has been proposed together with planning for special areas like slums, lakefront, shore among others, which is to be executed through Area Action plans[8]. The ISUD-Plan objective is to *"provide a framework for Kisumu's growth and development and to endow those in charge with both knowledge and tools to address the challenges or urban growth and local development."*

The Physical Planning Act of 1996 provides a legal framework which guides the planning process, not only in Kisumu but also in other Kenyan cities. Various Physical Planning Liaison Committees created by the act, provide direction and mechanisms for dispute and conflict resolution to planning issues. The act is

[8] Kisumu city has prioritized seven "Action Plans"; city planning initiatives, urban transport, urban poverty, solid waste management, water and sanitation initiatives, improving governance initiatives and health improvement (Steyn, 2012).

responsible for development control (Part V), and it states that: "*No person shall carry out development within the area of a local authority without development permission granted by the local authority under section 33."* This is the Act that is behind the controlled development seen in the planned fragments. Urban areas and Cities Act of 2011, grants the County Government power to initiate urban planning process for settlements. It also allows residents to participate in decision making processes and management of the urban areas.

4.1.1. Contributors to residential fragmentation in Kisumu city

Residential fragmentation in Kisumu city dates back to the pre-colonial era. It is both a product and a perpetuation of racial segregation, which manifests itself in the form of socio-economic class segregation in the post-colonial era. The British colonialists initiated a racially-segregated planning approach when they first settled in the city. Accordingly, the city grew to take the form that Anyumba (1995) has categorised into three zones: old city (previously the colonial town), slum belt (previously housing Africans who served mainly as domestic workers for the Europeans) and peri-urban areas of the city (later condensed into the city after the city boundary extensions of 1972). Therefore, pre-colonial traits have heightened residential fragmentation in Kisumu city just like in other Kenyan cities like Nairobi as also noted by (Jimmy, 2018).

The second factor contributing to residential fragmentation is zoning of the city which is based on economic status, as was revealed from the in-depth interviews with the informants and available literature. The initial urban development plan of the city, the 1984 (structure plan), allowed zoning of the residential areas based on the economic status of high income, middle income and low income. This in itself facilitates residential fragmentation as noted by one of the informants:

> *"When you look at Obunga and Tom Mboya, the initial urban development plan of the city already segregates different neighbourhoods, so that you have Tom Mboya as a middle-income residential place and it is neatly designated as that in the plan of the city." Key Informant 4*

The third factor contributing to residential fragmentation is the land tenure system of Kisumu city. Land rights in Kenya are categorised into two; customary and statutory tenure. Under statutory tenure, there is freehold and leasehold tenure. On the one hand, the freehold tenure is where an individual has absolute right of ownership and privileges, and it is governed by Registered Land Act, cap 300 of the Laws of Kenya (Waiganjo & Ngugi, 2001). On the other hand, leasehold tenure refers to land granted for a certain period by either individual or the government (99 years for urban plots). Leasehold tenure is subject to certain development restrictions, for instance using the land for the purpose it was allocated, and any change of use must be referred to the government for approval (Olima & Obala, 1999). Freehold has no restriction to use and occupation.

Kisumu city has both leasehold and freehold tenure system. This has played a big role in residential fragmentation in the city. Leasehold zones are more controlled regarding development as compared to freehold zones which do not have guidelines and standards regarding planning. Freehold tenure system is the most dominant in the city and estimated at over 50% of the city's land (Nodalis Conseil, 2013). Land under freehold tenure is considered private land, limiting physical planners authority to plan for such parcels of land. It, therefore makes planning and development control very difficult as suggested by Olima and Obala (1999). This, therefore, would imply that the County Government needs to do a compulsory acquisition of land for most development projects like roads, market, schools among others (Bard & Lennmalm, 2015). The key informants had the same sentiments that freehold tenure poses limitations to development as compared to leasehold tenure as stated by one of them:

> *"UN-Habitat, together with NGOs, have been trying to look at informal settlements and thinking of re-planning them so that they can be regularised regarding parcel patterns, to have regular ones. But now the challenge is bringing people together and reaching a consensus on amalgamating and sub-dividing land to some regular portions simply*

because considering public utilities and infrastructure…roads, water, sewer etc., the population feels that they are going to lose a lot of land from the little that they have." Key informant 3.

It is, therefore, easier to implement development plans in leasehold and even guide and control developments as compared to freehold tenure. The leasehold zones have standards and guidelines that regulate development and thus have better infrastructural services like piped water, electricity, good road network, among others. Freehold tenure allows free development and sub-division of land leading to unplanned settlements with inadequate infrastructural services. Lack of infrastructural services in these zones (unplanned) has widened the gap between neighbourhoods leading to polarization and resulting in residential fragmentation.

4.2. Categories of residential fragments in Kisumu city

The physical morphology of Kisumu dates back to the pre-colonial era. The current spatial patterns of residential areas follow the colonial pattern as stated by Anyumba (1995) and discussed earlier in Sub-section 3.1.1. Categorization of residential fragments was analysed from existing literature and key informant interviews.

4.2.1. Categorization and spatial distribution of residential fragments

Three common categories of residential fragments for Kisumu city were identified through key informants and from the existing literature. These include; planned gated, planned non-gated and unplanned or informal. They have been categorised following the morphological characteristics that they possess. Figure 4-1 shows the spatial distribution of the identified common categories of residential fragments in Kisumu city. Visualization of the fragments in *Figure 4-1* reveals that the unplanned fragments cover the more substantial part of the residential area of the city, followed by the planned non-gated and planned gated fragments. The map in *Figure 4-1* depicts the contextual understanding and spatial knowledge of residential categories in Kisumu city. Area coverage has been discussed in section 3.1.2.

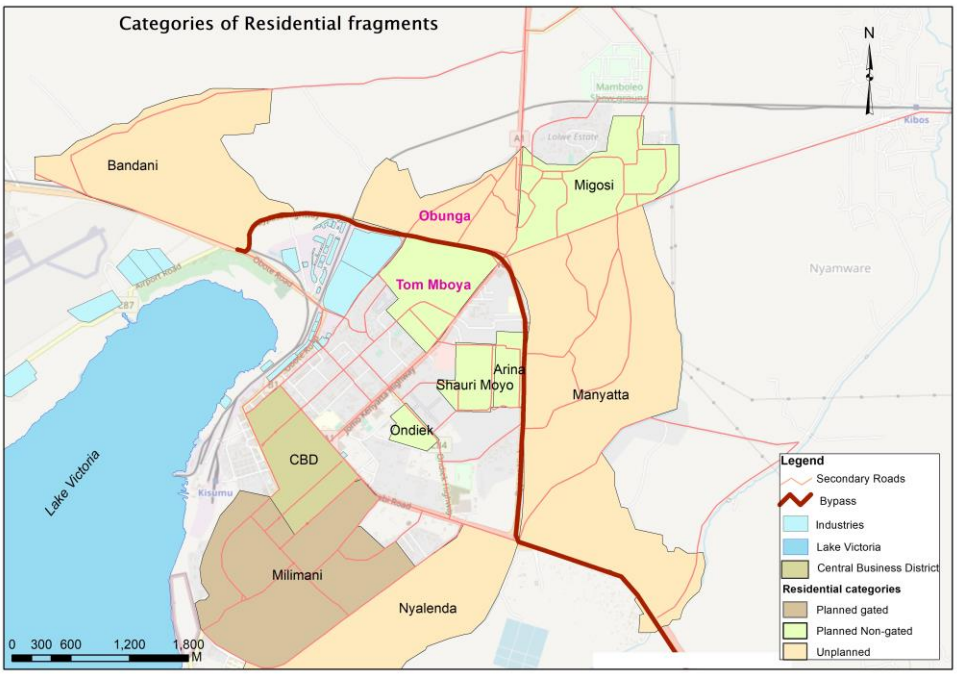

Figure 4-1: Spatial distribution of common categories of residential fragments in Kisumu city
Source: Dymling (2006), OSM and Author, 2018

Spatial characteristics of the residential fragments

To analyse the spatial characteristics of the categorised fragments, both secondary and primary data were analysed.

planned gated fragment

Planned gated fragments are located close to the City Centre (CBD) and were formerly occupied by the colonialists and are now being occupied by the high-income residents. They are low-density residential areas with green spaces. These residential areas have planned housing developments under the leasehold system and are characterised by wide streets with light traffic and well-maintained street lights by the County government. They are designated by individual perimeter walls and controlled gate entrance, restricting access to non-residents, hence better security as compared to the unplanned fragments (Dymling, 2006). Life in these residential areas goes on behind the perimeter walls and can only be viewed from the streets. There is almost no social interaction between residents and the available recreational spaces are rarely used as some of the residents have recreational facilities in their compounds. The area has better infrastructural services like road network, water supply, electricity, education and health facilities, than the unplanned fragments. The area has a delineated boundary extent, and there is no demand for local businesses in these areas (Dymling, 2006). Milimani neighbourhood is an example of a planned gated fragment within Kisumu city. *See Figure 4-2* which shows the aerial view of a planned gated fragment in Kisumu city.

Figure 4-2: Aerial view of the planned gated fragment (Milimani)
Source: Google Earth, 2018

Planned non-gated fragments

Kisumu's planned non-gated fragments are also located close to the CBD and confined between the lake shore and the half circle ring road that marks the boundary of the old city as discussed in section 3.1.1. The Asians formerly occupied some of the planned non-gated fragments during the pre-colonial period. They are middle-income residential areas and may sometimes include both gated and non-gated residential areas and experience some physical differences. The housing typology ranges from new to old buildings (Dymling, 2006). However, they have the following common characteristics; they are low-density residential areas with buildings which are well planned to attain the designed logical spatial structure. They are developed based on guidelines and standards of planning in the city and have leasehold land tenure, thus controlled development. The road network within these neighbourhoods is well arranged though poorly maintained in some places, with infrastructural services like electricity, piped water and other social amenities. Planned non-gated fragments, therefore, appear official and formal as envisaged by urban plans. They are also defined by a regular boundary extent and social interaction sometimes take place on the streets, either on their way home or from home. However, they have a mix of both residential and commercial land uses. Examples of planned non-gated fragments in Kisumu city include; Tom Mboya, Migosi, Arina, Ondiek, Shauri Moyo, Lumumba and Nubian estates among others. *Figure 4-3* shows

distinctive spatial patterns in a planned non-gated fragment (Tom Mboya) with the well distributed road network.

Figure 4-3: Aerial view of planned non-gated fragment showing part of Tom Mboya (Left) and unplanned fragment-part of Obunga (Right)
Source: Google Earth, 2018

Unplanned fragments

Unplanned fragments are high-density residential areas, which are sometimes referred to as informal fragments and are occupied mostly by low-income residents. They house more than 60% of the city population which has been estimated to be 500,000 (Steyn, 2012; Kola, Onyango, & Oindo, 2015). They have limited green spaces and were formally occupied by the African natives, and this is still the case in some places. The unplanned fragments have no planning guidelines and standards because they are on freehold lands (privately owned land), which makes it difficult for controlled development to take place. They are, therefore characterised by overcrowding, inadequate infrastructural services like clean drinking water and sanitation facilities, solid waste disposals and houses are constructed with materials which are not durable thus poor quality of housing in some cases (Simiyu, Cairncross, & Swilling, 2018; Karanja, 2010). The residents in these fragments have many informal meeting places that facilitate interaction like the streets, market, churches and mosque among others. The residents mainly dominate in conducting informal businesses which are financed by savings from welfare groups. Morphologically these areas are homogenous, but there is a variation in income levels. Examples of unplanned fragments in Kisumu city include; Bandani, Obunga, Manyatta and Nyalenda among others. Some of the developments or buildings in the unplanned fragments have individual gates to enhance security. *Figure 4-3 (Right)* shows an aerial view of the unplanned fragment (Obunga) adjacent to the planned fragment with bypass road between them and with minimal green space.

4.2.2. Planned and Unplanned residential fragments in the study area

The study analyses how residents of the planned and unplanned fragments interact and how change in interaction may affect the residents' subjective Quality of Life. The planned fragment in this study refers to a non-gated one. To achieve this objective, Tom Mboya and Obunga are studied as the planned and unplanned fragments respectively. The characteristics of the two fragments bring to the fore the inequalities that prevail between the fragments especially about accessibility to basic facilities and housing typology.

Tom Mboya neighbourhood (Planned non-gated fragment)

In this study, Tom Mboya neighbourhood is categorised as a planned fragment considering the characteristics described in section 4.2.1. Tom Mboya neighbourhood borders Obunga and has a rich history from the colonial period of the city. In the pre-colonial years, Asians lived in this neighbourhood while the British settled in Milimani estate. The neighbourhood started with Robert Ouko estate which was built by the East African community, which later collapsed. Tom Mboya comprises of both high and medium income residents with leasehold plots. The neighbourhood is well planned, proper allocations were done, a scheme and a plan were prepared after independence by the Ministry of Physical Planning to guide the development of this neighbourhood. There was a guide on road infrastructure and minimum plot sizes (in hectares) to be observed, and even the building heights (number of floors) as remarked by one informant:

> *"Tom Mboya is well planned, and there were proper allocations; a scheme and a plan were prepared after independence, it was around 1983 or 1984. There was a guide on how to provide for road infrastructure and minimum land sizes to be observed, building heights and lines etc., those minimum requirements that are key in guiding development that is what brought that type of settlement." Key Informant 3*

Administratively, Tom Mboya is in Nyawita Sub-location, East Kisumu Location, Kisumu Central Sub-County in Kisumu County and it is approximately one and a half kilometres from the city centre.

Figure 4-4: Photographs of physical characteristics of Tom Mboya; individual house fenced (Left) and good road network (right)

The neighbourhood does not have public facilities like schools and health clinics but has more private ones. There is gating and walling of individual houses and institutions within the neighbourhood. Houses are built using durable materials as shown in *Figure 4-4*. Residents of this neighbourhood majorly interact on streets as they move from their houses or when coming back to their houses. The neighbourhood has limited business opportunities, thus very few informal traders. Green areas or open spaces are many in the neighbourhood, though not fully utilised as recreation areas.

Obunga neighbourhood (Unplanned fragment)

In this study, Obunga is categorized as the unplanned fragment. Obunga is located to the west of Kisumu city and borders Kenya breweries and Tom Mboya neighbourhood to the South, the railway line marks the boundary to the West and Kakamega-Kisumu road marks the boundary to the East. During the pre-colonial period, the neighbourhood was occupied by the Africans who were natives. Most of the residents in Obunga are low-income people though pockets of middle-income people exist. The neighbourhood does not have guidelines and standards for planning, and the land tenure is freehold. It is located two and

a half kilometres from the city centre. Administratively, Obunga is in Kanyakwar Sub-location, East Kisumu Location, Kisumu Central Sub-County in Kisumu County and covers an area of approximately eight square Kilometres. It consists of five units: Obunga Central one (1), Obunga Central two (2), Kamakowa, Sega-Sega and Kasarani.

Apart from having different characteristics, the two neighbourhoods fall under different zones of the city, with Tom Mboya being medium income and Obunga as low-income residential areas and also informally referred to as part of the slum-belt of Kisumu. Obunga is not necessarily a slum but native areas that have been incorporated into the city boundary. One informant had this to say:

> *"The two neighbourhoods are different, because just as the zoning plan of the city, Tom Mboya is a medium income residential area. Obunga is not classified but the majority of those who live there are the poor, and that is why informally they are referred to as slum-belt of Kisumu. They are not slums, these are what would be the villages that have been subsumed by the city. Obunga is a low-income residential area." Key Informant 4*

Figure 4-5: Photographs of physical characteristics of Obunga; (left) a mixture of low & middle standard buildings and (Right) Marram access road

Obunga is characterised by overcrowding (high-density residential area), inadequate infrastructural services like sanitation facilities, clean drinking water, solid waste disposals, poor drainage system within the neighbourhood among other facilities. However, there are new access roads traversing the neighbourhood emanating from the bypass and connecting Obunga neighbourhood to other neighbourhoods, thus a source of interaction. There is also improved drainage along these roads. The neighbourhood has limited public facilities like schools and health clinics, hence depend on private facilities or on public facilities outside the neighbourhood. The houses are built haphazardly with no plan and with materials which are not durable as shown in *Figure 4-5*. The residents have many informal meeting places that facilitate both social and spatial interaction within the neighbourhood like the access roads, market, shops, community hall and resource centres, churches and mosque among others. Informal businesses dominate within the neighbourhood and are conducted along the access roads and the bypass. Green areas or open spaces are limited in the neighbourhood, but residents make full use of the available playground in Sega Sega area, Northern part of Obunga.

4.3. Socio-economic characteristics of the categorised residential fragments

The characteristics of the categorised residential fragments were analysed from both secondary and primary data (household surveys). This was to give a general view of the socio-economic status of the two fragments by assessing their education level, employment status and family income.

Education level

Education is a vital pillar towards the realization of Kenya's vision 2030[9], it imparts knowledge and builds the capacity of individuals. Kenya's education system starts with pre-primary, primary, secondary, tertiary (college) and University (KNBS, 2010). In this study, the highest level of education attained by the households in the two fragments of planned and unplanned is shown in *Figure 4-6*. The analysis from the household survey revealed that in Obunga (Unplanned fragment) the majority of the respondents had attained Primary school level of education and registered the highest percentage of 48.8%. A similar trend was also observed using the analysis of census data of 2009 for Kisumu East which was used as proxy data for Railway ward, where the two fragments fall administratively. The majority of the residents had attained Primary school level of education (56.4%). However, for Tom Mboya (Planned fragment), those with university level of education registered the highest with 32.4% which is higher than census data (2009) of 2.7%. The analysis gives a general overview of the literacy level of the residents in both planned and unplanned fragments. Education allows residents to meet and interact and bond especially those at the same level, for example, graduates or college level.

Question: What is the highest level of education that you have completed?

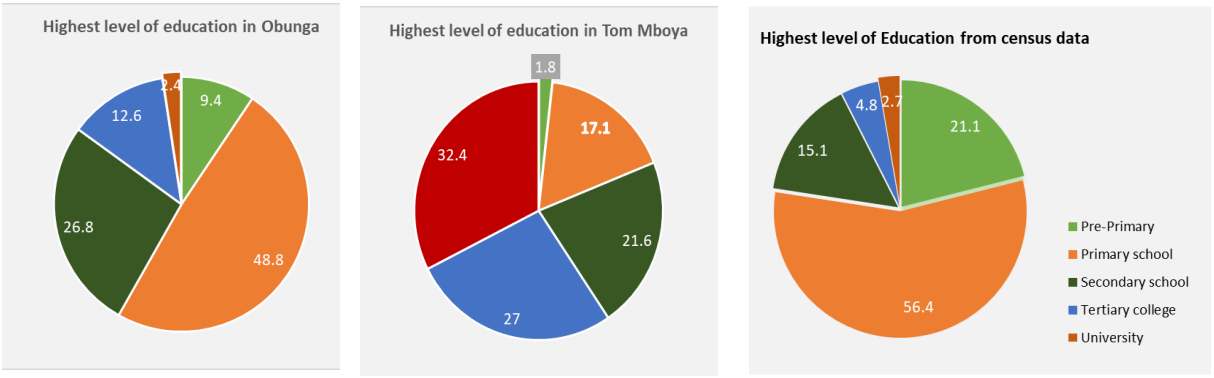

Figure 4-6: Percentages of highest education level attained by residents in the two fragments
Source: Census data for Kisumu East (KNBS, 2010) and Household survey (2018)

Employment

Employment status of the two fragments is categorised into four; employed, self-employed, unemployed (not employed) and volunteer as per the labour force framework (CBS, 2002). Employed category refers to residents who have regular or formal jobs from both national and county government, private sector (NGOs) and faith-based organizations like churches among others. Self-employed are those residents who run their businesses either on a small or large scale, for instance, running private schools, carpentry, food stalls, grocery shops, butchery and fish stalls among others. Family members run these businesses in most cases, or some may involve paid workers. Unemployed (Not employed) category refers to residents without jobs though some of them could be looking for jobs, and these may include university students, college and school dropouts, retirees and aged persons among others. Volunteer category refers to those who work without pay, they offer their services freely. From the analysis of the household survey, it is revealed that most residents in the two neighbourhoods are self-employed, the majority of the respondents both in Obunga (57%) and Tom Mboya (42.4%) neighbourhoods were running their businesses. On the one hand, Tom Mboya fragment registered the highest percentage of employed respondents (40.5%) as compared to Obunga with only 14.1%. On the other hand, Obunga had the

[9] Kenya's vision 2030 is a national long-term planning strategy whose objective is to create a globally competitive and prosperous nation with a high QoL by 2030, based on three pillars; economic, social and political (GoK, 2007).

highest percentage (28.1%) of those who were not employed as compared to Tom Mboya (17.1%). There were no volunteers in Tom Mboya. Refer to *Figure 4-7*.

Question: What is your employment status?

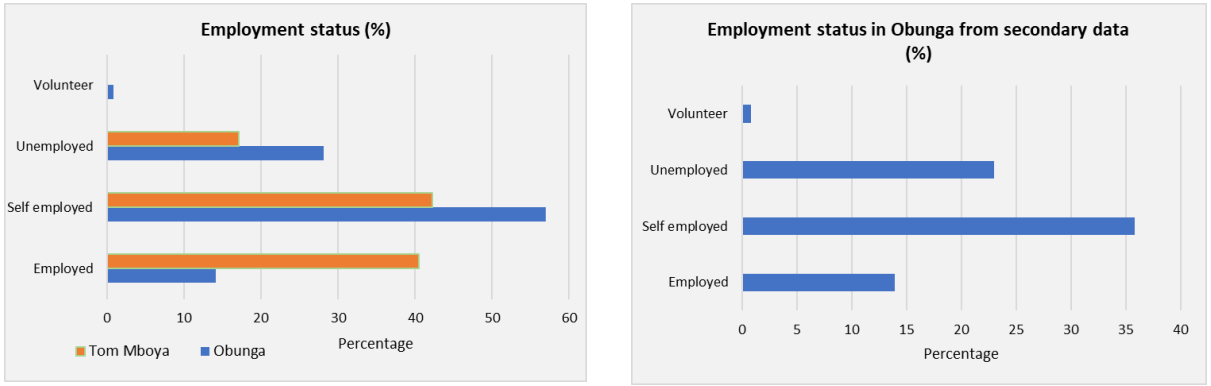

Figure 4-7: Employment status in the planned and unplanned fragments
Source: Household survey (2018)-*left* and secondary socio-economic data (Pamoja Trust, 2014)-*right*

Comparison of secondary and primary data for the unplanned fragment (Obunga) revealed the same trend with approximately 35.8% of the household members working as self-employed and registered the highest percentage just like in the household survey. This category was followed by those not employed (unemployed) and represented by 23% of the household members. Employment generally creates a platform of interaction between and within neighbourhoods and may lead to the satisfaction of subjective QoL of residents.

Satisfaction with family income

Income plays a big role in one's wellbeing, and it enables one to afford necessities of life especially if it is constant, thus facilitates interaction in neighbourhoods. The analysis was based on a Likert scale where one (1) represented *Very dissatisfied* and five (5) *Very satisfied*. From the analysis, respondents who were not satisfied nor dissatisfied (Neutral) with their family income before road expansion in planned fragment registered the highest percentage 36% (see *Figure 4-8)*. However, after road expansion, the percentage of those who were very satisfied increased from 6.3% to 10.8% in the planned fragment. For the unplanned fragment (Obunga), the majority was dissatisfied with their family income before road expansion thus registering 43.3%. Surprisingly, after road expansion, those who were satisfied with family income registered the highest percentage (41.4%). Looking at the analysis after road expansion, the percentage of those who were very dissatisfied went down in both fragment; 3.6% to 0.9% and 2.4% to 1.6% in the planned and unplanned fragments respectively. Noticeably, the two fragments show the same trend of satisfaction with their family income after road expansion.

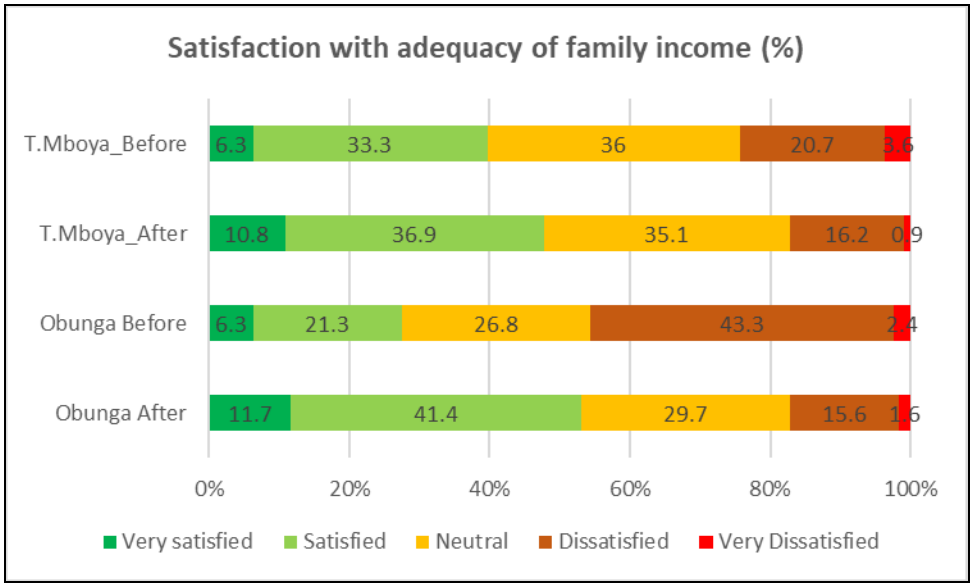

Figure 4-8: Respondents' satisfaction level with family income before and after road expansion
Source: Household survey, 2018 (T. Mboya refers to Tom Mboya)

Differences in socio-economic characteristics are key aspects that bring out patterns of inequality and spatial differences as also suggested by Chakravorty (1996). This plays a pivotal role in both social and spatial interaction between and within fragments.

4.4. The impacts of road infrastructure project and interaction

The objective of this section was to assess how the impacts of the road infrastructure project influences the interaction between and within the two fragments. The interaction was measured using the impacts from the bypass as perceived by the residents of the two fragments. This was analysed by considering both the anticipated impacts as stated in the ESIA report, 2004 and the actual impacts accruing from the bypass as perceived by both the respondents and the key informants. The second way of analysing interaction was through accessibility to facilities and services (spatial interaction).

4.4.1. Anticipated impacts of the road infrastructure project

To get the general view of the anticipated impacts, Environmental and Social Impact Assessment (ESIA) was conducted for the section of the Northern Corridor Road Improvement Project as already discussed in section 3.2.3. This was important because the road traverse between neighbourhoods and the rehabilitation of the road was to impact on the lives of the residents either socially, economically or spatially. ESIA was conducted with the aim of preparing a workable environmental management plan that would reduce impacts and minimise any adverse environmental impacts during and after road infrastructure project (MoRPW&H, 2004). ESIA is a decision-making tool, whose process is participatory and it involves even the public opinion as stated by one informant:

> *"Screening is done to determine which ESIA level is to be done, either project report or full study. Terms of Reference which include the scope of work and the experts required is done, and gazette notice is given within two weeks to get comments from the public. If issues come up within the two weeks, a public hearing will be organised. If the issues are so heavy and there are no possible mitigating measures, then the project may altogether be abandoned. If the public has no major issues, then the project will go on, and the conditional license is issued." Key Informant 6.*

Kisumu bypass, though in the initial Development plan of the city it existed as a narrow road and people had settled on the road reserves, subdivided land and erected business premises. This shows that people had encroached on the land reserved for the road as stated by one informant;

> *"Interestingly, the bypass has been there since 1978. When they were planning for Thika superhighway and Mombasa road, this was also there. It is only that most of the community members encroached into the road reserve. When the city boundary was extended, so many people sub-divided the bypass and sold but a big chunk of it was repossessed, and buildings brought down" Key Informant 3.*

The changes that had taken place on the road reserve necessitated the carrying out of an ESIA study. ESIA was to help identify potential positive and negative impacts that the rehabilitation of the road was to bring with it. Secondly, it identified those who were to be affected by the project and prepared a Resettlement plan for compensations. Relevant stakeholders organised for project disclosure meetings with the communities for purposes of sensitization as echoed by one informant:

> *"I know that community sensitization meetings were done and I attended one. Notices were given around one or two weeks before the firm that was conducting ESIA came to do the project disclosure to the communities. That was done through open public "baraza"*[10] *, and the notices were given to every Assistant chief, so every location and Sub-location was made aware. I remember we had a big crowd..." Key Informant 6.*

The impacts whether positive or negative were to influence the interaction of residents in the study area.

4.4.2. Actual impacts accruing from a road infrastructure project

Key informant interviews and household surveys were conducted to gain an in-depth understanding of the possible impacts that could be associated with the implementation of the road infrastructure project (bypass). Positive and negative impacts were identified and their possible influence on both social and spatial interaction of the residents between and within neighbourhoods assessed. This was also a way of establishing if the residents were happy and benefitting from the expanded road. The nature and magnitude of the impacts would reveal if the adverse effects that were identified during the ESIA study were well mitigated. During the identification process described in section 3.2.3, some of the impacts may not have been anticipated, and some that were considered positive during identification process could turn out to be unacceptable either to the community or the planning and environmental conditions. The actual impacts were assessed based on the time period of 2016 to 2018, following the opening of the road to use.

4.4.3. How impacts influence interaction between neighbourhoods

Impacts were identified based on two moments in time; during construction and after the construction of the road from both the residents and the informants in the study area. The identified impacts in the study area were grouped into two; positive and negative depending on how beneficial they were to the interaction process and subjective QoL of the residents. The positive ones included; enhanced accessibility, enhanced security, employment opportunities, increased commerce, improved welfare and landscaping. Subsequently, the negative ones were; displacement of human settlements, disruption of business, customers, income, noise, insecurity, traffic disruption and accidents.

4.4.4. Comparison of the anticipated and actual impacts of road infrastructure project

Results from this study are compared with the anticipated impacts from the ESIA report, 2004 by MoRPW. The comparison aimed at identifying which impacts materialised and in which fragment, and also verify if the anticipated mitigation measures were implemented to the latter. The actual impacts are assessed for the period during construction and after road expansion. Refer to *Table 4-1* and *Appendix 4* (positive impacts).

[10] *"baraza" means a deliberation meeting held by a group of people*

Table 4-1: Comparison of the anticipated and actual positive impacts of the road expansion

Dimension	Anticipated impacts (Positive)	Actual impacts (Performance)	
		Tom Mboya	**Obunga**
Accessibility	Easier access to social amenities	Easier access to basic facilities and services	
	Enhanced accessibility	Access roads have led to improved accessibility to both motorised and Non-Motorised Users (NMU)	
	Reduced vehicle operating costs, commuter travel time and costs	Connection to other neighbourhoods through access roads from the bypass	
Security	Enhanced security	Enhanced security from street lights and police patrols	
Safety	Enhanced non-motorist traffic safety (wider Pedestrian and cyclist paths)	Walking lane for pedestrians	
Employment opportunities	Generated employment opportunities		More Job opportunities during the construction phase and after
Improved business	Increased commerce		Improved business & market base
Improved Welfare	Indirect impact which was not anticipated	Increased number of registered welfare groups	
Landscaping	Landscaped road environment	Improved drainage system & increased green space	

Source: Author, 2018 and (MoRPW&H, 2004)

Positive impacts

1) Enhanced accessibility

Looking at accessibility, respondents from the two neighbourhoods confirmed improved accessibility to facilities and ease of movement (mobility), after road expansion. Access to facilities between and within neighbourhoods is perceived by residents as an indicator of interaction. Furthermore, it may facilitate social interaction with neighbours and service providers and promote a sense of living in a friendly environment to the residents as also discussed by Stoeckel and Litwin (2015). Most of the key informants were in agreement with the perception of the respondents about improved accessibility in the study area with one stating;

"The opening up of the Bypass has promoted accessibility in that you can easily go through Obunga or Tom Mboya and access the various activity zones that one may want to visit in that area. So we can say that the Bypass has promoted accessibility…… the bypass has also led to the opening up of some streets within Obunga like Pamba road which again encourages some residents from Tom Mboya to go through Obunga and join Kakamega road" Key Informant 5

The improved accessibility encourages Tom Mboya residents to go through Obunga as they join Kakamega road through Pamba road, and this creates a platform for interaction. Respondents from Obunga also view improved accessibility from the angle of reaching facilities like schools where school children can now use school buses and motorcycles to their respective schools in other adjacent neighbourhoods using the bypass and other access roads that have come up as a result of the bypass (Refer to *Figure 4-9*)), as confirmed by Obunga resident;

"There is increased accessibility, children from Obunga can now use school buses because of the Bypass, this was not possible before."

This confirms what had been anticipated in the ESIA report about easier access to social amenities, hence enhanced accessibility in the study area, likely to enhance spatial interaction and even influence subjective QoL.

2) Reduced vehicle operating costs, commuter travel and time costs

The bypass has supported auxiliary services like access roads which have been constructed from it to connect other neighbourhoods. A good example is the tarmacking of Pamba road which traverses through Obunga and connects to Kisumu-Kakamega road and other County roads within Obunga *(Refer to Figure 4-9*). The bypass itself has also connected Obunga with other adjacent neighbourhoods like Kondele, Tom Mboya and Bandani. This has resulted in improved accessibility and basic mobility of people from one place to the other as expressed by the respondents; *"Obunga is now connected to other adjacent neighbourhoods like Migosi and Kondele."* It had been envisioned that the road would lead to reduced vehicle operating costs, commuter travel time and costs, the connectivity aspect confirms this in the two neighbourhoods. It is worth noting that, as an area gets more connected, travel distances are likely to decrease because route options increase, this reduces time and cost. This is likely to enhance interaction between and within an also improve QoL within neighbourhoods.

Figure 4-9: County access road from the bypass traversing through Obunga

3) Enhanced security and safety

Respondents from the two neighbourhoods felt that their neighbourhood security had improved and safety enhanced, just as it was anticipated in the ESIA report. This was attributed to the presence of street lights along the bypass and frequent police patrols in the area, to maintain law and order as attested by one informant:

> *"The road has improved the security of the area….. because of frequent police patrols in the neighbourhood, and now there are street lights on the bypass. Also with the street lights, thieves have nowhere to hide." Key Informant 1.*

Another respondent also confirmed that the perception of the residents about insecurity and crime rate in Obunga neighbourhood had changed following the implementation of the bypass:

> *"It has assisted us a lot by reducing theft, traffic jam and insecurity in the area. Initially, you could not walk after 7 pm in Obunga, but now the area is safe, and one can walk even up to midnight. Street lights have opened up the area." Obunga resident.*

Respondents of Tom Mboya neighbourhood also noted improved security because of the street lights on the bypass. Tom Mboya residents were afraid of the Obunga residents before road expansion because they were seeing them as *"wrong people",* but this perception is changing. One the respondent had this to say during walking interview:

> *"It was not easy to get people staying in these houses before, because of robbery and fear. But now they are coming back because insecurity has gone down following the presence of street lights on the bypass and within the neighbourhood feeder roads." Tom Mboya resident*

Safe and secure neighbourhoods encourage interaction between residents and contribute to positive subjective QoL. The presence of street lights enable residents to move freely and at any time, thus encouraging interaction even on the road itself. *(Figure 4-10).*

Figure 4-10: A section of the Bypass in the study area with street lights

4) Increased employment opportunities

Access to job opportunities between and within neighbourhoods contributes to residents' QoL conditions. Employment is vital in integrating residents within neighbourhoods and encourages interaction. The expansion of the road enabled residents in the study area, especially from Obunga neighbourhood to get more jobs during the construction phase of the road. The same residents now operate motorcycle businesses and perform other informal businesses along the bypass as a way of being self-employed (*Figure 4-11*). The County government of Kisumu has provided motorcycle riders with parking shades which also have a small shop as part of the structure along the access roads, this aims at enhancing employment creation and improve QoL. One informant had this to say: *"….the area now has many businesses coming up. It has made the County government build many motorcycle shades." Key informant 2*

Figure 4-11: Motorcycle riders waiting to ferry passengers besides the bypass (left) and riders along Pamba road (right)
Source: (Kisumu County, 2018) and Author, 2018

As motorcycle riders[11] wait for passengers, they interact and create strong social bonds amongst themselves. This is likely to extend even to the passengers that they ferry to various destinations between and within neighbourhoods. Therefore, despite improving mobility between and within neighbourhoods, motorcycle business also facilitates both spatial and social interaction in neighbourhoods. Household survey results revealed that the majority of the residents in Obunga are self-employed, and in the informal sector where selling along the roads is very common. Some of the respondents from Obunga also confirmed that they were getting casual jobs in Tom Mboya as stated by one of them: *"I usually go to do*

[11] Motorcycle riders are locally referred to as "*boda boda*"

casual jobs in Tom Mboya like slashing, cleaning, gardening among other jobs." Further, it confirms what had been anticipated in the ESIA report that there would be employment opportunities generated from the expanded road during and after construction.

Improved welfare

Improved welfare of the residents in the two fragments comes as an indirect impact. Taking into account the increased job opportunities emanating from the expanded road, the number of registered welfare groups has been on the increase in the study area. Welfare groups are important because they give residents identity and facilitate social inclusion within neighbourhoods. It is a requirement by the Community Development Office of Kisumu County for those in the motorcycle business to register and operate under certain welfare groups as explained by one informant:

> *"Registration has gone up, so many people now register because like the motorcycle industry, when the bypass was constructed so many people have invested in motorcycle and we normally require them to register in a group for them to operate in a certain place. So we have been receiving so much from this sector, they have been coming for registration, and even women groups have been coming……" Key Informant 7*

The number of registered welfare groups as from the year 2016 to 2018 in Kisumu Central Sub-County where the two neighbourhoods fall administratively are shown in *Table 4-2*. This also refers to the period after road expansion. The data is used as proxy data to give a general view of welfare groups' performance in the study area. Looking at the trend, there is an increase in registration of the three categories, between the three years. Majority of the registered groups were from Obunga as compared to Tom Mboya, as stated the County Development officer;

> *"In Tom Mboya, we don't have many groups as such, but in Obunga we have. Tom Mboya, maybe just a few but not many. Obunga and Nyawita we have many groups."…Key informant 7*

The same trend was also noted during the household survey, where the majority of the respondent from Obunga were registered members of welfare groups as compared to their counterparts, Tom Mboya residents (*Refer to Table 4-3).*

Table 4-2: Number of registered welfare groups in Kisumu Central Sub-county

Groups	**2016**	**2017**	**2018**
Youth Groups	41	52	115
Women groups	50	34	128
Self-help groups	44	123	384

Note: This is only a representation of the registered groups in the Sub-County
Source: Statistics from the Department of Social Services, Kisumu (2018)

Table 4-3: Percentage of respondents registered in welfare/religious groups in the two fragments

	Tom Mboya	**Obunga**
Registered in groups	43.2%	57.8%
Not registered	56.8%	42.2%

Source: Household survey, 2018

Figure 4-11 (left) gives an example of a self-help group for motorcycle riders in Obunga- "*Obunga Bypass Self-help group*". Welfare groups play a pivotal role in bringing people together and create a platform for social networks which may enhance interaction in neighbourhoods and better subjective QoL.

5) Improved landscaped road environment

The Landscaping of the bypass was done through the provision of drainage works along the road and planting of grass and trees. This contributed to easy movement of stormwater thus reduced flooding in Obunga neighbourhood. Landscaped road also increased the area for green space because grass and trees

were planted along the road. This also contributes to interaction and subjective QoL in the area. See *Figure 4-12*. One informant stated that:

> *"Drainage system was very bad when it rained all the water from Kondele area would end up in Obunga, and the area has a high water table. Hence it would flood making the place pathetic, the sewage was bad…. It has improved because of drainage on both sides of the bypass so that the water that comes from Kondele goes straight to the lake. It has helped and now no flooding." Key Informant 2*

Figure 4-12: Improved drainage system along the bypass in the Study Area

6) Increased commerce

Sustainable market base plays a key role in the growing of the economy. Interview with residents of Obunga revealed that following improved accessibility, their market base had increased, the number of people coming to buy their products had gone up. Increased number of small businesses and long operating hours following the presence of street lights on the bypass are other benefits of the bypass to the residents as was observed by some informants;

> *"…the bypass has improved business in Obunga and women can now sell along the bypass till late hours of the night because of the street lights. It has improved business regarding operating hours and many people passing there have led to an increased market base." Key informant 2*

Figure 4-13 shows a section of the bypass between Obunga and Tom Mboya with small-scale businesses like welding, vegetable vendors, hairdressing among others being carried out beside the bypass on Obunga side and within the neighbourhood. As residents sell, they are likely to interact with different customers even those from Tom Mboya and create social networks which are necessary for sustaining their businesses. One of the respondents had this to say; *"When you walk along the Bypass, you can see businesses coming up (small-scale businesses), and people buy from both sides/ neighbourhoods. For instance, Tom Mboya residents are buying foodstuff from Obunga market." Key informant 5*

Figure 4-13: Small-scale businesses along the bypass and within Obunga neighbourhood

It was also confirmed by one of the Tom Mboya respondents that; *"The Obunga residents now have a market for their products, their market base has increased. There are no shops in Tom Mboya, so residents just have to go to Obunga for small purchases."* Business premises along the bypass on the Tom Mboya side are minimal as compared to Obunga. Sharing facilities like market and mosque may facilitate social interaction between Obunga and Tom Mboya residents.

The positive impacts accruing from the bypass are likely to create a platform for interaction between and within neighbourhoods and also better QoL within fragments as was perceived by both the respondents and informants. However, it can be said that the road expansion project has a more positive image for a larger segment of the population in Obunga neighbourhood as compared to Tom Mboya accruing from the expressed sentiments of a respondent; *"I think most changes or improvements can be seen in Obunga than Tom Mboya." Tom Mboya resident.*

Negative impacts

The implementation of the bypass also brought with it some adverse effects in the study area. Assessment of the negative impacts was based on the ESIA report of 2004 and primary data collected from the field. Interview with the respondents of the two fragments and informants revealed that some of the negative impacts were not well mitigated and to the contrary, some were not anticipated. The negative impacts are twofold; those that happened during the construction phase, and after road expansion. They include; displacement of human settlements, displacement of businesses, insecurity, traffic disruption and accidents, noise and atmospheric pollution and encroachment on road reserves. Refer to *Table 4-4* and *Appendix 4* (negative impacts).

Table 4-4: Comparison of the anticipated and actual negative impacts of the road expansion

Dimension	**Anticipated impacts (Negative)**	**Actual impacts**	
		Tom Mboya	**Obunga**
Road expansion	Displacement of human settlement		Displacement of People
	Displacement of businesses, customers and income		Disruption of businesses, customers & income during road construction phase
Insecurity	Was not anticipated	Overpass poses a danger to Non-Motorised Transport Users especially at night	
Increased traffic accidents	Traffic disruption and accidents	Increased incidences of accidents on the bypass	
Noise and atmospheric pollution	Noise, Gaseous and Dust pollution	Noise from the moving vehicles	
Encroachment on road reserves	Encroachment by upcoming generated infrastructure such as markets and other business premises	Encroachment on the road reserve through mushrooming of unplanned structures along the road reserves and human traffic conflict	
Increase in property value	Was not anticipated	Increase in land prices and house rent affected Obunga most	

Source: ESIA Report, 2014 and Author, 2018

1) Displacement of human settlements

The road existed for many years as a narrow road in the study area, and so residents settled on the road reserve especially in Obunga. During the implementation of the Bypass road, those who had settled on the road reserve had to pave the way for the same and were to be resettled under the Resettlement Action Plan (RAP). Those who had genuine title deeds for the land they were occupying along the reserve, were compensated. However, those who were not the registered owners of the land parcels, have their compensation pending. It is worth noting that some people were not satisfied with the government rates that were offered for compensation, so they declined the offer, and this led to evictions as stated by one of the informants;

"There was eviction, and those who were on the road reserve had to go. There was also conflict between people and the government because they were not paid before construction started. Again there was conflict between people themselves, some people bought land and did not transfer the land to become the registered owners, and some were given money and never moved. It is a major challenge, and some people have never been paid because of missing names on the compensation list because of transfer of land cases. Succession was not done, and the land remained in the names of the deceased as the registered owners." Key informant 2

There was no displacement of human settlements in Tom Mboya since there were no residents who had settled on the road reserve given the planning standards in place.

2) Displacement of business, customers and income

Interviews in the study area revealed that road expansion had interfered with residents businesses during the construction phase, especially in Obunga. Residents who had established social networks lost them because of their businesses being disrupted (social displacement). It is worth noting that most businesses in Obunga are informal and conducted along the road reserves. One of the informants noted;

"Construction of the Bypass led to the displacement of people and businesses that were being conducted on the road reserves, thus reducing access to their livelihood and affecting their QoL. They also lost their social networks, i.e. customer base and social groups. Flattening the structures, cutting off the sources of livelihood of these people, yet up to 60% of city revenue comes from this sector of informal traders." Key informant 4

Looking at the literacy level in the study area from the household survey, there is a high percentage of residents in Obunga who have attained primary school level of education. The only way these people have responded to their education status is by being self-employed through conducting informal businesses
Most of the informal businesses in Obunga are carried out along roads. Pulling down business premises that were on the road reserve during road construction was so inconveniencing to the Obunga residents. There was no disruption of businesses in Tom Mboya during the construction phase, as none was on the road reserve.

3) Insecurity

Although the bypass has led to improved security in the study area, its salient design features in some places contribute to insecurity. For instance, the overpasses have street lights on top only, and underneath there are no lights, this makes it dark at night and a hiding place for thieves and robbers, see *Figure 4-14 (left).* One of the informants stated that:

> *"When we talk about negative effects, the bypass road has also contributed to insecurity, there is a flyover (overpass) where thieves and muggers hide at night and attack people. The place is a bit dark at night, so thieves take advantage." Key Informant 2*

Figure 4-14: Overpass with railway line beneath (left) and Security firm in Tom Mboya (right)

The overpass poses a danger to the pedestrians who walk beneath and along the railway line to the city centre especially in the evenings or at night. However, insecurity affects both neighbourhoods in the study area equally. Security firms were spotted in Tom Mboya neighbourhood, this indicates that residents still fear, and so some of them engaged security guards as a way of enhancing their safety within the neighbourhood. Refer to *Figure 4-14 (right).* This negative impact was not envisioned during the ESIA report of 2004, it comes as an indirect impact from the road design. This may minimise interaction between fragments.

4) Increased traffic accidents

Increased incidents of accidents have been noted on this bypass by both residents of the two neighbourhoods and the informants. The accidents are linked to careless driving and assumption from either drivers or non-motorised users when crossing the road. Although traffic safety relies heavily on the road users to prevent accidents from happening, it can also be mitigated by providing relevant road signs along the road which are currently lacking in some sections. The bypass road serves both as an international passage for transit goods from Mombasa to the neighbouring countries and as an urban road as mentioned earlier in section 3.2.2. The speed at which vehicles move makes it difficult for non-motorised users to cross the road. One of the informants had these sentiments;

> *"As the road is being expanded, the typical reaction of a driver is that he feels safe on a wider road, and so drive faster. Our roads serve both the function of highways and at the same time local urban roads, how about the speeds and safety*

of the Non-Motorised Transport Users (NMTU). All that has been done is dedicated to motorised users, where do we take the NMTU?" Key Informant 4

According to Obunga residents, despite the bypass being a good project, their main concern has been the school going children, physically challenged and the aged persons. These group of people may not cross the road easily following the absence of zebra crossings in most sections of the road in the study area and the speeding vehicles. These hiccups could lead to reduced movement for non-motorised users and so affect the interaction between fragments. It was also felt that there was a category of people whom the design of the bypass had not catered for by the informants; the cyclists and pedestrians *(See Figure 4-15*) as stated by one of them;

"The safety factors… they did not incorporate enough safety factors when designing the roads, because we have cyclists, motorcycle riders, and all of them need to use the same road but the way the road was designed, the sides were not like earmarked for those other users. Our roads are not user-friendly for non-motorists." Key informant 6

The design of the bypass does not provide lanes for different road users in some sections. It is, therefore, difficult to share road space among different modes of transport that use the bypass, and this could easily cause accidents during rush hours. Walkability and cyclability ought to be encouraged in cities by providing the relevant space along roads. However, the issue of increased accidents, impacts on the two neighbourhoods equally especially during the crossing of the road.

Figure 4-15: Section of the Bypass with no zebra crossing and bicycle lane in the study area

5) Noise and atmospheric pollution

The respondents in the two neighbourhoods expressed concern about both noise and atmospheric pollution from the moving vehicles on the bypass. It had been anticipated in the ESIA that there would be noise during both construction and operation phases. The construction of the overpasses along the bypass road has led to a reduction in the number of turns, thus making both vehicles and people to make long stretches to get to the turns as stated by one informant;

"…. long stretches of turn arounds, the U-turns are far away from each other, and this looks like taking a double stretch thus contributing to pollution. When done cumulatively, people will be using more fuel, for example, people living in Tom Mboya have to go long stretch for them to turn at Patel flats." Key informant 6

Access roads from the bypass which traverse through Obunga are not tarmacked, and so dust is likely to affect residents as vehicles move on these roads. This could lead to airborne diseases in the neighbourhoods and affect the QoL of the residents.

6) Encroachment along road reserve

Encroachment on the road reserve through mushrooming of unplanned structures for small businesses and human traffic conflict has been experienced in the study area. Areas outside the road reserve which are considered environmentally sensitive have also been encroached on in some sections as stated by one informant;

"The only problem is that it is also causing encroachment into areas outside the road reserve and some parts of it are like wetland and swampy although they are not gazetted wetlands, but they are areas which we feel are environmentally sensitive." Key Informant 6

Encroachment on the road reserve had been anticipated in the ESIA report. It is more on the Obunga side of the bypass, because residents perform their small-scale trade along the roads. They target road users to buy their products. However, it is minimal on the Tom Mboya side of the bypass. Human traffic conflict experienced along the bypass during peak hours affects both neighbourhoods.

7) Increase in property value

Some respondents in the study area felt that improved accessibility had led to an increase in property value and this was contributing to the escalating house rent and land prices in the area. In Tom Mboya, the increase in property value was seen as a positive impact, but to the residents of Obunga, it had a negative connotation. This is likely to result in gentrification in neighbourhoods like Obunga, displacing those who are not able to pay for housing. A resident from Obunga confirmed that house rent had gone up, the same was noted by some of the informants;

"The construction of the Bypass has influenced housing. The property value of plots in Obunga has risen because people are seeing the opportunities now and if you check on the designs and quality of the upcoming houses, they are different from what used to be associated with Obunga. The people doing this may not be necessarily the Obunga residents….." Key informant 5

The adverse impacts of the bypass road which separates the two neighbourhoods could contribute to less interaction between residents. For instance, if people have to walk long stretches, this may discourage somebody from carrying out some activities like visitation. Some residents may try to cross the road from any point however dangerous it may be, and this exposes them to danger and accidents.

4.5. Interaction between and within neighbourhoods

One of the aims of this study was to assess how residents of the two residential fragments perceive both social and spatial interaction between and within neighbourhoods before and after road expansion.

4.5.1. Social interaction within own fragment (internal interaction)

Social interaction within fragments was conducted with the aim of bringing out the perception of residents on relationship within their fragments. The study explored social interaction by considering social networks within neighbourhoods. The results are presented using mean scores, standard deviation and percentage scores (stacked bars). It is worth noting that social interaction was only measured for the period after road expansion.

Perception of respondents on social network attributes

The dimension of social network entailed respondents feeling at home in the neighbourhood, receiving support from friends, relatives and neighbours; being member of either religious, association, women, youth or self-help group and chatting with neighbours. These are drivers of social interaction between residents and within fragments. Responses of respondents on perception to different social networks attributes in the study area are analysed in *Figure 4-16* and *Figure 4-17*. Results show that many respondents who perceived to be feeling at home in their neighbourhood, also perceived that they could rely on help of

their neighbours in case of problems in both planned and unplanned fragments. For instance, 50.5% and 43% of the respondents strongly agreed that they were feeling at home in the planned and unplanned fragments respectively. Additionally, 36.9% and 45.3% of the respondents in planned and unplanned fragments respectively, perceived to rely on help from neighbours when faced with a problem. Stacked bars have been produced to visualize the percentages of the respondents' perception on feeling at home and relying on their neighbours for help in the two fragments.

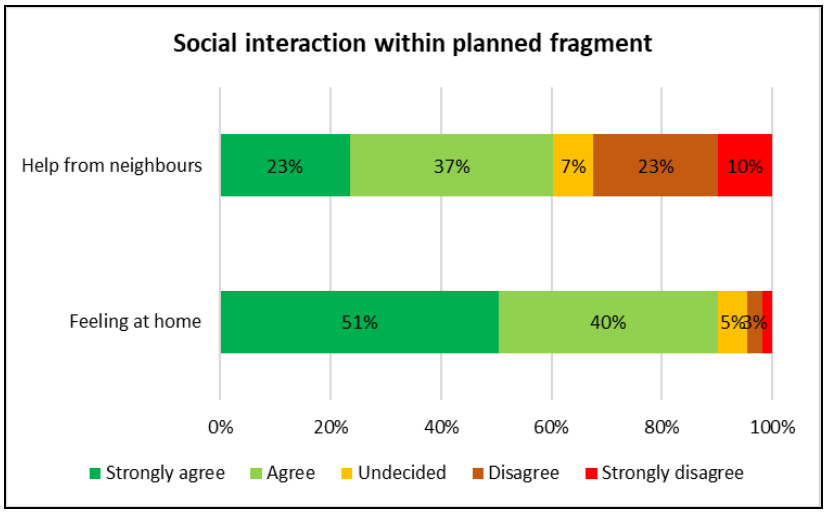

Figure 4-16: Residents perception on social interaction within the planned fragment (Tom Mboya)

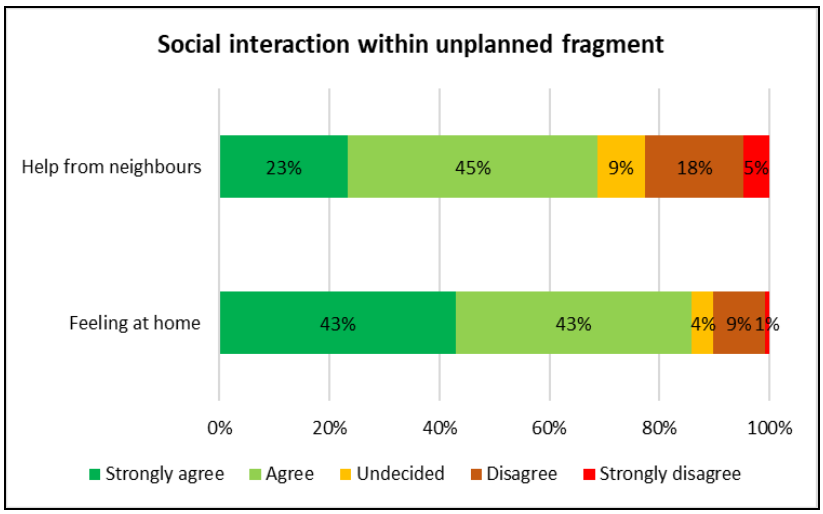

Figure 4-17: Residents perception on social interaction within the unplanned fragment (Obunga)

Perception of respondents in percentages on the frequencies about seeking for help from neighbours and neighbours seeking for help in return is shown in *Table 4-5*. Survey responses in the two fragments revealed that the majority of the respondents were rarely asking for help from neighbours in their neighbourhoods (32.4% and 43.8% in planned and unplanned fragments respectively). Additionally, those who were rarely being asked for help by their neighbours registered 31.5% and 45.3% for planned and unplanned fragments respectively.

Table 4-5: Perception of respondents on asking for help from neighbours

		Asking for help from neighbours	Neighbours asking for help
		Percentage (%)	
Planned (N=111)	Never	18.9	18
	Rarely	**32.4**	**31.5**
	Once a year	3.6	4.5
	Once a month	29.7	29.7
	Once a week	15.3	16.2
Unplanned (N=128)	Never	20.3	16.4
	Rarely	**43.8**	**45.3**
	Once a year	2.3	1.6
	Once a month	11.7	11.7
	Once a week	21.9	25

Perception of respondents on getting housing

In this section, avenues of getting housing in both planned and unplanned fragments are discussed based on how one can get a house either through friends, housing agency and physical search among others. *Table 4-6* shows possible arrangements on getting housing in the two fragments. On the one hand, the majority of the respondents from the planned fragment were getting houses in their neighbourhood through housing agencies (39.6%), followed by family and friends 27%. On the other hand, 76.6% of respondents from unplanned fragment indicated that getting houses in their fragment was through physical search, followed by family and friends 16.4%, just as had been perceived by those in the planned fragment. The respondents from the planned fragment perceived that they were getting houses in the unplanned fragment through physical house search (55.9%), followed by family and friends 22.5%. Further, 28.9% of the respondents from the unplanned fragment also indicated that houses in the planned fragment could be accessed through housing agencies followed by physical house search. Generally, getting housing in the two fragments was dominated by physical search, housing agencies and through family and friends.

Table 4-6: Perception of respondents on the arrangement of getting housing between and within fragments

		Getting housing in your neighbourhood	Getting housing in unplanned fragment
		Percentage (%)	
Planned	Via family/friends	27	22.5
	physical house search	12.6	55.9
	Housing agencies	39.6	6.3
	Brokers	5.4	6.3
	Advertisements	15.3	0.9
	Others		8.1
		Getting housing in your neighbourhood	Getting housing in planned fragment
Unplanned	Via family/friends	16.4	11.7
	physical house search	76.6	20.3
	Housing agencies	3.9	28.9
	Brokers		8.6
	Advertisements	1.6	10.9
	Others	1.6	19.5

4.5.2. Social interaction between fragments (External interaction)

Social interaction between planned and unplanned fragments aimed at bringing out respondents' perception of how they relate between neighbourhoods. This was measured by considering the number of people that they visit, chat and even discuss personal matters with. It reveals the frequency of contact between residents. *Table 4-7* shows the perception of respondents on different attributes of social interaction between fragments. What was striking is that at least 20.7% of the respondents in the planned fragment were being visited by those from the unplanned fragment. Additionally, 20.7% from planned fragment was chatting with those in the unplanned fragment. On the contrary, around 80% of those from the unplanned fragment were not relating with anyone from the planned fragment. However, there is some interaction between the two fragments, though not as strong within fragments.

Table 4-7: Perception of respondents on different attributes of social interaction between fragments (bold: mentioned in the text)

		Residents you visit in unplanned fragment	Residents from unplanned fragment who visit sit you	Residents you chat with in unplanned fragment	Residents from unplanned fragment who chat with you
		Percentage (%)			
Planned (N=111)	No one	57.3	57.7	51.4	52.3
	Hardly anybody	11.8	9.9	14.4	12.6
	Just a few of them	**18.2**	**20.7**	**20.7**	**20.7**
	Most of them	12.7	11.7	**13.5**	14.4
	All of them				
		Residents you visit in planned fragment	Residents from planned fragment who visit you	Residents you chat with in planned fragment	Residents from planned fragment who chat with you
		Percentage (%)			
Unplanned (N=128)	No one	**80.5**	**82.8**	**82.8**	**81.3**
	Hardly anybody	11.7	11.7	10.9	11.7
	Just a few of them	7	4.7	5.5	6.3
	Most of them	0.8	0.8	0.8	0.8
	All of them				

4.5.3. Spatial interaction (Spatial accessibility to facilities)

The aim of conducting spatial interaction through assessing accessibility to facilities and services in the study area was to obtain responses on respondents' perception on both internal and external interaction between and within neighbourhoods, before and after road expansion. Spatial accessibility was measured using access to education, health, recreation facilities, church/mosque and cultural/social institutions.

Places where residents in the two fragments access facilities and services

An overview of places where household members access facilities and services from where they live in Tom Mboya neighbourhood (planned fragment) is shown in *Table* 4-8. However, they could be accessing facilities in more than one place. Therefore, multiple responses were expected since respondents have different preferences to places that they would access these facilities. The percentages are calculated based on the number of responses, divided by the total number of respondents (N) and multiplied by one hundred percent. Therefore, the row percentages add up to 100% or more. On average, the majority of the respondents from the planned fragment accessed most facilities outside own and adjacent neighbourhoods, but within the city. Education and health are the most accessed facilities within the

neighbourhood by 22.5% and 20.7% respectively, and even within other adjacent neighbourhoods including Obunga neighbourhood.

Table 4-8: Places where Tom Mboya respondents access facilities and services

Facilities	Access to facilities and services (%) (bold: mentioned in the text)					
	Within own neighbourhood	Within Obunga	Within other adjacent neighbourhoods	Outside own and adjacent neighbourhood but within the city	Outside the city	Not applicable
Education	**22.5**	**21.6**	30.6	**34.2**	10.8	10.8
Health	**20.7**	**15.3**	**48.6**	**46.8**	0.9	0.9
Recreation	5.4	5.4	22.5	**61.3**	1.8	14.4
Church	5.4	7.2	31.5	**51.4**	2.7	8.1
Mosque	0.9	1.8	5.4	9.0	0.9	85.6
Cultural institution	2.7	1.8	8.1	**63.1**	3.6	27.9

(N=111)

On average, the majority of respondents in the unplanned fragment were accessing most facilities and services outside their own and adjacent neighbourhoods but within the city, followed by other adjacent neighbourhoods *(Table 4-9)*. This included access to education, health, recreation areas and churches. On the contrary, facilities within Tom Mboya neighbourhood and those outside the city, were the least accessed by the Obunga respondents. For instance, only 5.5% and 6.3% were accessing education and health respectively in Tom Mboya. It is worth noting that some respondents were accessing facilities and services in more than one place.

Table 4-9: Places where Obunga respondents access facilities and services

Facilities	Access to facilities and services (%) (bold: mentioned in the text)					
	Within own neighbourhood	Within Tom Mboya	Within other adjacent neighbourhoods	Outside own and adjacent neighbourhood but within the city	Outside the city	Not applicable
Education	25.80	5.50	**53.90**	**45.30**	10.20	1.60
Health	9.40	6.30	**47.70**	**72.70**	0.80	0.00
Recreation	9.40	0.00	16.40	**57.00**	6.30	26.60
Church	17.70	1.60	**38.70**	**44.40**	1.60	7.30
Mosque	2.50	0.80	19.30	11.80	1.70	69.70
Cultural institution	1.60	0.00	7.00	72.70	7.80	22.70

(N=128)

Considering access to health, the majority of the respondents from both Tom Mboya and Obunga were accessing facilities within other adjacent neighbourhoods by 48.6% and 47.70% respectively. This study focused on two neighbourhoods adjacent to the road, therefore, there could be other factors that determine where residents access facilities other than the road (improved accessibility).

Residents' perception on access to facilities and services within fragments

The objective of this section of the study was to understand how residents perceive the closeness to facilities from where they live. Access to facilities was measured using a Likert scale of one (very low accessibility) to five (very high accessibility), where very high accessibility referred to a facility that was very close to the respondent in terms of distance and very low accessibility meant far away from the respondents' residence (house). Respondents from both planned and unplanned fragments revealed low accessibility to facilities before road expansion, this was depicted through the mean scores *(Table 4-10)*. However, the mean scores after road expansion, show improvement in respondents' perception towards access to facilities within their neighbourhoods, both in planned and unplanned fragments. For instance,

there was high accessibility to education facilities after road expansion in both planned and unplanned fragments, with mean scores of 3.59 and 3.78 respectively. This may imply that more respondents now have access to educational facilities than before, partly due to enhanced accessibility in the study area after road expansion. See *Appendix 1* for more details on respondents' perceived access to facilities within fragments.

Table 4-10: Summary of respondents' perception on access to facilities within own neighbourhood before and after road expansion

		Planned (N=111)		Unplanned (N=128)	
		Before	**After**	**Before**	**After**
Education	Mean	2.73	**3.59**	2.29	**3.78**
	Standard Deviation	1.04	0.836	0.723	0.822
Health	Mean	2.74	**3.62**	2.38	**3.71**
	Standard Deviation	0.997	0.763	0.754	0.862
Recreation	Mean	2.86	**3.59**	2.5	**3.5**
	Standard Deviation	1.018	0.779	0.721	0.813
Church/Mosque	Mean	2.82	**3.62**	2.58	**3.53**
	Standard Deviation	0.94	0.742	0.706	0.813
Cultural Institutions	Mean	2.88	**3.54**	2.52	**3.48**
	Standard Deviation	0.951	0.774	0.742	0.823

Likert scale 1-5 where one (1) = *Very low accessibility* and five (5) =*Very high accessibility*. (Bold: mentioned in the text)

Residents' perception on access to facilities and services between fragments

Table 4-11 shows the perception of Tom Mboya residents (planned fragment) on access to facilities in Obunga (unplanned fragment). This analysis was conducted to understand how respondents of planned and unplanned fragments were accessing facilities (externally). Surprisingly, the findings show high accessibility by respondents of the planned fragment to education and health facilities 52.3% and 50.5%, respectively in the unplanned fragment. This is an increase as compared to before by 12.6% and 15.3% respectively. The respondent's perception of access to recreation, church or mosque and cultural institutions in the unplanned fragment (Obunga) was in between low and high accessibility (neutral) after road expansion. On average, mean scores improved after road expansion across access to facilities. The trend of respondents access to facilities between planned and unplanned fragments is shown in *Appendix 2*.

Table 4-11: Perception of Tom Mboya residents on access to facilities in Obunga (unplanned fragment) before and after road expansion

	Education Before	Education After	Health Before	Health After	Recreation Before	Recreation After	Church Before	Church After	Cultural Before	Cultur alAfter
					Percentage (%)					
Very low accessibility	6.3		4.5		5.4		5.4	0.9	4.5	0.9
Low accessibility	45	9	41.4	3.6	31.5	7.2	28.8	7.2	32.4	7.3
Neutral	34.2	33.3	36.9	41.4	**45.9**	**46.8**	**50.5**	**48.6**	**49.5**	**50.9**
High accessibility	**12.6**	**52.3**	**15.3**	**50.5**	17.1	41.4	14.4	38.7	12.6	36.4
Very high accessibility	1.8	5.4	1.8	4.5		4.5	0.9	4.5	0.9	4.5
Mean	2.59	3.54	2.68	3.56	2.75	3.43	2.77	3.39	2.73	3.36
Std. Deviation	0.858	0.736	0.853	0.642	0.803	0.696	0.797	0.728	0.774	0.726

N=111 (bold: mentioned in the text)

Perception of Obunga respondents (unplanned fragment) on access to facilities in Tom Mboya neighbourhood (planned) before and after road expansion is shown in *Table 4-12*. The majority of the respondents rated access to most facilities in planned fragment to be neutral, before and even after road expansion though with some slight improvement. For instance, 35.5% of the respondents rated access to education to be neutral before road expansion, this increased to 39.1% after road expansion.

Table 4-12: Perception of Obunga residents on access to facilities in Tom Mboya (Planned fragment) before and after road expansion

	Education Before	Education After	Health Before	Health After	Recreation Before	Recreation After	Church Before	Church After	Cultural Before	Cultural After
					Percentage (%)					
Very low accessibility	3.1	1.6	2.3	1.6	1.6	1.6	0.8	0.8	0.8	
Low accessibility	47.7	10.9	34.4	6.3	26.6	7	24.2	6.3	27.3	7.1
Neutral	**35.2**	**39.1**	**56.3**	**57**	**65.6**	**66.4**	**70.3**	**71.7**	**64.8**	**66.1**
High accessibility	**12.5**	**39.8**	6.3	**29.7**	5.5	18.8	3.9	15	7	20.5
Very high accessibility	1.6	8.6	0.8	5.5	0.8	6.3	0.8	6.3		6.3
Mean	2.62	3.43	2.69	3.31	2.77	3.21	2.8	3.2	2.78	3.26
Std. Deviation	0.805	0.857	0.661	0.74	0.605	0.728	0.552	0.679	0.574	0.681

N=128 (bold: mentioned in the text)

4.5.4. The spatial outcome of respondents on access to facilities between fragments

The respondents in the two fragments generally registered improvement in access to facilities between fragments after road expansion *(Table 4-11 and Table 4-12)*. From the results, the respondents expressed high accessibility to education and health facilities as compared to recreation, church or mosque and cultural institutions, between fragments after road expansion. The same trend is seen in the visualization of the spatial distribution of the respondents in relation to access to education and health facilities between fragments, before and after road expansion (*Figure 4-18* and *Figure 4-19)*. Surprisingly, in this study, more than 50% of the respondents from the planned fragment were accessing education and health facilities in the unplanned fragment. In literature, the planned fragments are presumed to have better facilities than the unplanned, as stated by some of the earlier studies such as Dymling (2006). Respondents who expressed low accessibility to facilities before road expansion in the two fragments had change in perception on access to facilities after road expansion. They may have perceived better access to facilities (high accessibility). More schools and health facilities also came up after road expansion, this may have contributed to the change in perception. Perceived access to education and health facilities has been visualised to appreciate the change in accessibility to facilities by respondents between fragments before and after road expansion. This is likely to contribute to spatial interaction between fragments.

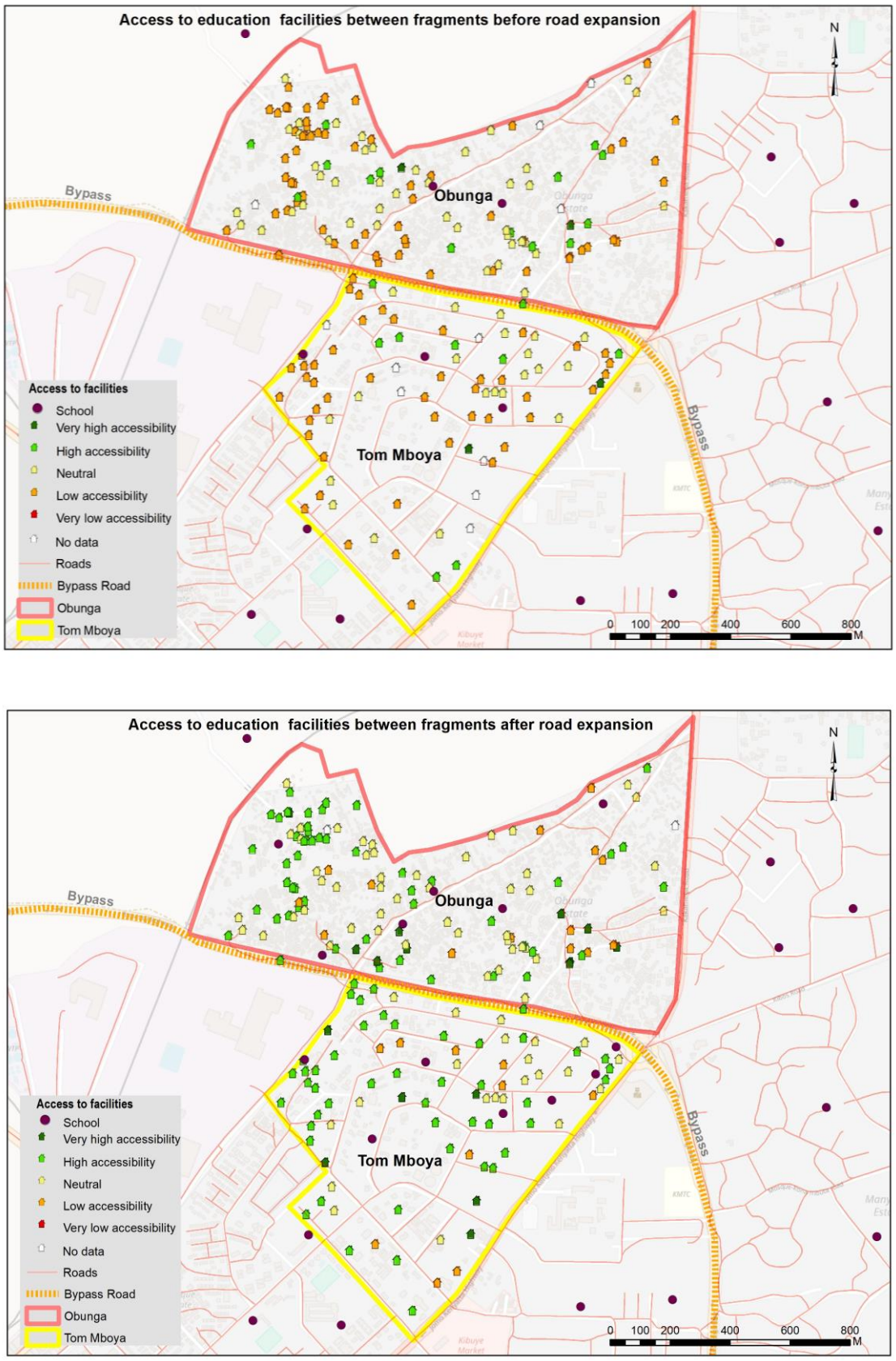

Figure 4-18: Spatial distribution of respondents on perceived access to education facilities between fragments before and after road expansion.
Source: ArcGIS online (Kisumu schools-2016) and Author, 2018

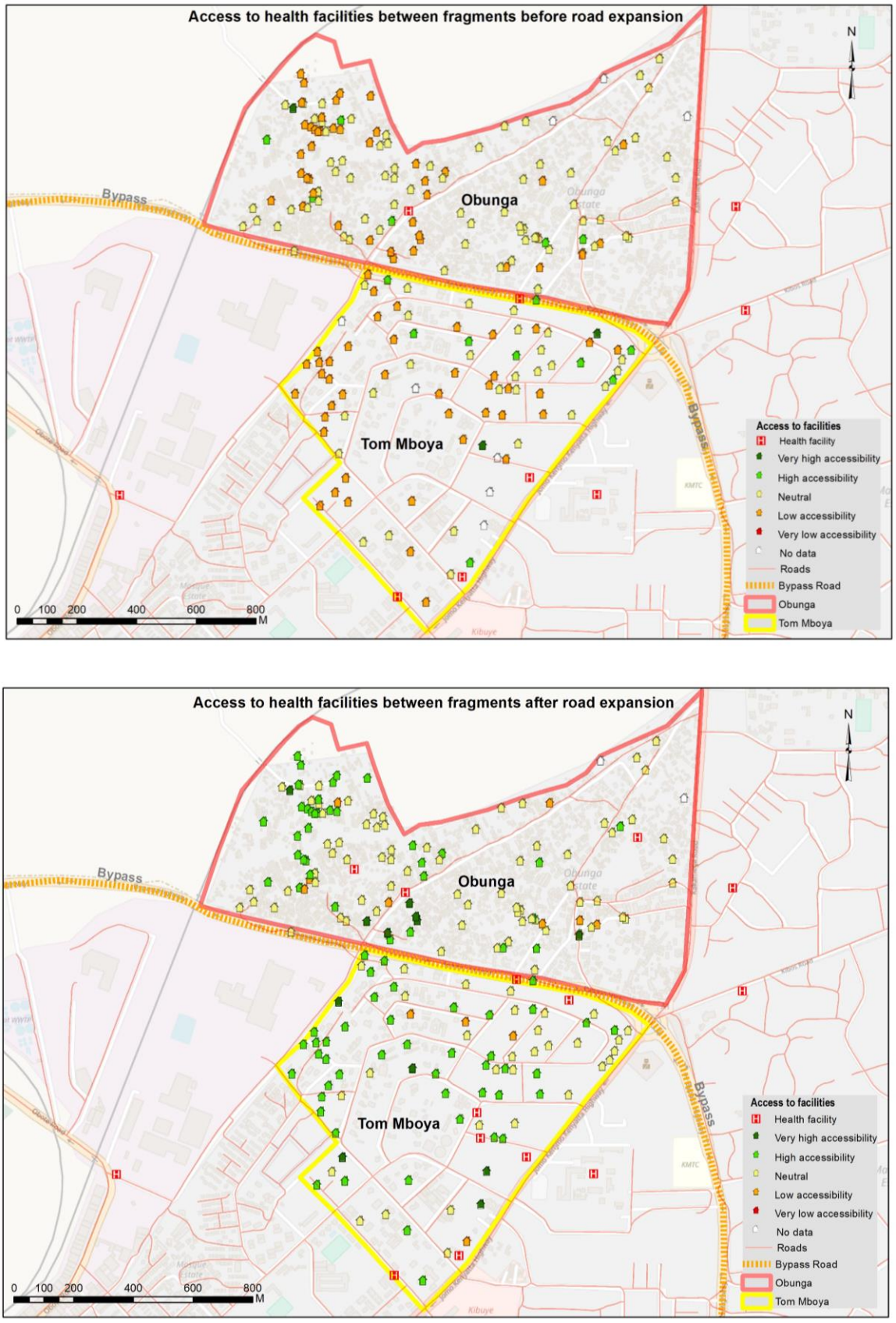

Figure 4-19: Spatial distribution of respondents on perceived access to health facilities between fragments before and after road expansion.
Source: ArcGIS online (Kisumu health facilities-2016) and Author, 2018

4.5.5. Summary of interaction within fragments

With regard to interaction, this study found that there is interaction between and within fragments, which improved after road expansion. *Table 4-13* gives an overview of the performance of dimensions and attributes of subjective QoL concerning interaction within fragments after road expansion.

Table 4-13: Summary on perceived interaction within fragments after road expansion

Dimensions	Attributes	Planned (N=111)	Unplanned (N=128)
Social Networks	Feeling at home in the neighbourhood	90.1%	86%
	Support received from friends & neighbours	60.3%	68.7%
	Chat and discuss personal matters with neighbours	34.2%	6.3%
	Member of welfare groups, religious & associations	43.2%	57.8%
	Access to churches/ mosque within neighbourhoods	62.8%	50.7%
	Availability and access to cultural institutions	56.4%	48.5%
Employment	Access to job opportunities	53.2%	53.9%
	Employment status of the household heads	82.9%	71.1%
	Adequacy with family income	47.7%	53.1%
Educational facilities	Access to pre-primary, primary & secondary	64%	76.5%
Health	Access to health facilities & services	67.6%	70.3%
Recreational areas	Access to parks and open spaces & playgrounds	64%	48.5%
Housing	Getting housing within neighbourhoods	39.6%	76.6%

4.6. Quality of Life perception within residential fragments

The objective of this section was to understand how residents in the two residential fragments perceive their subjective Quality of Life, before and after road expansion. This was analysed using the satisfaction level of the residents with access to facilities and services in neighbourhoods. Neighbourhoods are considered ideal in measuring QoL because they represent an immediate environment where people live and operate day to day activities (Slavuj, 2011). In this study, neighbourhoods (residential fragments) are the spatial units of analysis.

4.6.1. Quality of Life satisfaction levels in the two fragments

The study analysed the subjective QoL of the residents in the two fragments using dimensions of QoL already discussed in section 3.3.1. Descriptive statistics were used to measure satisfaction level in relation to subjective QoL at the neighbourhood level as also suggested by Tesfazghi, Martinez and Verplanke (2010). The respondents were, for instance, asked: *"how satisfied were you with access to education facilities in your neighbourhood before road expansion?"* and Likert scale ranging from one (very dissatisfied) to five (very satisfied) was used, and results presented inform of mean scores, standard deviation and stacked bars. Low standard deviation indicated homogeneity in the responses and very close to the mean, and high standard deviation reveals that the responses deviated away from the mean. *Table 4-14* shows mean scores and standard deviation on perceived satisfaction levels of the respondents with dimensions of life condition within fragments, before and after road expansion. Higher level of satisfaction indicated better subjective QoL. Satisfaction has been used to measure neighbourhood quality in earlier studies as noted by Oktay,

Rustemli and Marans (2009), and the level of satisfaction is guided by a number of factors which are both social and physical indicators of the neighbourhood environment.

Table 4-14: Respondents' satisfaction level with dimensions of QoL and Coefficient of Variance within the two residential fragments

QoL dimensions		**Planned (N=111)**		**Unplanned (N=128)**	
		Before	**After**	**Before**	**After**
Education	Mean	2.93	**3.73**	2.58	**3.66**
	Standard Deviation	1.029	0.824	0.849	0.9
	Coefficient of variance (%)	**35.12**	**22.09**	**32.91**	**24.59**
Health	Mean	**3.02**	**3.84**	2.67	**3.64**
	Standard Deviation	1.036	0.745	0.852	0.858
	Coefficient of variance (%)	**34.30**	**19.40**	**31.91**	**23.57**
Employment (Job opportunities)	Mean	2.87	**3.41**	2.64	**3.31**
	Standard Deviation	0.973	0.958	0.858	0.903
	Coefficient of variance (%)	**33.90**	**28.09**	**32.50**	**27.28**
Recreation	Mean	2.85	**3.63**	2.79	**3.28**
	Standard Deviation	0.822	0.785	0.717	0.763
	Coefficient of variance (%)	**28.84**	**21.63**	**25.70**	**23.26**
Housing	Mean	3.23	**3.42**	2.95	**3.16**
	Standard Deviation	1.059	1.066	1.315	1.031
	Coefficient of variance (%)	**32.79**	**31.17**	**44.58**	**32.63**

Likert scale 1-5 where one (1) = *Very dissatisfied* and five (5) =*Very satisfied.* (bold: mentioned in the text)

Table 4-15 shows mean scores and standard deviation on perceived satisfaction levels of the residents with dimensions of Quality of Life between fragments, before and after road expansion. The table analyses the satisfaction levels of the respondents from the planned fragment on access to facilities and services in the unplanned fragment and vice versa. Looking at the mean scores across the dimensions of Quality of Life, they show improvement and suggest that the respondents perceived better QoL conditions after road expansion.

Table 4-15: Respondents' satisfaction level with dimensions of QoL between the two residential fragments

QoL dimensions		**Planned (N=111)**		**Unplanned (N=128)**	
		Before in unplanned	**After in unplanned**	**Before in planned**	**After in planned**
Education	Mean	2.89	3.53	2.87	3.27
	Standard Deviation	0.878	0.761	0.632	0.681
Health	Mean	3	3.44	2.84	3.32
	Standard Deviation	0.798	0.783	0.558	0.687
Employment (Job opportunities)	Mean	2.81	3.3	2.89	3.02
	Standard Deviation	0.769	0.859	0.618	0.687
Recreation	Mean	2.9	3.41	2.91	3.17
	Standard Deviation	0.786	0.813	0.518	0.59
Housing	Mean	2.91	3.38	2.85	3.07
	Standard Deviation	0.837	0.843	0.7	0.591

Likert scale 1-5 where one (1) = *Very dissatisfied* and five (5) =*Very satisfied.* (bold: mentioned in the text)

Satisfaction with Education facilities

This dimension of QoL entailed residents' perceived satisfaction level on access to pre-primary, primary and secondary schools before and after road expansion, in the planned and unplanned fragments. *Table 4-14 and Table 4-15* shows mean scores and standard deviation on access to education between and within fragments, before and after road expansion. The results show that there was an improvement in the mean scores in the two fragments after road expansion. The improvement suggests that the respondents were satisfied with access to education facilities between and within fragments after road expansion. *Figure 4-19* shows the percentage of those who felt satisfied with access to education after road expansion in the planned fragment of 50.5%. The majority of the respondents in the unplanned fragment though felt satisfied with accessing education in the planned fragment, after road expansion, it was predominantly neutral *(Figure 4-20).*

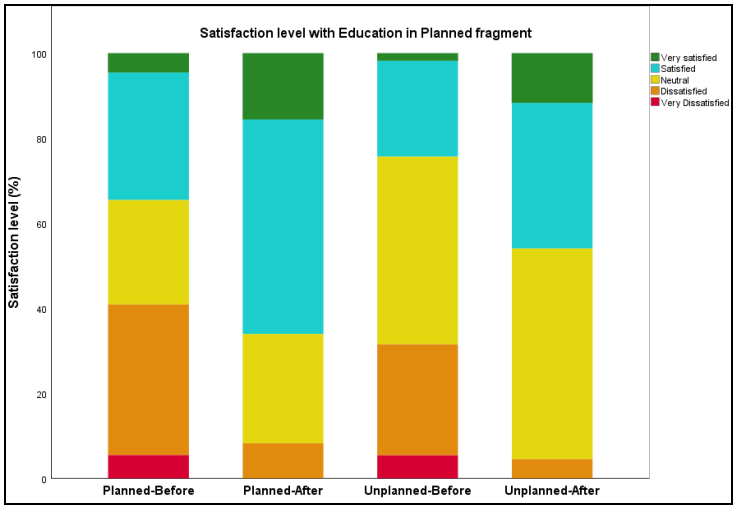

Figure 4-19: Respondents' satisfaction with education in the planned fragment before and after road expansion

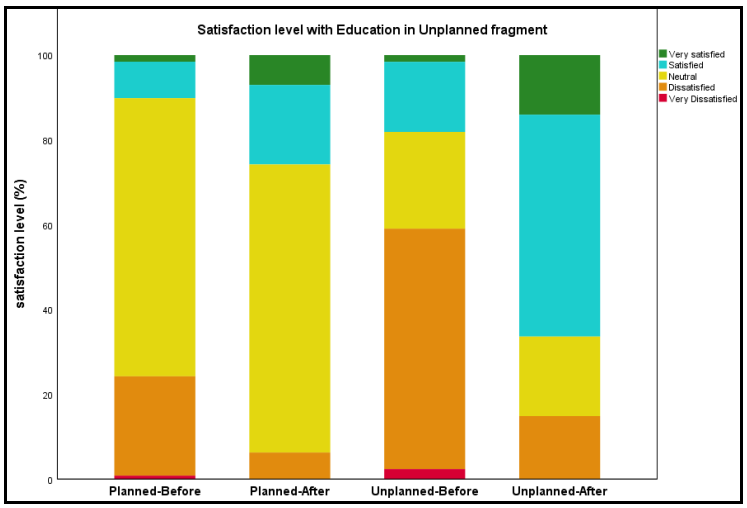

Figure 4-20: Respondents' satisfaction with education in the unplanned fragment before and after road expansion

Satisfaction with Health dimension

Table 4-14 and Table 4-15 show the mean and standard deviation on the satisfaction level of the residents with health services in the planned and unplanned fragments, before and after road expansion. Looking at the mean scores on satisfaction levels within the planned fragment, it can be noted that satisfaction of the respondents improved from 3.02 to 3.84 after road expansion *(Table 4-14).* Percentages of satisfaction level with health services from respondents of planned fragment did not change much towards the unplanned fragment for those who were neither satisfied nor dissatisfied (55.9% before and 55% after road

expansion). Refer to *Figure 4-21*. It is worth noting that respondents from the unplanned fragment who were dissatisfied with health services within their fragment before road expansion (51.6%), the same percentage felt satisfied after road expansion 51.6% *(Figure 4-22)*.

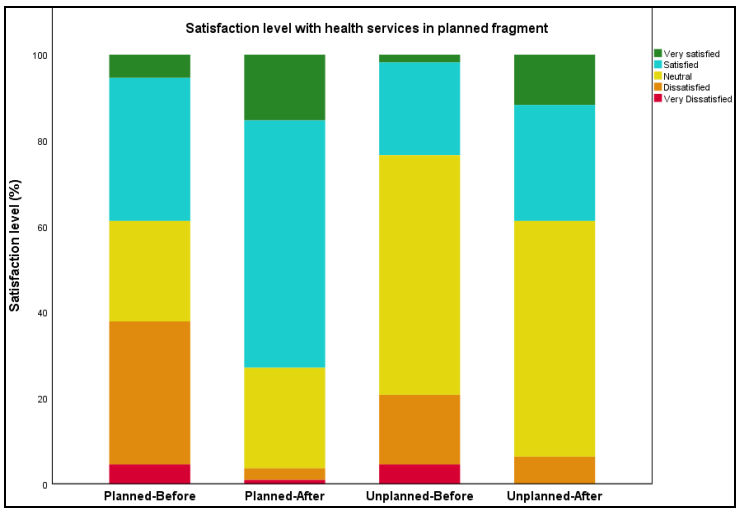

Figure 4-21: Respondents' satisfaction with health services in planned fragment before and after road expansion

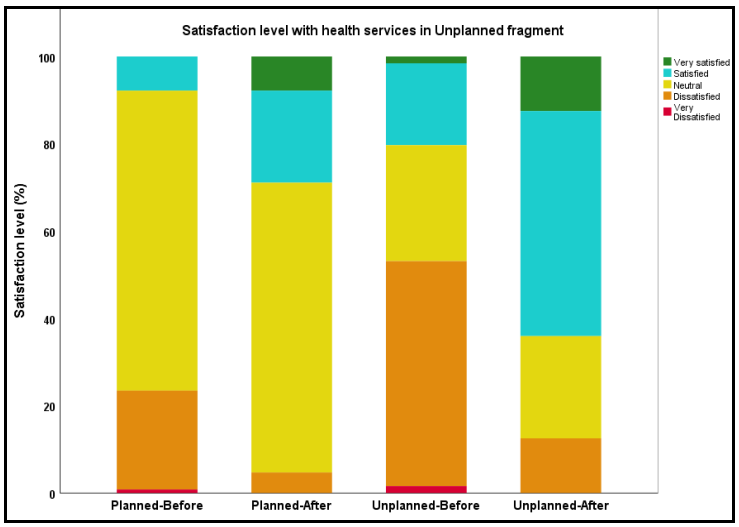

Figure 4-22: Respondents' satisfaction with health services in unplanned fragment before and after road expansion

Satisfaction with Employment dimension

This dimension aimed at assessing respondents' perception on satisfaction with getting jobs in both planned and unplanned fragments, before and after road expansion. The jobs here referred to either formal or informal. *Table 4-14 and Table 4-15* show mean scores and standard deviation on the satisfaction level of the residents with job opportunities in the two fragments. The results reveal that mean scores in both planned and unplanned fragments improved after road expansion, this may mean that a number of the respondents felt satisfied with access to job opportunities because of more jobs coming up. For instance, within the planned fragment, the mean increased from 2.87 to 3.41. *Figure 4-23 and Figure 4-24* show percentages of satisfaction level of the respondents with employment in the two fragments. About 45.3% of the respondents in the unplanned fragment felt satisfied with getting jobs within their fragment after road expansion *Figure 4-24*.

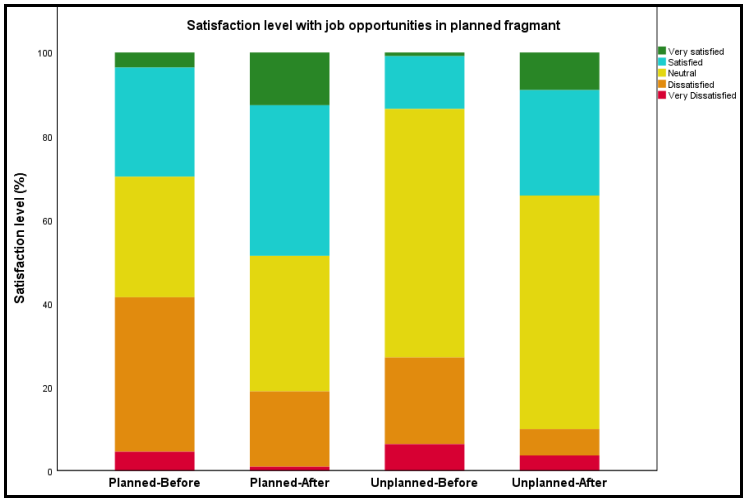

Figure 4-23: Respondents' satisfaction with getting jobs in the planned fragment, before and after road expansion

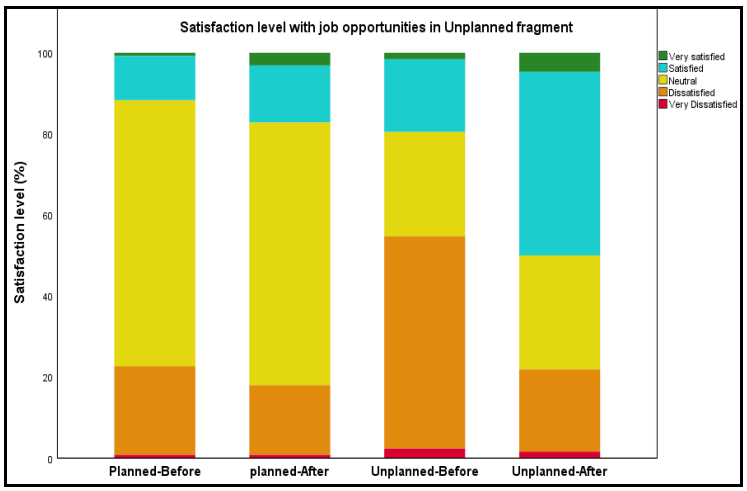

Figure 4-24: Respondents' satisfaction with getting jobs in unplanned fragment before and after road expansion

Satisfaction with recreation areas/facilities

Results on satisfaction with recreation revealed that in the planned fragment, a number of the respondents were satisfied with the availability of recreation areas in their fragment after road expansion, *Figure 4-25*. This registered mean score of 3.63 and a standard deviation of 0.785 (*Table 4-14*). The same trend is seen with their satisfaction, with recreation in the unplanned fragment. Relatively, the percentage of respondents whose satisfaction level did not change much (neutral) in the unplanned fragments, before and after road expansion was the highest. More than 70% of the respondents from unplanned fragment were neither satisfied nor dissatisfied (neutral) with the availability of recreational areas in the planned fragment. See *Figure 4-26* for details.

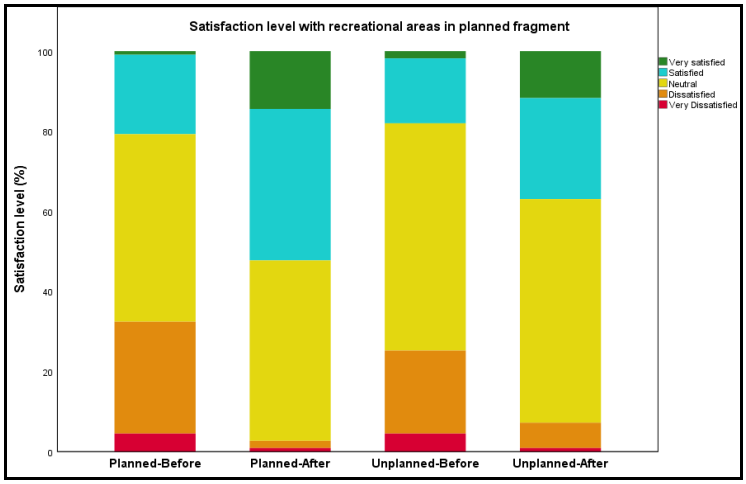

Figure 4-25: Respondents' satisfaction with availability of recreational areas in planned fragment before and after road expansion

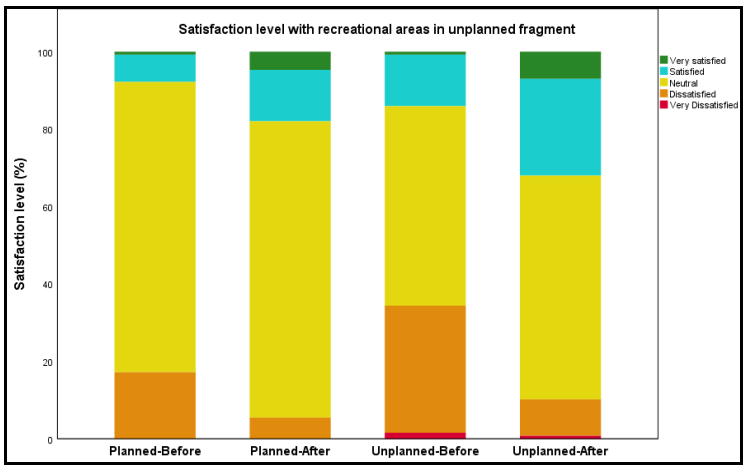

Figure 4-26: Respondents' satisfaction with availability of recreational areas in unplanned fragment before and after road expansion

Satisfaction with getting housing

Figure 4-27 and Figure 4-28 show the percentages of the respondents' satisfaction level with housing in the two fragments. Checking mean scores across the two fragments, it is worth noting that the scores increased after road expansion. *Figure 4-27* shows that cumulatively, the percentage of respondents who were very satisfied and satisfied with housing in the planned fragment improved from 52.2% before to 54%, after road expansion. 74.2% of the respondents from the unplanned fragments expressed their satisfaction with getting housing in the planned fragment to be neutral, after road expansion *(Figure 4-28)*.

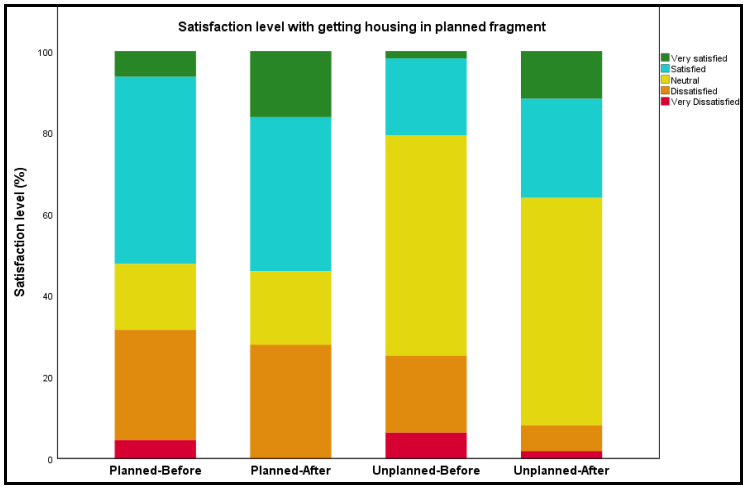

Figure 4-27: Respondents' satisfaction with getting housing in planned fragment before and after road expansion

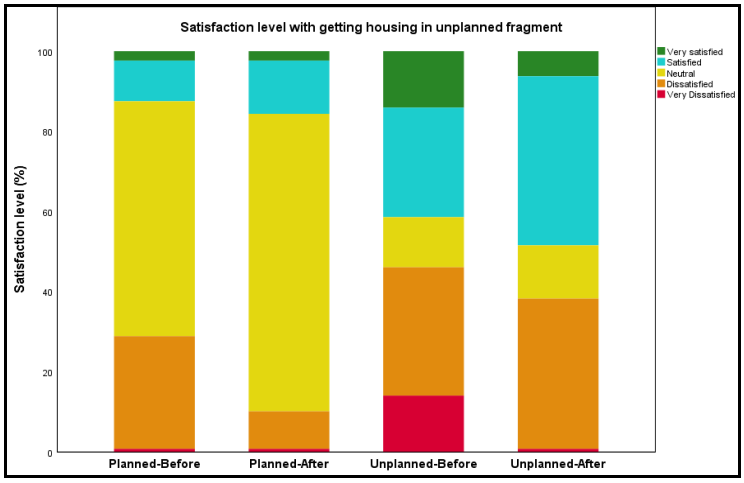

Figure 4-28: Respondents' satisfaction with getting housing in unplanned fragment before and after road expansion

4.6.2. Variation in subjective Quality of life in the two fragments

This section aimed at understanding how subjective QoL varies in the two residential fragments. To assess variation in subjective QoL in the two fragments, the coefficients of variance was calculated for the two moments in time of before and after road expansion. The coefficient of variation[12] (CV) was computed using the standard deviation of the subjective QoL, divided by the mean of the scores and multiplied by one hundred, represented as a percentage and this indicated the absolute variability (Tesfazghi et al., 2010). The CV is useful in comparing variation between variables, the higher the percentage of CV, the greater the dispersion from the mean (higher variability) and a lower percentage of CV means less dispersion (less variability). Considering mean scores and CV, the CV provides better clarification on QoL variability within the residential fragments since it the ratio of standard deviation to the mean as also noted by Tesfazghi et al. (2010). *Table 4-14* shows the coefficients of variance with regard to respondents' satisfaction with subjective QoL dimensions within the two fragments. The respondents from the two fragments both registered high percentages in coefficient of variation in satisfaction with access to facilities within their fragments across the five dimensions of QoL before road expansion. The CV decreased in the two fragments after road expansion across the dimensions of QoL ranging between 19.40% to 31.17% and 23.26% to 32.63% for the planned and unplanned fragments respectively, this implied less variability in QoL within fragments. The respondents in both planned and unplanned

[12] Coefficient of variance (CV) is computed as a ratio of standard deviation of subjective QoL and mean scores. High percentage of CV means higher variability and low percentage means less variability.

fragments perceived better subjective QoL after road expansion. However, on average, the planned fragment seems to have less variability (more homogenous) as compared to the unplanned.

4.7. The relationship between interaction and Subjective QoL in residential fragments

To explore the perception of respondents on perceived interaction and the likely effect it could have on subjective QoL in the two fragments, the relationship between the two concepts was assessed. The study considered the two moments in time of before and after road expansion, in assessing for change in perceived interaction and satisfaction levels for subjective QoL in the two fragments. This was executed by assessing the results of spatial interaction (accessibility to facilities), social interaction (social networks) and actual impacts of the bypass vis-a-vis attributes of subjective QoL.

Accessibility and subjective QoL

Residents of the two fragments and key informants confirmed improved access to basic facilities in the study area during interviews, just as had been envisioned in the ESIA report of 2004. Results on spatial accessibility shown in *Table 4-11 and Table 4-12*, revealed that respondents acknowledged the improvement in accessibility to facilities between fragments after road expansion. For instance, respondents access to education in both planned and unplanned fragments improved after road expansion owing to enhanced accessibility from the bypass, new schools coming up, improved connection to other adjacent neighbourhoods among other factors. Accessibility to facilities enables spatial interaction within and between residents of the two neighbourhoods. Looking at the satisfaction level of the respondents across the five dimensions of QoL in the two fragments, improvement is seen in the mean scores after road expansion *(See Table 4-14 and Table 15*). Visualization of the stacked bars also revealed the same trend. Satisfaction with access to facilities may indicate perceived better QoL among respondents and improved perceived interaction, between and within fragments after road expansion (section 4.6.1). Therefore, improved accessibility may indicate a change in perceived interaction and perceived better QoL.

Social networks and subjective QoL

Majority of the respondents who were feeling at home in their fragment also answered that they rely on help from their neighbours in both planned and unplanned fragments. Satisfaction with interaction with neighbours and people living in the neighbourhood seem to have an effect on the residents' subjective QoL in this study. This could be related to what was discussed by Ghani and Badarulzaman (2012) about neighbourhood satisfaction being an indicator of satisfaction with life. Findings in *Table 4-5* revealed that residents who rarely ask for help from their neighbours were also rarely being asked for help, in both planned and unplanned fragments. This may explain the presence of those whose social interaction is not active. Results on social interaction between fragments *(Table 4-7)* revealed that at least 20.7% of the respondents in the planned fragment were being visited by those from the unplanned fragment. Additionally, 20.7% from planned fragment was chatting with those in the unplanned fragment. On the contrary, around 80% of the respondents from the unplanned fragment were not relating to anyone from the planned fragment. This may indicate limited social interaction between fragments as compared to within fragments, which may also impact on social life.

Actual impacts and subjective QoL

Potential impacts accruing from road expansion were used to measure the interaction between and within the two residential fragments. Most of the positive impacts like enhanced accessibility, easy access to social amenities, reduced commuter travel time and costs, enhanced security, improved welfare and landscaped road environment happened in both fragments, except for traffic safety (happened in planned fragment), more employment opportunities and increased commerce (happened in unplanned). Generally, positive impacts such as enhanced accessibility, reduced commuter travel time and costs and enhanced security facilitated both social and spatial interaction between and within fragments as discussed in section 4.4.4.

On the contrary, most adverse impacts happened in the unplanned fragment more than the planned, for instance, displacement of human settlement and businesses which led to the loss of social networks and livelihood thus affecting subjective QoL. The negative impacts in the study area like increased incidences of accidents on the road affect both social and spatial interaction between fragments. This may affect the satisfaction with physical and social features of the residents in the neighbourhoods, thus affect their overall feelings and subjective QoL as also stated by Ghani and Badarulzaman (2012) when looking at QoL of residents in urban neighbourhoods.

5. DISCUSSION

This chapter discusses the study findings as per the objectives of the study and the conceptual framework in relation to earlier studies on residential fragmentation, road infrastructure development, perceived interaction, and subjective Quality of Life. The general insights coming up from the study findings are addressed here.

5.1. Categories of residential fragments in Kisumu city

The study sought to identify the common categories of residential fragments within Kisumu city. Three common categories were identified; planned gated, planned non-gated and unplanned or informal. They were categorised following their morphological characteristics of pre-colonial times, land tenure system and economic status (income variance). The categories coexist as planned and unplanned (Figure 4-1), formal and informal residential settlements as also seen in Nairobi city (Jimmy, 2018). Visualisation of the residential categories revealed that the majority of the city population lives in the unplanned fragments, where most of them are self-employed and in the informal business sector, with a low level of education. Patterns of residential fragmentation seem to evolve around the gap between the rich and the poor (polarization) in Kisumu city, parallel to some of Latin America cities (Bucheli, 2016). Unlike in Latin American cities where social class differentiation has been stressed as the main contributor to residential fragmentation (Bucheli, 2016), in Kisumu city, it is a combination of social differentiation and colonial patterns.

Similar to Nairobi city (Jimmy, 2018), residential categories in Kisumu city show inequalities that exist, especially about infrastructural services like road network, water supply, education and health facilities among others. It is evident that the planned fragments enjoy better services and facilities as compared to unplanned fragments. Unequal access to services and facilities coupled with the scarcity of job opportunities among the residential fragments explain how fragmentation may affect the distribution of subjective QoL of residents (Bucheli, 2016). However, this differs from the findings of this study as access to facilities showed improvement after road expansion in both fragments.

The Land tenure system of leasehold and freehold as discussed in section 4.1.1 dictate how development has been carried out in Kisumu city, and this has contributed to residential fragmentation that is experienced in the city. Leasehold lands which form or make up the planned fragments of the city have controlled development, being shaped by the planning standards. This is in contrast to the freehold land (unplanned fragments) with no development guidelines and standards, as it is considered to be private lands (Olima & Obala, 1999; Kola et al., 2015). This tenure system that governs the zoning of Kisumu city into the low, medium and high-income residential areas (spatial clustering) is similar to what was discussed by Bocarejo et al. (2015) in the city of Bogota, regarding zoning in the city based on different social groups of low, medium and high-income.

5.1.1. What has changed over time in relation to the residential categories

Interviews with the key informants revealed that changes were on-going within the residential categories, and both social and physical changes existed. In planned fragments quest for land was noted, and densities were changing, and land sub-division was going on, in some cases below the recommended minimum plot sizes. Change in land use from residential to commercial in both the planned gated and planned non-gated fragments was noted. However, the study revealed an emerging trend within the planned fragments, where the residents were leasing out their residential houses for commercial use *Figure 5-1*. These areas were originally zoned for single-family residential, low density as per the 1984 structure plan of the city. The scarcity for office space within the Central Business District largely influences the leasing out of the

residential houses. The changes were observed in Milimani and Tom Mboya, areas that were initially zoned for residential use. This may impact on social interaction within fragments through loss of already established social networks. Those moving out of the planned fragments are settling in the peri-urban areas of Riat and Ukweli which have no planning guidelines and standards and so another category of *"unplanned gated"* is likely to evolve in Kisumu city. However, the haphazard development of the city has necessitated the County Government to prepare the Kisumu Integrated Strategic Urban Development Plan, (KISUD-Plan) 2013, to allow re-zoning of some areas and also allow residents to develop more floors in such neighbourhoods.

Figure 5-1: Change in land use in Tom Mboya from residential (left) to commercial-hotel (right)

The quality of housing in unplanned fragments like Obunga is changing and middle standard buildings could be noted during walking interviews *(Figure 4-5)*. The County Government of Kisumu together with politicians and NGOs are making attempts to improve the QoL of the residents in the unplanned residential fragments as opposed to the already planned ones. The grant received from the French Development Aid Organization (*Agence Francaise de Development*) from the French government, has been used in the provision of infrastructural services like roads, lighting up streets and water supply among other activities in unplanned neighbourhoods, under upgrading of informal areas programme. This has been championed through the implementation of the KISUD-Plan as also discussed by Bard and Lennmalm (2015). However, most of the programmes are geared towards empowering women, the physically challenged and youth mostly through welfare groups, thus impacting on their QoL as well. Though this is a people-based intervention, which does not target the unplanned fragments alone.

5.2. Socio-economic characteristics of the categorised residential fragments

Socio-economic characteristics were analysed with the aim of understanding the social and economic status of the residents in the two fragments which also informed their QoL conditions. The results revealed that the majority of the residents in the unplanned fragment engage in informal businesses as the main source of income. This type of business is characterised by low income which is not stable, unlike formal employment. The self-employed category of employment dominates in the two fragments though at different scales. Most businesses in the unplanned fragment were being handled by the family members with no involvement of paid workers. Generally operated along the road reserves within the neighbourhood and along the bypass. A small percentage were operating businesses outside the neighbourhood in designated markets like Kibuye and Kondele. This can be attributed to the small nature of businesses with unstable low returns or income that can hardly sustain employed people. These findings are comparable to the socio-economic report by Pamoja Trust for the unplanned fragment (Pamoja Trust, 2014). It was found that the majority of the residents were working as self-employed, and running businesses operated by family members, where almost half (46.2%) were set along the roads within the fragment. Around 10.2% were operating from designated markets, and some were mobile vendors 6.5% (Pamoja Trust, 2014).

Studies on the socio-economic status of Tom Mboya neighbourhood are visibly absent in literature, making it difficult to give a comparison with the present study. However, the present study found that though the majority of the residents in Tom Mboya were self-employed, they were not operating businesses within their neighbourhood. They had designated places like Kondele and Kibuye markets, and some had businesses in the city centre. Generally, about employment in the planned and unplanned fragments, the majority of the residents in the planned fragment are retirees and civil servants employed by the government. This was revealed during the walking interviews. This may explain the differences seen in education level, employment categories and income variations in the two fragments.

The results about education level show that the majority of the residents from the planned fragment (Tom Mboya) attained university level of education, as compared to unplanned fragment, where the majority had primary school level of education. This may imply that neighbourhood income and QoL conditions contribute to the attainment of education levels. This finding is in tandem with Nieuwenhuis & Hooimeijer (2016) when looking at the effects of neighbourhoods on education, found that neighbourhood characteristics are likely to impact on educational outcomes of residents. Common characteristics that may define education level in neighbourhoods are; neighbourhood poverty, educational condition and behaviour of neighbours (peer groups). On the one hand, this may explain why the unplanned fragment with low-income residents, who may also be experiencing poverty, have the majority of its residents with the low level of education as compared to the planned. On the other hand, it may also mean that the planned fragment attract mainly middle-income employees perceived to be degree holders with well-paying jobs. Neighbourhood residents cluster together because of some common characteristics like income and education, thus the genesis of social differentiation that exists between neighbourhoods (Nieuwenhuis & Hooimeijer, 2016)

The majority of the residents from the two fragments felt satisfied with their family income after road expansion, which could be an indication of perceived better QoL. However, findings on the characteristics of the socio-economic status (SES) of the two fragments discussed in section 4.3, show that residents from the planned fragment experience higher socio-economic status as compared to the unplanned fragment.

5.3. The impacts of road infrastructure project

The objective of this section is to explore the possible impacts that accrue from the implementation of the road infrastructure project and assess the influence on the social and spatial interaction between and within fragments. This is assessed by considering the anticipated impacts that were identified during the Environmental and Social Impact Assessment report, and the actual impacts accruing from road expansion. (Refer to section 4-4).

5.3.1. Comparison of the anticipated and actual impacts of road infrastructure project

The main objective of the bypass was to reduce traffic congestion in the city centre and improve traffic flow as stated in the Kisumu Integrated Strategic Urban Development Plan (Nodalis Conseil, 2013). This is similar to the objectives of other road infrastructure projects like Thika superhighway in Nairobi as stated by Chepchieng, Gariy and Mwatela (2015) and the construction of bypasses in the United States of America (Sabol, 1996). The reasons provided for the implementation of the bypass gave the base for assessing the impacts, check whether it fulfilled the purpose. Both positive and negative impacts were anticipated during the ESIA study (MoRPW&H, 2004), and mitigation measures to reduce the adverse effects were also identified. Anticipated and potential impacts of road expansion were analysed to identify both positive and negative impacts of the road on the interaction of the two residential fragments.

Positive impacts

The anticipated impacts, especially the positive ones, materialised in the two residential fragments as discussed in *section 4.4.4 and Table 4-1*. Most of the positive impacts occurred in both the fragments except for increased commerce that was more in the unplanned fragment; walking lane for pedestrian and cyclists paths were on the side of planned fragment alone, and employment opportunities happened more to the residents of the unplanned fragment. It is worth noting that, some impacts happened indirectly and had not been anticipated like improved welfare through group registrations from businesses like the motorcycle transport sector.

Survey responses from the residents of the two residential fragments indicated that the bypass road had improved access to facilities and services in the study area, hence improved accessibility. The improved accessibility may explain the building of more houses, hotels, offices, schools and even health facilities in the planned fragment. Some of these facilities were being accessed by the residents from the unplanned fragment as well, a sign of spatial interaction. During interviews, several respondents from the two fragments indicated that reduced travel time had connected the neighbourhoods to other areas. This is likely to enhance both social and spatial interaction in the area and beyond because residents are likely to interact with those they meet as they go shopping or even walk on the streets. This is similar to what was suggested by Hickman (2010), when looking at public places away from home and work, as a platform of interaction in deprived neighbourhoods of Great Britain. Hoogerbrugge and Burger (2018) argue that neighbourhoods are pivotal in facilitating social connections. Further, Al Shawish (2015) also discuss how small-scale shops along roads provide safety in the neighbourhoods by keeping an eye on the roads which makes them know strangers. Therefore, these connections are vital in residents' perceived interaction, as also found in this study.

Employment opportunities materialised in the unplanned fragment (Obunga) more than in the planned (Tom Mboya), especially through informal businesses which go on along roads. More job opportunities like vegetable vendors and motorcycle sector for transportation purposes was on the increase in the unplanned fragment. The majority of the motorcycle riders come from Obunga, though there could be a few coming from other adjacent neighbourhoods. Some of the riders are allowed to operate in Tom Mboya neighbourhood, an indication of interaction between fragments. Since the motorcycle riders are expected to register and operate under a welfare group, the number of welfare groups increased after road expansion *(Table 4-2 and Table 4-3)*. Members of these groups interact as they meet, and can get loans from the groups and in return better their QoL conditions. This is in agreement with what Sirgy et al. (2008) suggested about satisfaction with job availability and finance, being determinant of well-being and QoL. However, improved welfare of the residents was not among the anticipated impacts in the ESIA, report of 2004. Those who indicated not being in any welfare groups or associations in the unplanned fragment gave reasons from past experience and lack of trust in group management. For the planned fragment, they gave reasons for not being interested in joining groups and limited interaction between residents as everyone seemed busy, among other reasons.

Considering responses from the household survey in the two fragments and the key informants, the bypass road project seems to have a positive image among a large segment of the residents from the unplanned fragment as compared to planned fragment. For the planned fragment, interviews revealed that those close to the bypass were benefitting more because of improved security from the street lights on the bypass and frequent police patrols coupled with enhanced accessibility. This finding could be compared to the residents of Kop Van Zuid in Rotterdam, where those who were close to the flagship waterfront project, looked at it positively with regard to proximity to facilities (Doucet, Kempen, & Weesep, 2011).

Negative impacts

The road infrastructure project brought with it adverse effects in the study area. In the ESIA report, it had been anticipated that the negative effects would be minimised by putting in place mitigation measures *Table 3-3).* Interviews with the residents of the two fragments and key informants revealed that negative impacts that were being experienced in the study area as a result of road expansion included increased traffic accidents, insecurity, noise pollution from moving vehicles among others *(Table 4-4).* Some of the negative impacts of this study have been compared with other studies to draw similarities and differences.

In terms of traffic safety, the findings of the present study have been compared with a study conducted by University of Nairobi Enterprises and Services Limited (UNES), to monitor and evaluate impacts of the Northern corridor road improvement from Mombasa to Busia and Malaba (Ugandan Border) on road safety (Gichaga, 2017). The survey revealed that drivers and pedestrians were the main causes of accidents, followed by pedal cyclists, passengers and obstructions along the Kenyan section of the Northern corridor. Similar results were also revealed in the present study through resident's perception about traffic safety on the bypass. Careless driving and careless crossing by pedestrians (Non-Motorised Transport Users) came out strongly as main causes of increased accidents on the bypass.

Additionally, a similar study conducted on Thika superhighway in Nairobi on effects of road improvement, identified types of accidents on the road as vehicle to pedestrian, vehicle to vehicle and cyclist to the vehicle (Chepchieng et al., 2015). Pedestrian to the vehicle was the highest in occurrence and this, therefore, means that pedestrians continue to be the most vulnerable road users. The findings on Thika superhighway also revealed that the number of accidents increased after completion of the road. This was attributed to over speeding from drivers as a result of a smooth and wide road. A similar situation was confirmed in this study during interviews with both residents and the informants. It was evident that drivers were over speeding and causing accidents on the bypass. According to the ESIA report, traffic disruption and accidents were to be mitigated by sensitizing drivers on road safety. Road signage and adequate shoulders on the roadsides were to be provided. Lack of road signs in some sections of the road has made it difficult for Non-Motorised Users to cross the bypass, thus impacting on perceived interaction and subjective QoL.

Encroachment on the road reserves was noted in the unplanned fragment. Residents were carrying out their small-scale businesses along roads, which aligns with the findings of the socio-economic survey report by Pamoja Trust (2014) in the area (See section 5.2). This is similar to what had been anticipated in the ESIA report about markets and business premises coming-up along the road reserves (See Table 3-3). Considering the negative impacts of the road infrastructure project, the unplanned fragment seems to experience most of the adverse effects like displacement of businesses and human settlement which resulted in the loss of social networks and livelihood, impacting on QoL condition of the residents. This agrees with what Sabol (1996) discussed about individual businesses suffering when new bypasses are opened up in an area. Insecurity was not anticipated among the negative impacts in the ESIA report, but interviews with residents indicated that the overpasses were risky places to pass in the evenings and at night since they lacked lights beneath. This has made the residents of the two fragments live in fear of being attacked on some sections of the bypass especially under the overpasses. Presence of security firms in the planned fragment is an indication of residents enhancing security by engaging security guards and gating their entrances. Blandy (2018), in a study conducted in Thswane in South Africa, found that property crime and violence was high, and positive association with burglary was happening both during the day and night time. Somehow, this is comparable with the findings of this study, where fear of being mugged or robbed grope in the evenings and at night particularly in poorly lit areas like beneath the overpass.

5.3.2. Social interaction between and within fragments

The aim of conducting social interaction was to assess the relationship between residents, between and within the two fragments. Findings on social interaction within fragments revealed that the majority of the respondents feel at home and rely on their neighbours in case of problems, in both planned and unplanned fragments *Table 4-16 and Table 4-17).* The results also reflect a strong sense of belonging and inclusivity in respondents' neighbourhoods when asked about feeling at home. The findings agree with Hoogerbrugge and Burger (2018) and Farahani (2016), who argue that residents who feel at home, are likely to develop stronger social ties within their neighbourhoods and report higher levels of subjective QoL, coupled with a sense of community attachment. However, in the present study for those who were not feeling at home in the unplanned fragment gave reasons of insecurity, poor sanitation and some were just not comfortable. For the planned fragment, they gave reasons of change in land use that was on-going, from residential to commercial leading to up-coming of schools, hotels and health facilities among others, as infringing on their privacy and quiet life. Being able to rely on help from their neighbours was indicative of social interaction between neighbours. Concerning getting housing, residents from both fragments could get housing through family and friends (social networks), which is indicative of social ties that exist in neighbourhoods *(Refer to Table 4-6).* This is in tandem with what Hoogerbrugge and Burger (2018) describe as residential networks which are important in day to day life and pillars of social cohesion. Subsequently, it was also revealed that respondents who rarely ask for help from neighbours in their neighbourhood, also rarely have their neighbours ask for help from them, and the trend was the same in the two fragments *(Table 4-5).*

Social interaction between fragments provides a platform for social network cohesiveness between residents. Social networks are said to be spatially constructed. In neighbourhoods, people go to visit and chat with those they have contact with. Findings of this study show that only 20.7% of respondents from the planned fragment were chatting with those in the unplanned fragment. Subsequently, another 20.7% from the unplanned fragment were chatting with those in the planned fragment. This may suggest minimal social interaction between the residents of the planned and unplanned fragments, owing to the differences in QoL conditions (social differences) as also explained by the informants during interviews. It is also coherent with the findings of Michelutti (2008) on social network disintegration and links between residential fragments. Generally, the chats may happen as residents of the two fragments meet when accessing facilities like schools, health facilities, market place, churches among others. However, the chats could also be in the form of phone calls and not necessarily physical contact. Farahani (2016) explains that social ties are not limited to people who are physically close, but even those who are far because of opportunities that exist like virtual networking and high-speed mobility. The results also show that a small percentage (5.5%) of the respondents from the unplanned fragment were chatting with those from the planned fragment. Therefore, from the findings, social interaction within fragments is better than between fragments in the study area.

The interview with the Dean, School of Planning and Architecture, Maseno University revealed that a study on social interaction between fragments, especially between the low and high-income neighbourhoods had been conducted in Kisumu city some years back. The study was between Milimani (planned gated) and Nyalenda (unplanned) fragments and aimed at improving interaction between the two residential fragments. Some of the study proposals have been implemented by the city especially infrastructure which received funding from the government. A shopping mall (Tumaini) in Milimani which serves both Milimani and Nyalenda residents has come-up courtesy of that study, and this is likely to enhance interaction between the two fragments. Unfortunately, the study was not published and so could not be traced for reference. This would have given a relevant comparison with the current study, given that it was also looking at the interaction between planned and unplanned fragments, opposite each other, and with the road in between them *(Refer to Figure 4-1).*

5.3.3. Spatial interaction between and within fragments

The objective of analysing spatial interaction in the two fragments was to understand residents' perceived access to facilities and services between and within neighbourhoods (regarding distance). Low accessibility to facilities and services before road expansion was reported in the two fragments, but the situation improved after road expansion to high accessibility *(See Table 4-11and Table 4-12)*. This may have been influenced by improved connection of the fragments to other adjacent neighbourhoods through the construction of the bypass and other access roads originating from it. The County government of Kisumu has also done some access roads in this area. According to Jimmy (2018) and Dymling (2006), planned fragments are presumed to have better facilities and services than the unplanned, but in this study, it was found that residents from the planned fragment were accessing facilities and services in the unplanned fragment after road expansion more than before. For instance, there was high accessibility to education and health facilities in the unplanned fragment by the residents of the planned fragment. This may be explained by the improved access to public schools like Kudho primary and secondary, and the coming-up of private ones like Bridge school among others in the unplanned fragment which are also affordable.

However, the respondents of the unplanned fragment though agreed to the improved accessibility to facilities in the planned fragment after road expansion, it was predominantly neutral (between low and high accessibility). This suggests that residents from the unplanned fragment following their neighbourhood income, are not able to afford some services like recreational facilities and access some facilities like schools in the planned fragment despite them being open to everyone. A similar situation was also noted by McKenzie, Moody, Carlson, Lopez and Elder (2013) when discussing disparities with community recreation facilities. Secondly, facilities like churches and cultural institutions are also few in the planned fragment, this is from the author's local knowledge of the study area.

Findings of this study also show that availability of facilities determined places where residents of the two fragments could access basic facilities and services. The residents in the two fragments were also accessing facilities and services in other adjacent neighbourhoods and within the city, other than their neighbourhoods. For instance, Manyatta and Migosi which are adjacent neighbourhoods to the study area, have more public schools both primary and secondary and even cultural facilities like Kosawo social hall in Manyatta. According to earlier studies, inequalities that exist in urban areas and urban development processes, affect the way facilities are distributed in neighbourhoods as noted by Modai-snir and Ham (2018), when looking at neighbourhood change and spatial polarization in the case of Tel-Aviv in Israel. Similar to this study, residents were accessing facilities based on accessibility, availability and affordability.

5.4. Quality of Life within residential fragments

Improving Quality of Life (QoL) of residents at the neighbourhood level is one of the tasks that cities have today especially in the Global South. In this study, subjective QoL condition was measured using the satisfaction level of the residents on access and availability of facilities and services. The respondents were asked how satisfied they were with their lives in general as also suggested by Hoogerbrugge and Burger (2018). This is because the dimensions of QoL differ from place to place and depend on the individual perception of one's environment or neighbourhood (Sirgy et al., 2008). Results revealed that the respondents of both fragments perceived better subjective QoL conditions after road expansion across the five dimensions of QoL, which include education, employment, health, recreation and housing, and are discussed below:

Education dimension

This dimension entailed the perceived satisfaction of the respondents with access to educational facilities (pre-primary, primary and secondary). Findings revealed that the percentage of the respondents who were satisfied with access to education facilities increased in both planned and unplanned fragments after road expansion. The explanation for this increase in satisfaction in the unplanned fragment was that school

children could easily walk to school or be ferried by motorcycles and even school buses because of the improved accessibility and connection to other neighbourhoods, unlike before. The unplanned fragment has an insufficient number of schools especially public ones, and so easy access to both private and public schools in other adjacent neighbourhoods was a relief to them. Improved education climate as also discussed by Nieuwenhuis and Hooimeijer (2016) may explain the satisfaction of the respondents with education after road expansion. Improvement and construction of schools through the Constituency Development Fund[13] (CDF) in neighbourhoods and the availability of bursaries for the needy children may also explain satisfaction with education. The findings of this study to some extent agree with the report done by Pamoja Trust (Pamoja Trust, 2014) on a socio-economic survey in Obunga (unplanned fragment), which revealed that school attendance among children aged 5-17 years was encouraging. Improved accessibility from the bypass may partly have contributed to the coming up of more schools in the planned fragment, like Mudasa academy, K-Met pre-primary, Kisumu Bright Future Academy, Life Centre Junior School and among others. These are schools which have been built after road expansion and are open to everyone. Satisfaction with education may strengthen social bonds between different social groups and enhance social interaction, and the overall social life as revealed by Sirgy et al. (2008).

Health dimension

This dimension looked at the perceived satisfaction of the respondents with access to health services and facilities in the study area. Findings revealed that the same percentage of respondents from the unplanned fragment who were dissatisfied with health services before road expansion became satisfied after road expansion (51.56%), see *Figure 4-22*. This may imply that the residents were able to reach health facilities easily following improved accessibility in the area and connection to other adjacent neighbourhoods. Interviews with residents revealed that more private health facilities also came up in the area after road expansion, like Saint Vincent De' Paul clinic along Pamba road and Sister Sarah clinic in the unplanned fragment. Additionally, residents from unplanned fragment can now access health facilities in the planned fragment, like K-Met Health facility, Marie Stopes, Oasis doctors among other facilities at subsidised rates using the National Health Insurance Fund (NHIF) card. The respondents from the planned fragment were also satisfied with the access to health facilities within their fragment, basically because of the private health facilities coming up in the area and improved accessibility *Figure 4-21*. Generally, the residents in the two fragments were satisfied with access to health facilities after road expansion, this may suggest healthy and liveable neighbourhoods. This may partly agree with what Lowe et al. (2015) suggested that healthy and liveable neighbourhoods shape residents' perception towards QoL and interaction. Further, satisfaction with health increases satisfaction with life overall of residents (Sirgy et al., 2008).

Employment (Job opportunities)

Regarding getting jobs in the two fragments, the satisfaction level of the respondents improved after road expansion. However, the satisfaction was more within the fragment than between fragments. For the unplanned fragment, the number of informal businesses went up along the bypass and other access roads, therefore an increase in satisfaction level. Motorcycle riding attracted many as a business sector which was also being supported by the County government through the provision of parking shades (Nodalis Conseil, 2013). From the findings of this study on the socio-economic status of the two fragments, it came out clearly that the majority of the respondents were self-employed and in the informal sector, especially in the unplanned fragments. This is in agreement with the Kisumu County Integrated Development Plan II, 2018-2022 report (Kisumu County, 2018), which state that the informal sector employs approximately 60% of those in gainful employment within the County. Findings of this study revealed that the

[13] The Kenyan Constituency Development Fund (CDF) was introduced in 2003, to support constituency development projects especially those aiming to combat poverty and reduce inequality in resource distribution. Construction and improvement of infrastructural services like schools, health facilities and roads are some of the key projects being implemented under this fund at constituency level. CDF is guided by Constituencies Development Fund Act (No.30 of 2013).

respondents of the unplanned fragment were least satisfied with getting jobs in the planned fragment as they could only be offered casual jobs or motorcycle riding. This is contrary to the respondents from the planned fragment whose satisfaction level of getting jobs in the unplanned fragment increased after road expansion. Satisfaction with job opportunities within fragments in this study may suggest better subjective QoL of the residents, as also expressed through satisfaction with family income after road expansion. This confirms what is discussed by Sirgy et al. (2008), on satisfaction with job availability being mirrored through family life and income.

Recreation dimension

Recreation areas are key in residents' life and well-being, they offer quiet places for relaxing, reflecting, resting and playgrounds for all ages and social groups. Findings revealed that respondents of the planned fragment were more satisfied with the availability of recreation areas and services in their fragment than in the unplanned fragment after road expansion *(Table 4-25)*. This may be explained by the coming up of recreation services like gym and swimming within the neighbourhood. Notably, more than 70% of the respondents from the unplanned fragment did not feel much change in the availability and access to recreation areas in the planned fragment after road expansion. Generally, this may be attributed to the fact that the available facilities for recreation like gym and swimming were to be accessed at a cost in the planned fragment. However, there were no restrictions for the residents from unplanned accessing the facilities in the planned fragment, a window for interaction. The bypass in itself offers good scenery for recreation, the fresh air that one gets while walking along the road and enjoying the ambience is more fulfilling than before. More than 50% of the respondents from the unplanned fragment felt like status quo remained the same about satisfaction on availability and access to recreation areas in their fragment (neutral). However, a number of the respondents still felt satisfied with access and availability of recreation areas within the unplanned fragment after road expansion, owing to improved accessibility. This aligns with the KISUD-Plan, 2013, where open spaces and parks need to be distributed in neighbourhoods for ease of accessibility by residents and promotion of interaction.

Housing dimension

Housing is one of the basic needs of any human being and therefore, it is vital for all to have accommodation. Satisfaction with housing contributes to the positive social life of residents in a neighbourhood (Sirgy et al., 2008). Findings of this study show that respondents from the two fragments were more satisfied with getting housing within their fragment than in the other fragment after road expansion *(Figure 4-27 and Figure 4-28)*. The results revealed that housing within fragments was being accessed through friends and family (social networks), which explains the satisfaction with housing within fragments. However, the respondents from the unplanned fragment registered the least satisfaction in getting housing in the planned fragment. According to the residents of the unplanned fragment, getting housing in the planned fragment was mainly through housing agencies and physical search. Their least satisfaction may be explained owing to the issue of affordability and minimal interaction being experienced between residents of the two fragments. In the planned fragment, more houses were being constructed following the improved accessibility as was noted during the walking interviews. This confirms how the availability of housing explains satisfaction with getting housing within the planned fragment, thus better-perceived QoL.

5.5. Variation of Subjective Quality of Life within residential fragments

Findings on variation in subjective QoL within fragments revealed that both planned and unplanned fragments maintained a high Coefficient of variation (CV) in satisfaction with access to facilities and services within the fragment before road expansion. The variability of subjective QoL decreased in the two fragments after road expansion, and this may suggest that the subjective QoL was perceived better by the respondents across the dimensions of QoL. These findings agree with Tesfazghi et al. (2010) when looking at the variability of subjective QoL at Kebele level in Kirkos sub-city of Addis Ababa in Ethiopia. Generally, subjective QoL was perceived better by the respondents of the two fragments after road expansion. However, on average, the CV for the planned fragment is lower than that of unplanned after road expansion. This may suggest that the planned fragment is experiencing higher subjective QoL, hence perceived to be relatively more homogeneous, as compared to unplanned fragment with lower subjective QoL *(See Table 4-14)*. It is worth noting that earlier studies that quantify the variability of QoL at the neighbourhood level are limited as was also noted by Tesfazghi et al. (2010).

5.6. The relationship between perceived interaction and Subjective Quality of Life

Findings show that there may be a relationship between perceived interaction and subjective QoL, after road expansion. Looking at accessibility, the respondents who reported high accessibility to facilities and services, also felt satisfied with the access to facilities in the two neighbourhoods, after road expansion. The change in accessibility to facilities after road expansion facilitated change in both social and spatial interaction between and within fragments. *Table 4-13* revealed that respondents from the planned fragment were accessing more facilities in the unplanned fragment after road expansion. This may be explained by the construction of more access roads in the area, and adjacent neighbourhoods enabling residents from the planned fragment to access facilities like playgrounds, churches and mosque, schools, health clinics and community hall, thus platforms for interaction between the fragments. Subsequently, there was also a slight increase in accessibility to facilities like schools and health facilities, after road expansion in the planned fragment by the residents of the unplanned fragment *(Table 4-14)*. However, the respondents of the two fragments were also accessing facilities in other adjacent neighbourhoods and within the city. Spatial interaction which largely refers to how people access facilities is key in reducing the inequalities that exist between neighbourhoods, and so contribute to subjective QoL of residents. Therefore, a change in access to facilities may suggest a change in perceived interaction and perceived better QoL.

The findings of this study on social interaction show that residents are able to rely on their neighbours for help within their fragments. They also have a strong sense of belonging in their fragments, a sign of satisfaction with their neighbourhood life. This is in tandem with earlier studies which have shown that social interaction is significant in improving the subjective QoL of individuals especially through social support (Datta et al., 2015; Farahani, 2016). Therefore, interaction has a pivotal role in improving the subjective QoL of individuals in residential areas.

The study found that positive impacts accruing from road expansion enhanced both social and spatial interaction in the study area. For instance, motorcycle riding as a way of transportation contributes to interaction within and between fragments. The riders also operate in registered welfare groups where they can borrow money and improve their QoL. The County government through the Department of Social Services, empower youths, women and the physically challenged and also build their capacities. The department also connects the youths with other organizations that can empower them in business skills, like Self-Help Africa, Designer group and K-met. The government has reserved some funds for these groups, like women enterprise fund, where they can secure loans and repay within a year at the interest of

5% and 3% for the physically challenged. As the government empower these social groups, it creates a platform for them to interact and even better their subjective QoL. This may enhance interaction and contribute positively to the subjective QoL of the residents.

The findings show that there is an improvement in perceived interaction and subjective QoL after road in the fragments. However, the findings do not claim causation (cause-effect relationship) since there could be other influencing factors to change in interaction and subjective QoL in the study area, other than road expansion. This may include County government interventions, NGOs and other development agencies contributions.

6. CONCLUSION AND RECOMMENDATIONS

The objective of this study was to investigate how the bypass road in Kisumu influences social-spatial interaction between and within urban fragments and how change in interaction may affect the subjective Quality of Life of the residents.

6.1. Reflection on study findings

The study analysed two residential fragments of planned and unplanned characteristics. The study found that the residential zoning of Kisumu city is based on the influence of the pre-colonial era coupled with land tenure system and socio-economic status. The planning guidelines and standards of the city favour the planned fragments leaving the unplanned fragments with limited planned development. This study examined the inequalities that exist between the two residential categories in relation to road infrastructure project, and perceived interaction and subjective QoL of the residents. Two moments in time of before and after, the construction of the road infrastructure project were considered (2012-2018).

The major findings of this study shows that perceived interaction and subjective QoL improved in the two fragments after road expansion. The present study does not bring out the issue of more fragmentation between neighbourhoods as had been initially expected based on earlier studies on road infrastructure and fragmentation. In the case of Bogota city, social fragmentation was seen as a consequence of road infrastructure project (Bocarejo et al., 2015). However, it is possible that the changes in perceived interaction and subjective QoL coincide with other unmeasured neighbourhood characteristics like interventions from the county government, NGOs and other development agencies. This need to be looked into to establish the interplay between interaction and QoL.

The study had three specific objectives, the conclusion for each is presented below:

Specific objective 1: **To analyse categories of residential fragmentation and characteristics of interaction between these categories**

The residential fragments in Kisumu city were categorised into three as; planned gated, planned non-gated and unplanned based on the morphological characteristics of pre-colonial times, land tenure system and economic status (income variance). Their spatial distribution revealed that they coexist as planned and unplanned fragments. Land use distribution of Kisumu city revealed that the highest percentage was under informal (unplanned) settlement (38.61%) as compared to planned residential (11.68%). This may mean that the majority of the city population lives in the unplanned settlements. The study also revealed the different characteristics that exist between the three categories in terms of physical characteristics, socio-economic status of the residents and infrastructure services. Planned gated and planned non-gated are low-density residential areas with planned developments, meant for high and medium in-come residents, and with better infrastructure services at their disposal. However, they experience limited interaction as most residents lead a private life in their compounds. The unplanned fragments are high-density residential areas with limited facilities and services and experience over-crowding and poor quality of housing in some cases. Unlike the planned fragments, they have no planning guidelines and standards. They interact in many places like streets, market, shops among others (see section 4.2.1).

Results on the socio-economic status of the residents in the two fragments revealed differences in highest education level attained by residents, with planned fragment having a majority with the university level of education as opposed to unplanned whose majority had a primary level of education. This explains the income variations that exist between the fragments (section 4.3).

Specific objective 2: To find out how road expansion influences the social-spatial interaction between urban fragments

Considering the analysis of the anticipated impacts of the road infrastructure project, the positive ones were largely achieved in the two fragments, though relatively the unplanned fragment benefitted more. Some indirect positive impacts like improved welfare of the residents through group registration were noted. Survey responses from the residents of the two fragments indicated that the bypass road had improved access to facilities and services in the study area. There was a positive effect on socio-economic aspects in terms of more employment opportunities, improved commerce, reduced commuter travel time and costs. The Connectivity between neighbourhoods also improved following construction of access roads from the bypass, and this enhanced accessibility to facilities even in other adjacent neighbourhoods. In terms of the environmental aspect, landscaping improved the drainage system and increased green spaces in the study area. Findings of this study show that positive impacts facilitated both social and spatial interaction between and within fragments, which also had an effect on the QoL of the residents.

The road infrastructure project also brought with it adverse effects. During the construction period, both human settlements and businesses that were along the road reserve were displaced to pave the way for the construction. Nevertheless, the Resettlement Action Plan (RAP) was prepared, and the project affected persons (PAP) were compensated. Noise pollution and dust from the busy roads especially during peak hours was also being experienced in the study area. There has been an increase in road accidents on the bypass as a result of road users (drivers and pedestrians) not being careful. The absence of road signs like zebra crossings, footbridges and pedestrian lanes has made crossing the road a nightmare especially to the non-motorised users in the study area. This may have contributed negatively to the interaction between the two fragments. However, study findings revealed that negative impacts affected the two fragments differently. The unplanned fragment experienced most of the adverse effects of the road infrastructure project (See section 4.4.4).

The analysis of social interaction within fragments revealed a strong sense of belonging and inclusivity, respondents were feeling at home and could rely on their neighbours for help in both planned and unplanned fragments. However, social interaction between fragments was not strong as within fragments (See section 4.5.1). Results of this study on spatial accessibility indicate that accessibility to facilities and services improved after road between and within fragments. However, for the respondents of the unplanned fragment accessing facilities in the planned fragment did not improve so much as compared to planned fragment accessing facilities in the unplanned fragment (See section 5.3.3). Planned fragments are presumed to have better facilities and services than the unplanned from literature, but in this study, it was found that respondents from the planned fragment were accessing facilities and services in the unplanned fragment after road expansion more than before.

From the findings of this study, it can be deduced that there is perceived interaction between and within fragments, which even improved after road expansion. From literature, it is known that interaction between neighbourhoods contributes to social cohesion which encourages sharing facilities. However, to bring this to fruition in the study area, there is a need to connect the two fragments by ensuring safe ways of crossing the road, and integration of the residents as well. This is already happening to some extent through the sharing of facilities and services. The two fragments are in the same constituency (Kisumu central), and hence share administrative services offered by CDF and Women Representative offices located in Tom Mboya (planned fragment). This encourages co-existence that urban communities need to have in sustainable cities, and may make the city more cohesive than before.

Specific objective 3: To understand from the residents of the two residential fragments how they perceive interaction between fragments and likely effects on subjective Quality of Life before and after road expansion.

Regarding subjective QoL, the findings show improved perceived QoL within fragments across the five dimensions of QoL (education, health, employment, recreation and housing). The results, on the one hand, revealed that variability of subjective QoL decreased in both planned and unplanned fragments after road expansion, as QoL conditions increased across the five dimensions of QoL. However, on average, the CV for the planned fragment was found to be lower than that of the unplanned fragment. This may suggest that despite the fact that areas became more homogenous in both fragments, the planned one is generally experiencing high subjective QoL (lower variability), as compared to the unplanned fragment which is experiencing low subjective QoL (higher variability).

Pertaining to the association between perceived interaction and subjective QoL, the results on perceived interaction and subjective QoL were explored. The findings show that there may be a relationship between the two. Respondents who registered high accessibility to facilities may also have felt satisfied with the access to facilities and services in the two fragments, after road expansion. Therefore, it can be concluded that many respondents who experienced a change in perceived interaction, also experienced a change in subjective QoL, after road expansion. This may suggest that there is an association in the way the respondents perceive the level of interaction and subjective QoL after road expansion. However, the change may not be necessarily a result of the cause-effect relationship since there may be other influencing factors in the study area, other than road expansion.

6.2. Study limitations

This study had some limitations despite some of the findings agreeing with other research findings. The study only considers subjective QoL based on survey responses to understand residents' perceptions on interaction and QoL before and after road expansion, in the two residential fragments. Subjective QoL in some cases may fail to give the actual neighbourhood life of an area, given that it is based on people's perceptions, often dictated by one's expectations in life and the surrounding environment. However, this study did not consider objective QoL conditions which have a high measurement of reliability about QoL conditions, for instance understanding the unemployment rate in the study area. Combination of both subjective and objective QoL measures would have allowed a better understanding of the four states of QoL conditions within the residential fragments: well-being, deprivation, adaptation and dissonance. This could be considered for future research.

The study looked into two moments in time of before and after road expansion and the respondents were asked to give responses to both moments. However, evaluation of memory sometimes may lead to a bias of recall, respondents might remember specific questions and recent memories but not the past, this may result in biases in the responses. This might have influenced some of the responses during the household survey. However, this study tried to narrow down the gap by conducting walking interviews which enabled respondents to recall by seeing, and bring out the change in real time.

The study interviewed residents that remained in the study area after the construction of the road infrastructure project. Only residents who had lived in the study area for five years or longer (2012-2018), were eligible to participate in the household survey. Interviews with the residents of Obunga revealed that some of the displaced persons who had settled on the road reserve had moved elsewhere. Therefore, their views on interaction and QoL conditions are not known since they were outside the scope of this study. This can be investigated in another research.

6.3. Recommendations

This study offers possible areas for further research on interaction and QoL in residential fragments. It also gives policy recommendations on some issues related to road infrastructure projects and planning principles in urban areas.

Further research
There is limited literature on the interaction of neighbourhoods and QoL studies in Kisumu city. This study, therefore contributes to scientific knowledge and enriches academic literature on residential fragmentation from the angle of the influence of road infrastructure projects on the interaction of urban fragments, and act as a baseline for more researches in this field. The study also recommends comparative studies in other cities where Northern corridor transport improvement project passes in Kenya. This may assist in informing policy makers, and planners about residents' perceptions about road development projects and also contribute to area-based interventions to reduce inequalities in rapidly urbanizing cities.

Case study approach was employed to understand how the bypass could be influencing the social-spatial interaction between and within urban fragments that are adjacent to it, and the likely effects on subjective Quality of Life of the residents by analysing two fragments. It is, therefore, important to carry out research on more than two fragments adjacent to the bypass and assess if the results found in this study are unique or can be generalised to other fragments within Kisumu city.

The study found that many respondents who experienced a high change in perceived interaction also experienced a high change in subjective QoL within fragments after road expansion. There could be change, but it is not necessarily a cause-effect relationship, as there could be other contributing factors, other than road expansion. Therefore, for a better understanding of this direction of the relationship, more research is needed.

Policy recommendations
Road infrastructure project has necessitated a change in land use in the planned fragments (Tom Mboya) following enhanced accessibility in the study area. Residents from the planned fragments are relocating to the peri-urban areas and leasing out their premises for commercial use. This has resulted in scaling up of land prices in peri-urban areas as they have become active zones for development, this could lead to displacement of the natives (gentrification) if not controlled. The peri-urban areas of Kisumu city are not guided by any planning principles. The study recommends the city authority to prepare urban development plans to translate the strategies proposed in the KISUD-Plan of 2013 into actionable plans that can be implemented to guide development in the peri-urban areas of Kisumu city.

From the findings on the adverse impacts of the bypass on the interaction of the two fragments, this study recommends improvement on road signage especially in areas where pedestrians cross the road. The inclusion of zebra crossing and footbridges into the design is recommended. This will ease movement to the other side of the road in neighbourhoods where the road traverse. Since traffic safeties rely more on the users, safety campaigns which create awareness to the users should be encouraged from time to time, just as a reminder of what is expected while on the road. This might reduce the incidences of traffic road accidents and also improve interaction between fragments. Therefore, the outcome of this study may help Kenya National Highways Authority (KeNHA) and the Physical planners in understanding adverse effects that road infrastructure projects have on interaction and QoL of residents of adjacent neighbourhoods and consider revising the designs of bypasses.

The bypass road is important in the study area because it is a meeting point for business and interaction. Nevertheless, the question is, should we have businesses along the road reserves and risk people's lives

and also encourage encroachment on road reserves. If the road is very important to the local economy of the area, then the study recommends that some safety measures be put in place. The county government of Kisumu to consider constructing a market in Obunga close to the bypass road, where the residents can sell their products in a confined place and attractive to the customers too. This has been done with other roadside markets within the city boundary. Markets play both social and economic role in the community, this might contribute greatly to sustainable urbanization.

Personal reflection

In this section, I reflect on the main issues of this study and what I have learnt which can assist me to improve my career and research field.

The main focus of this study was to investigate how the bypass road in Kisumu influences social-spatial interaction between and within urban fragments and how change in interaction may affect the subjective Quality of Life of the residents. Results of this study indicate that perceived interaction and subjective QoL improved after road expansion, though this may not be fully attributed to the road as there could be other factors influencing the change. Looking at the impacts that accrue from the implementation of the road project, it would be good to incorporate other concepts like walkability and cyclability in the designs to accommodate other road users and minimise accidents. From literature, large-scale projects have been seen to be contributors to economic development in areas where they are implemented. This is evident in this study too, we see more jobs and businesses coming up after road expansion. The participatory approach employed, where communities get involved from the beginning during project disclosure meetings to identification of impacts during ESIA study, contributes to the successful implementation of development projects. These are lessons learnt for the success of other projects to come.

Generally, I have learnt a lot on the roles played by different departments and stakeholders in the implementation of projects, the effects of expanding a road between neighbourhoods and how important interaction and QoL is to residents at the neighbourhood level. I have also come to understand that mean scores and standard deviation have advantage of revealing statistical differences at smaller sample sizes, thus recommended for use with ordinal data especially in social science studies. I have gained insights in administering an online questionnaire using open data kit app (ODK), and this has improved my skills in data collection.

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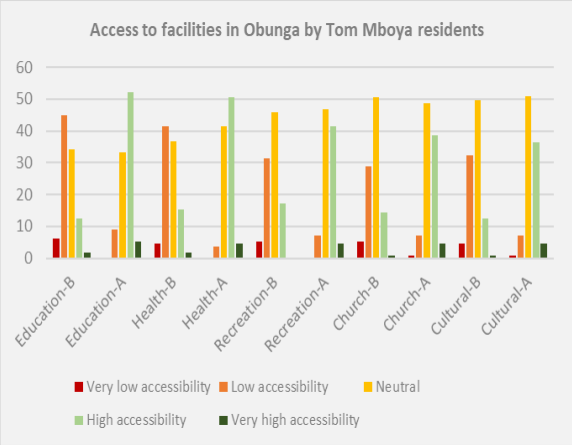
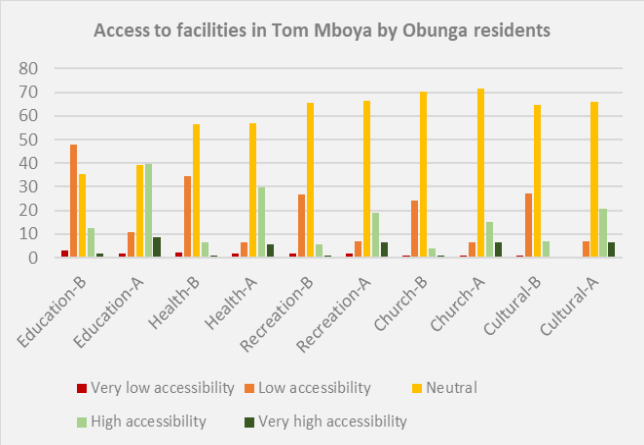
APPENDICES

Appendix 1: Perception of respondents on access to facilities within their neighbourhoods

		EducationBefore	EducationAfter	Health Before	Health After	RecreationBefore	RecreationAfter	Church Before	ChurchAfter	Cultural Before	CulturalAfter
						Percentage (%)					
Planned	Very low accessibility	7.3	0.9	6.3	0.9	4.5	0.9	4.5		5.4	
	Low accessibility	44.5	11.7	44.1	9	40.9	9	39.1	8.2	32.4	10
	Neutral	20.9	23.4	21.6	22.5	22.7	26.1	28.2	29.1	33.3	33.6
	High accessibility	**22.7**	**55.9**	**25.2**	**62.2**	**27.3**	**57.7**	**26.4**	**55.5**	**26.1**	**49.1**
	Very high accessibility	**4.5**	**8.1**	**2.7**	**5.4**	**4.5**	**6.3**	**1.8**	**7.3**	**2.7**	**7.3**
	Mean	2.73	3.59	2.74	3.62	2.86	3.59	2.82	3.62	2.88	3.54
	Std. Deviation	1.04	0.836	0.997	0.763	1.018	0.779	0.94	0.742	0.951	0.774
Unplanned	Very low accessibility	7	3.1	5.5	2.3	5.5	1.6	3.1	0.8	6.3	0.8
	Low accessibility	65.6	3.9	61.7	7	46.1	5.5	45.3	7	43.8	8.6
	Neutral	18.8	16.4	21.9	20.3	42.2	44.5	42.2	41.4	41.4	42.2
	High accessibility	**8.6**	**64.8**	**10.9**	**57.8**	**5.5**	**38.3**	**9.4**	**39.8**	**8.6**	**38.3**
	Very high accessibility		**11.7**		**12.5**	**0.8**	**10.2**		**10.9**		**10.2**
	Mean	2.29	3.78	2.38	3.71	2.5	3.5	2.58	3.53	2.52	3.48
	Std. Deviation	0.723	0.822	0.754	0.862	0.721	0.813	0.706	0.813	0.742	0.823

Appendix 2: Access to facilities between fragments before and after road expansion





Appendix 3: Open Data Kit (ODK) App for online data collection

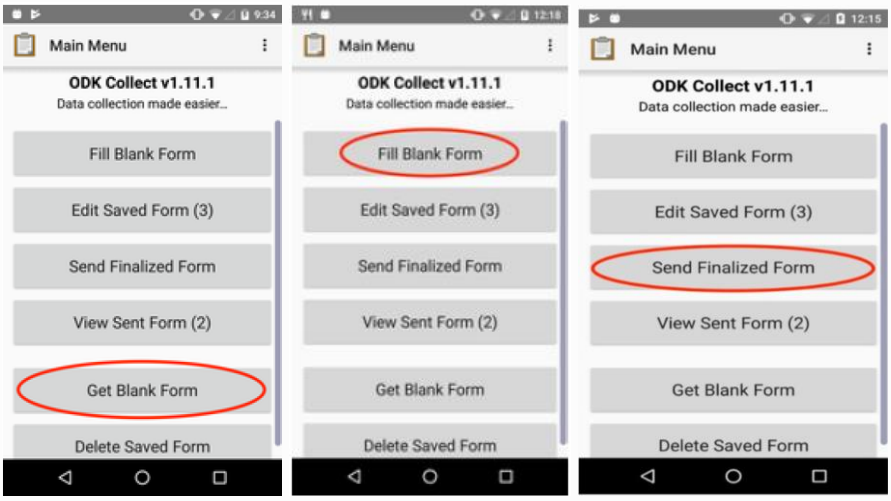
ODK Collect is an open source android app that is used in survey-based data collection. It supports a wide range of question and answer types, and is designed to work well without network connectivity (offline). ODK Collect renders forms into a sequence of input prompts that apply form logic, entry constraints, and repeating sub-structures. Users work through the prompts and can save the submission at any point. Finalized submissions can be sent to (and new forms downloaded from) a server. It supports multiple-choice, numeric responses, images, locations among others.

Setting up ODK collect

ODK collect is used to complete surveys with participants. Before you get started, select general settings from the action button (menu), select server, select type and set it to ODK aggregate and lastly edit ODK aggregate. ODK aggregate provides a robust data repository with tools for data visualization, querying, and export.

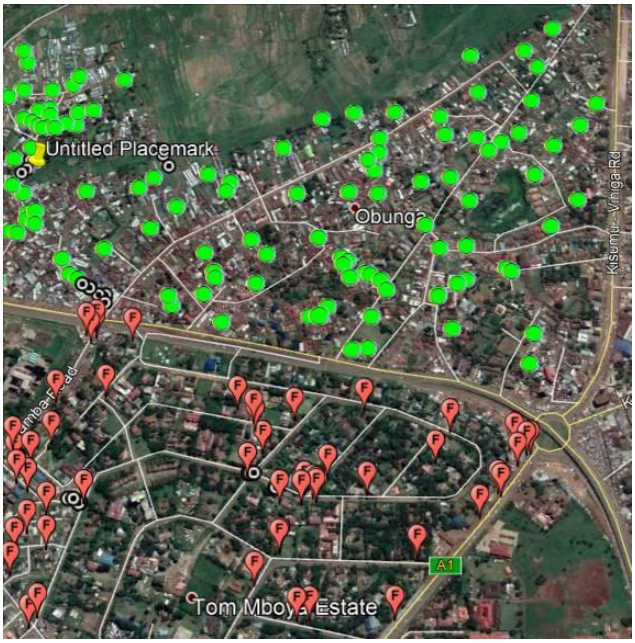
Using ODK collect for data collection

1. Select *Fill Blank Form* from the main menu
2. Select a form to fill (questionnaire).
   The questionnaires were uploaded to the ODK aggregate server in Xml format using neighbourhood names (ODK-Obunga_1 and ODK-Tom_Mboya_1)



Uploading finalised forms

3. Once the form is filled, complete by finalizing and take Geopoints of the household, then save the form. The Saved and finalized forms can be edited by selecting *Edit Saved Form* from the main menu, before uploading. Use *Send Finalized Form* to upload the form to the ODK Aggregate server or google drive account for analysis and aggregation. Sent forms cannot be edited, but can be viewed using *View Sent Form* from the menu.
4. The geopoints can be visualized using google maps or open street maps.



5. The filled form can be downloaded from the server in csv. Format for analysis

ODK_Obunga_1_results.csv - Excel

File Home Insert Page Layout Formulas Data Review View Help FlowBreeze (Trial) Tell me what you want to do

AutoSave Off

I1 part1:neighbourhood_knowledge

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
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2	Mon Oct 15	Mon Oct 15 06:5	Mon Oct 1	3.58E+14	3.58E+14	10	own	yes	relatives			strongly_agree	because I	strongly_a	rarely
3	Mon Oct 15	Mon Oct 15 07:2	Mon Oct 1	3.58E+14	3.58E+14	7	own	yes	friends			strongly_agree	accessible	strongly_a	rarely
4	Mon Oct 15	Mon Oct 15 07:5	Mon Oct 1	3.58E+14	3.58E+14	5	own	yes	family			strongly_agree	because I	strongly_a	rarely
5	Mon Oct 15	Mon Oct 15 08:1	Mon Oct 1	3.58E+14	3.58E+14	10	own	no				donot_agree	low incom	strongly_a	rarely
6	Mon Oct 15	Mon Oct 15 08:4	Mon Oct 1	3.58E+14	3.58E+14	20	own	no				strongly_agree	am in Luo	strongly_a	rarely
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11	Mon Oct 15	Mon Oct 15 10:5	Mon Oct 1	3.58E+14	3.58E+14	10	own	yes	relatives			strongly_agree	I have sta	strongly_a	rarely
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14	Mon Oct 15	Mon Oct 15 08:1	Mon Oct 1	8.62E+14	8.62E+14	5	own	yes	friends			strongly_agree	environm	agree	once_mor
15	Mon Oct 15	Mon Oct 15 08:4	Mon Oct 1	8.62E+14	8.62E+14	10	friends	yes	relatives			strongly_agree	it is a nice	donot_agr	rarely
16	Mon Oct 15	Mon Oct 15 08:5	Mon Oct 1	8.62E+14	8.62E+14	12	friends	yes	relatives			strongly_agree	am leavin	agree	once_yea
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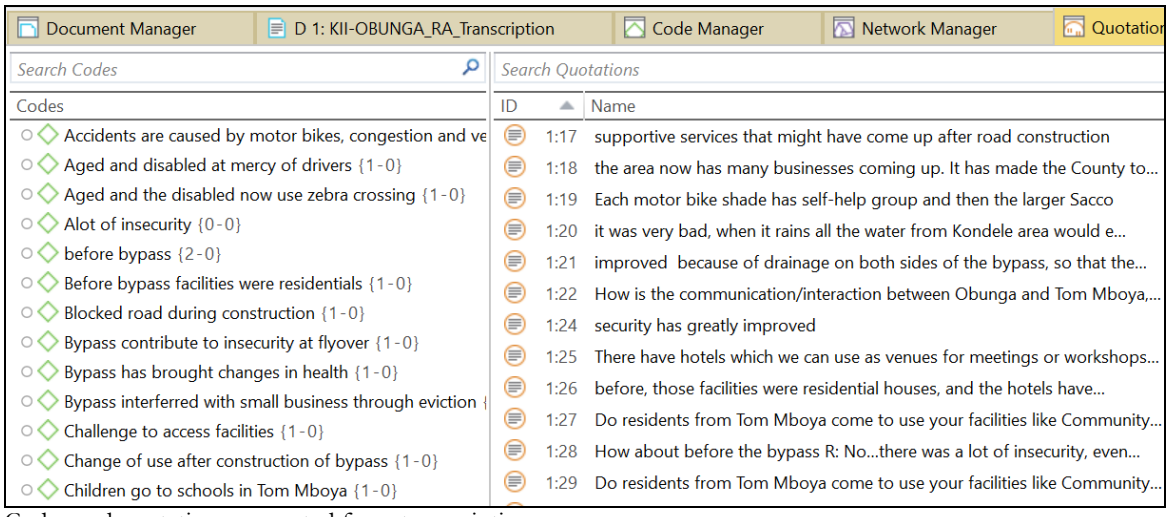
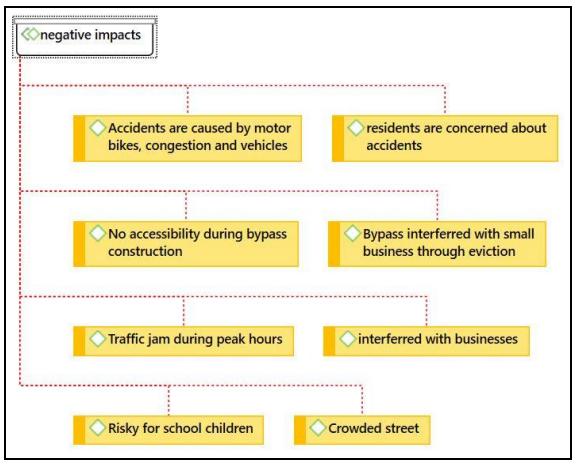
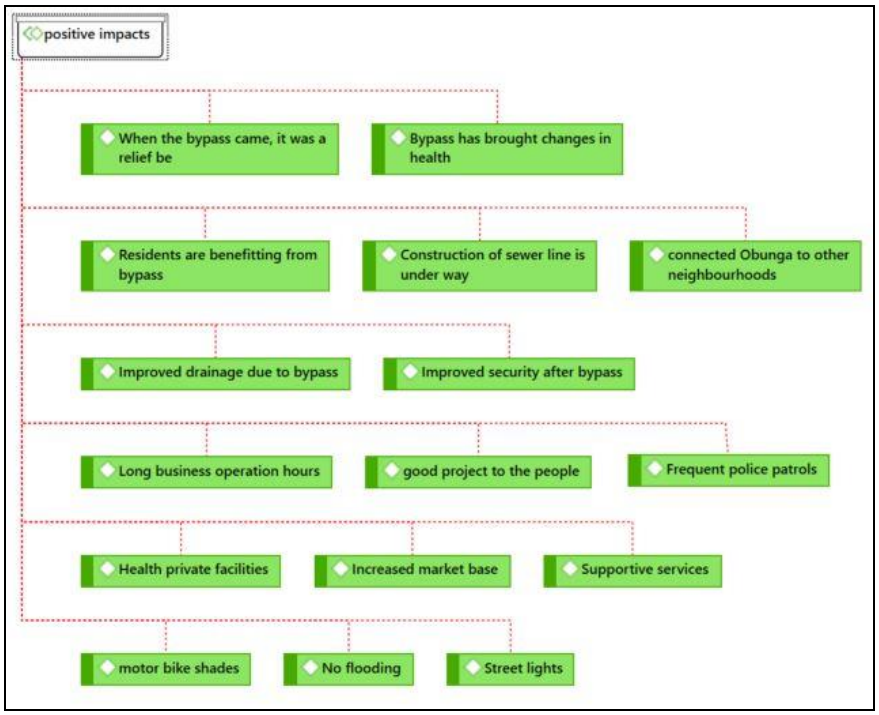
6. You can delete saved forms, finalized, sent and Blank forms by selecting *Delete saved Form* from the menu.

Appendix 4: Analysis of transcription using Atlas.Ti



Codes and quotations generated from transcription





Codes on negative impacts of the bypass as identified by Obunga residents

Appendix 5: Key Informant Interview guide

Introduction

My name is **Risper Sarah Khanani,** and I am a Master student at the University of Twente, The Netherlands. I am undertaking MSc. research project entitled ***"The impact of road infrastructure project on socio-spatial interaction and quality of life of planned and unplanned fragments in Kisumu City"***
The purpose of this interview is to gather in-depth information about how the Bypass road in Kisumu influences social and spatial interaction and how a change in interaction may affects subjective Quality of life of the residents in Tom Mboya and Obunga neighbourhoods.
The interview is entirely for academic purpose and the information provided will be confidential and treated anonymously. I request for your consent to record the interview. It will take approximately **45 minutes**.

READ THE INFORMED CONSENT FORM TO THE RESPONDENT(S) AND ASK THEM TO SIGN IT.
Fragmentation refers to the breaking up or disintegration of the urban environment into fragments, that seem independent and detached from each other with less or no interaction (Landman, 2011; Bocarejo et al., 2015)

Quality of life refers to people's feeling of well-being and satisfaction from the surrounding environment.

Guiding topics -General

1.1 Gender of the key informant?
Note: *To be assessed by the interviewer.*
□ Man
□ Woman
1.2 What is your current position in the department?

1.3 For how long have you worked in this neighbourhood/city?
□ Less than 1 year
□ More than 1 year and less than 5 years
□ More than 5 years and less than 10 years
□ More than 10 years
Specific questions

1.4 Physical Planning Department/Academic researcher (spatial planning lecturer)

- Emerging patterns of fragmentation in Kisumu city
- Causes /reasons/drivers of fragmentation in Kisumu city
- Are you familiar with different categories of residential fragments in Kisumu city (e.g planned gated, planned non-gated, unplanned etc)
- What has changed over time in relation to the categories?
- Updated list or map of categorised residential fragments in the city (*map showing the spatial distribution or list)*
- What are the typical characteristics of these fragments
- Development of different categorised residential fragments in Kisumu city
- What, in your opinion are the relevant dimensions and indicators of QoL that can be used to measure of QoL and interaction of neighbourhoods?
- What are the Socio-economic characteristics of the fragments (categorised)
- How does residential fragmentation influence Quality of Life of residents?
- Does the department have regulations and standards that guide the development for the residential fragments?
- Does the department have regularization guidelines for the unplanned residential fragments?

1.5 Academic person/spatial planning lecturer

- What is your perception of residential fragmentation in Kisumu city?
- Is there any current study on fragmentation which is yet to be published?
- Are you aware of any effects of the bypass road on the residents of the adjacent neighbourhoods?

1.6 National Environment Management Authority (NEMA)

- What were the envisioned impacts and mitigating measures of the Bypass road project on the residents of the adjacent neighbourhoods?
- How were the residents sensitised about the possible impacts of the bypass road especially on social life?

1.7 Community Development Office (CDO)

- Please elaborate on welfare groups in Tom Mboya and Obunga neighbourhoods
- How is the membership of the social/welfare groups in the two neighbourhoods. And what has changed in membership registration since 2016?
- From your assessment, how active are the residents of the two neighbourhoods in participating in cultural events/activities to enhance interaction between them.
- How beneficial are the groups to the residents in regard to Quality of life
- Anything else that you would wish to share in relation to performance of social groups (women groups, youth groups etc) in Tom Mboya and Obunga neighbourhoods

1.8 Residents Association Office

- How do the residents of Tom Mboya/Obunga neighbourhood generally view the bypass road regarding development in the area?
- In your opinion, how are the residents benefitting from the constructed bypass road?
- Are there complaints coming up from the residents about the presence of the bypass road?
- What are the actual impacts (positive and negative) of the bypass road on the residents of these two neighbourhoods?
- What are the auxiliary (secondary) services that might have come up in relation to the construction of the bypass road e.g motorcycle shades, businesses, drainage system, street lights etc?
- How is the interaction of the residents between Tom Mboya/Obunga neighbourhoods in relation to the bypass road?
- In your opinion, how was the Quality of Life of the residents **before** the construction of the bypass road **(2012)**?
- In relation to your previous response, what has changed **after** the construction of the bypass road? *(Request for socio-economic data and maps if available)*
- At what stage were you involved during the construction of the bypass road?
- Was the bypass road a good project for the County government of Kisumu?
- Which was the worst moment in relation to access of basic facilities and Quality of Life in general for the residents during the construction period (2013-2016)
- How is the safety of non-motorised users of the bypass road (the aged, physically challenged persons, children etc)
- Are there more incidents of accidents on the bypass road?

1.9 Kenya National Highways Authority (KeNHA) Representative

- What were the salient design features of the bypass road (Southern Bypass)? (Over pass, under pass, foot bridges etc)
- How did the road design consider the needs of the non-motorised users (pedestrians) on the bypass road?
- What is the actual role of the Authority in road maintenance and management (Monitoring) and conducting annual Environmental Audits, ESIA reports etc.
- What are the emerging trends in relation to the impacts of the bypass road on the residents of the adjacent neighbourhoods that Environmental Audits reveal.
- Any challenges that were experienced during the construction period of the Bypass road? (for example, resistance from the residents from the adjacent neighbourhoods)

 What is your perception about the impacts of the bypass road on Quality of Life of the residents of the adjacent neighbourhoods?

Any General remark on the impacts of the Bypass?

Thank you for your time

Appendix 6: Household Questionnaire

Source: Some parts of the questionnaire adopted from World Health Organization (2000)

INSTITUTION: UNIVERSITY OF TWENTE, ITC

STUDENT: RISPER SARAH KHANANI

INTRODUCTION

Read: Hello, my name is …… and I am here on behalf of **Risper Sarah Khanani** who is studying at the University of Twente in The Netherlands. Do you have some time to participate and answer questions for us? The interview should take approximately **30 minutes**.

About the interview

Read: Before starting the interview, I would like to briefly tell you about the purpose of this interview. The study concerns the impacts of the bypass road on the social life and developments. We would like to know about your life in **OBUNGA neighbourhood**, especially about your social and neighbourhood connection and your Quality of Life **before** the construction of the Bypass road and **after**. People may have different feelings and perceptions towards the expansion of the road and the neighbourhood they live in since their expectations and experiences differ. And this is what we would like to know.

You are invited to answer the questions on voluntary basis, and you can stop at any time, without having to give a reason. Personal information and data collected during this research will be maintained confidential and anonymous. In answering our questions, there is no right or wrong answer for this case since we want to know your feelings and perceptions. Do you have any question before we start?

Interviewer: *Please include questions here:*

PART 1: NEIGHBOURHOOD AND RESIDENTIAL HISTORY

Read: I would like to start by asking you some questions about the neighbourhood and your residential history.

Interviewer: *Please fill in and tick the appropriate response. (Only household heads who have lived in the neighbourhood for 5 years or longer are legible to participant in the survey.)*

PART 2: MEASUREMENT OF INTERACTION

Assessment Attributes					
1. How long have you lived in this neighbourhood? (years)	*(**Interviewer**, if less than 5 years please terminate interview)*				
2. When you moved to the neighbourhood, did you choose to live here?	Yes, I chose to move here	No, someone brought me here.	No, just ended up here	No, I would have preferred another neighbourhood	Don't know
3. Did you know anyone in the neighbourhood, before you moved here?					
3b. If yes, who were they? (**Interviewer:** *More than one answer is possible)*	Family (Parents, siblings, children)	Relatives (uncle, aunt or cousin)	Friends	Housing agents/broker	Resident Association official

a) Social Interaction (with neighbours)

Read: First we would like to ask questions about your contact/relationship with your neighbours in this neighbourhood, then we would like to know a little bit more about your relationship with people from the other neighbourhood on the other side of the Bypass road (Tom Mboya).
Note to the interviewer: *Emphasize words in bold while reading.*
Interviewer: *Please show Obunga neighbourhood on the paper map to the respondent*

Assessment Attributes	**5**	**4**	**3**	**2**	**1**
Interaction within your own neighbourhood					
4. I **feel** at home in my neighbourhood	Strongly Agree	Agree	Undecided	Disagree	Strongly disagree
4b. Please explain your response in the previous question					
5. When I have a problem I can rely on the **help** of my neighbours.	Strongly Agree	Agree	Undecided	Disagree	Strongly disagree
6. How often do you ask for help from your neighbours?	Once a week	Once a month	Once a year	Rarely	Never
7. How often do residents within your neighbourhood ask you for **help**?	Once a week	Once a month	Once a year	Rarely	Never
8. Do you belong to any **welfare/religious group/ association**?					
8b. If so, which ones? If no, please explain 'why'					
Interaction with the other neighbourhood (Tom Mboya)					
9. How often do you or any member of your household participate in inter-neighbourhood **social activities** (competition/ matches/cultural events etc) with your neighbours in Tom Mboya?	Once a week	Once a month	Once a year	Rarely	Never
9b. Please mention examples					
10. How often do you ask for **assistance/help** from people living in Tom Mboya?	Once a week	Once a month	Once a year	Rarely	Never
10b. How often do Tom Mboya residents ask for **assistance/help** from you**?**	Once a week	Once a month	Once a year	Rarely	Never
11. How many people living in Tom Mboya do you regularly **visit** at home?	All of them	Most of them	Just a few of them	Hardly anybody	No one
11b. How many people living in Tom Mboya regularly **visit** you at home?	All of them	Most of them	Just a few of them	Hardly anybody	No one
12. How many people living in Tom Mboya do you **chat/talk/discuss matters** with?	All of them	Most of them	Just a few of them	Hardly anybody	No one
12b. How many people living in Tom Mboya do **chat/talk/discuss matters** with you?	All of them	Most of them	Just a few of them	Hardly anybody	No one
13. I rely on people from Tom Mboya for jobs (cleaning the house or compound etc).	Strongly Agree	Agree	Undecided	Disagree	Strongly disagree
13b. People from Tom Mboya rely on jobs (cleaning the house or compound etc) from Obunga.	Strongly Agree	Agree	Undecided	Disagree	Strongly disagree

Interviewer: *More than one option is possible*

14. With whom from your **social network** of friends/family can you discuss personal matters?	My parents	Siblings	Relatives	My children	Friends	Others
14b. If others, please specify						

a) Spatial accessibility to facilities (Spatial interaction)

Read: This section of the survey has questions about how reachable the **basic facilities** are from where you live.

15. Where do you or other household members access the following facilities (health, education, recreation, church, mosque and cultural institutions)?

Facilities	**Place of access**					
	Within own neighbourhood	Within Tom Mboya neighbourhood	Within adjacent neighbourhoods	Outside own and other adjacent neighbourhoods but within the city	Outside the city	Not applicable
Education						
Health						
Recreation areas						
Church						
Mosque						
Cultural institutions						

Interviewer: *Use a cross **(x)** in the cell to indicate the response. More than one option is possible*

Read: We would like to know how you rate access to facilities within your neighbourhood **before** road expansion (2012) and how the access is **now** (after road expansion).

Interviewer: *Please indicate the satisfaction level of spatial accessibility by **ticking t**he appropriate response.*

Assessment Attributes	**5**	**4**	**3**	**2**	**1**
16. How was accessibility to **education facilities** (Pre-primary, Primary, Secondary schools etc) in your neighbourhood **before** road expansion?	Very high accessibility	High accessibility	Neutral	Low accessibility	Very low accessibility
16b. How is accessibility to **education facilities** in your neighbourhood **now?**	Very high accessibility	High accessibility	Neutral	Low accessibility	Very low accessibility
17. How was accessibility to **health facilities** in your neighbourhood **before** road expansion?	Very high accessibility	High accessibility	Neutral	Low accessibility	Very low accessibility
17b. How is accessibility to **health facilities** in your neighbourhood **now?**	Very high accessibility	High accessibility	Neutral	Low accessibility	Very low accessibility
18. How was accessibility to **recreation areas/facilities** in your neighbourhood **before** road expansion?	Very high accessibility	High accessibility	Neutral	Low accessibility	Very low accessibility
18b. How is accessibility to **recreation areas/facilities** in your neighbourhood **now**?	Very high accessibility	High accessibility	Neutral	Low accessibility	Very low accessibility
19. How was accessibility to **church/Mosque** in your neighbourhood **before** road expansion?	Very high accessibility	High accessibility	Neutral	Low accessibility	Very low accessibility

19b. How is accessibility to **church/Mosque** in your neighbourhood **now**?	Very high accessibility	High accessibility	Neutral	Low accessibility	Very low accessibility
20. How was accessibility to the **Cultural/social institutions** (social halls, resource centres etc) in your neighbourhood **before** road expansion?	Very high accessibility	High accessibility	Neutral	Low accessibility	Very low accessibility
20b. How is accessibility to the **Cultural/social institutions** in your neighbourhood **now**?	Very high accessibility	High accessibility	Neutral	Low accessibility	Very low accessibility

Read: We would like to know the most common way of getting jobs and finding houses in your neighbourhood.

21. How do people **get jobs** in your neighbourhood?	Informal via family/friends	Formal job application	Job agency	Social services	Media (TV, radio etc)/Social media	Others
21b. If others, please specify						
22. How is the arrangement of getting **housing** in your neighbourhood?	Via family/friends	Physical house search	Housing agencies	Brokers	Advertisements	Others
22b. If others, please specify						

Read: Now we would like to know how you rate access to facilities within **Tom Mboya neighbourhood before** road expansion (2013) and how the access is **now.**

Assessment Attributes	**5**	**4**	**3**	**2**	**1**
23. How was accessibility to **education facilities** (Pre-primary, Primary & Secondary schools) in Tom Mboya **before** road expansion?	Very high accessibility	High accessibility	Neutral	Low accessibility	Very low accessibility
23b. How is accessibility to **education** facilities in Tom Mboya **now?**	Very high accessibility	High accessibility	Neutral	Low accessibility	Very low accessibility
24. How was accessibility to **health facilities** in Tom Mboya **before** road expansion?	Very high accessibility	High accessibility	Neutral	Low accessibility	Very low accessibility
24b. How is accessibility to **health facilities** in Tom Mboya **now**?	Very high accessibility	High accessibility	Neutral	Low accessibility	Very low accessibility
25. How was accessibility to **recreation areas/facilities** in Tom Mboya **before** road expansion?	Very high accessibility	High accessibility	Neutral	Low accessibility	Very low accessibility
25b. How is accessibility to **recreation areas/facilities** in Tom Mboya **now**?	Very high accessibility	High accessibility	Neutral	Low accessibility	Very low accessibility
26. How was accessibility to **church/Mosque** in Tom Mboya neighbourhood **before** road expansion?	Very high accessibility	High accessibility	Neutral	Low accessibility	Very low accessibility
26b. How is accessibility to church/Mosque in Tom Mboya **now**?	Very high accessibility	High accessibility	Neutral	Low accessibility	Very low accessibility
27. How was accessibility to **Cultural/Social institutions** in Tom Mboya **before** road expansion?	Very high accessibility	High accessibility	Neutral	Low accessibility	Very low accessibility
27b. How is accessibility to **Cultural/Social institutions** in Tom Mboya **now**?	Very high accessibility	High accessibility	Neutral	Low accessibility	Very low accessibility

Read: We would like to know the most common way of getting jobs and finding houses within **Tom Mboya** neighbourhood

28. How do people **get jobs** in Tom Mboya neighbourhood?	Informal via family/friends	Formal job application	Job agency	Social services	Media (TV, radio etc)/Social media	Others
28b. If others, please specify						
29. How is the arrangement of getting **housing** in Tom Mboya neighbourhood?	Via family/friends	Physical house search	Housing agencies	Brokers	Advertisements	Others
29b. If others, please specify						

PART 3: QUALITY OF LIFE PERCEPTION

Read: The following questions are about your satisfaction level with your life and access to facilities and services within neighbourhoods. We would like to know how you feel about the impact of road expansion on your Quality of life. First, we would like to ask about your perception and feelings **before** road expansion **(2012),** and **after** road expansion (now/current situation). It is your opinion on domains of life.

Attributes	**Level of Assessment**				
	5	**4**	**3**	**2**	**1**
30. How satisfied were you with your life **before** the construction of the bypass road?	Very satisfied	Satisfied	Neutral	Dissatisfied	Very Dissatisfied
30b. **At this present moment**, how satisfied are you with your life as a whole?	Very satisfied	Satisfied	Neutral	Dissatisfied	Very Dissatisfied
30c. Please explain your response in the previous question					
Education (Pre-primary, Primary, Secondary schools)					
31. How satisfied were you with the access of **education facilities** in your neighbourhood **before** road expansion?	Very satisfied	Satisfied	Neutral	Dissatisfied	Very Dissatisfied
31b. How satisfied are you **now** with the access of **education facilities** in your neighbourhood?	Very satisfied	Satisfied	Neutral	Dissatisfied	Very Dissatisfied
32. How satisfied were you with the access of **education facilities** within Tom Mboya **before** road expansion?	Very satisfied	Satisfied	Neutral	Dissatisfied	Very Dissatisfied
32b. How satisfied are you **now** with the access of **education facilities** within Tom Mboya?	Very satisfied	Satisfied	Neutral	Dissatisfied	Very Dissatisfied
Health services					
33. How satisfied were you with the **health services** in your neighbourhood **before** road expansion?	Very satisfied	Satisfied	Neutral	Dissatisfied	Very Dissatisfied
33b. How satisfied are you **now** with **health services** in your neighbourhood?	Very satisfied	Satisfied	Neutral	Dissatisfied	Very Dissatisfied
34. How satisfied were you with **health services** within Tom Mboya **before** road expansion?	Very satisfied	Satisfied	Neutral	Dissatisfied	Very Dissatisfied
34b. How satisfied are you **now** with **health services** within Tom Mboya?	Very satisfied	Satisfied	Neutral	Dissatisfied	Very Dissatisfied
Recreation (open/green spaces & sports facilities/playground)					

35. How satisfied were you with the availability of **recreation areas/facilities** in your neighbourhood **before** road expansion?	Very satisfied	Satisfied	Neutral	Dissatisfied	Very Dissatisfied
35b. How satisfied are you **now** with the availability of **recreation areas/facilities** in your neighbourhood?	Very satisfied	Satisfied	Neutral	Dissatisfied	Very Dissatisfied
36. How satisfied were you with the availability of **recreation areas/facilities** within Tom Mboya **before** road expansion?	Very satisfied	Satisfied	Neutral	Dissatisfied	Very Dissatisfied
36b. How satisfied are you **now** with the availability of **recreation areas/facilities** within Tom Mboya?	Very satisfied	Satisfied	Neutral	Dissatisfied	Very Dissatisfied

Read: We would like to know how satisfied you are with getting jobs and housing in the neighbourhoods

Attributes	**5**	**4**	**3**	**2**	**1**
Employment					
37. How satisfied were you with getting **job opportunities** in your neighbourhood **before** road expansion?	Very satisfied	Satisfied	Neutral	Dissatisfied	Very Dissatisfied
37b. How satisfied are you **now** with getting **job opportunities** in your neighbourhood?	Very satisfied	Satisfied	Neutral	Dissatisfied	Very Dissatisfied
38. How satisfied were you with getting **job opportunities** within Tom Mboya **before** road expansion?	Very satisfied	Satisfied	Neutral	Dissatisfied	Very Dissatisfied
38b. How satisfied are you **now** with getting **job opportunities** within Tom Mboya?	Very satisfied	Satisfied	Neutral	Dissatisfied	Very Dissatisfied
39. How satisfied were you with the adequacy of family income **before** road expansion?	Very satisfied	Satisfied	Neutral	Dissatisfied	Very Dissatisfied
39b. How satisfied are you now with the adequacy of family income?	Very satisfied	Satisfied	Neutral	Dissatisfied	Very Dissatisfied
Housing					
40. How satisfied were you with getting **housing** in your neighbourhood **before** road expansion?	Very satisfied	Satisfied	Neutral	Dissatisfied	Very Dissatisfied
40b. How satisfied are you **now** with getting housing in your neighbourhood?	Very satisfied	Satisfied	Neutral	Dissatisfied	Very Dissatisfied
41. How satisfied were you with getting **housing** within Tom Mboya **before** road expansion?	Very satisfied	Satisfied	Neutral	Dissatisfied	Very Dissatisfied
41b. How satisfied are you **now** with getting **housing** within Tom Mboya?	Very satisfied	Satisfied	Neutral	Dissatisfied	Very Dissatisfied

PART 4: RESPONDENT'S PROFILE

Read: This is the last section and has questions enquiring on your background information.
Interviewer: *Please **tick** the appropriate response by the respondent.*

42. Gender (***Interviewer:*** *Please observe and fill in)*
1. Man ( )
2. Woman ( )
43. May I ask your age …… ***(interviewer,*** *please note that this will be age at last birthday)*
44. What is the highest level of education that you have completed?

O 1. Less than Primary school
O 2. Primary school
O 3. Secondary school
O 4. Tertiary college
O 5. University undergraduate
O 6. University postgraduate

45. What is your employment status?
O 1. Employed
O 2. Self-employed
O 3. Not employed
O 4. Volunteer

46. What are the three most important reasons you choose to live in this neighbourhood?

1.	Close to job	
2.	Convenient for recreation activities	
3.	Convenient for public transportation	
4.	Close to family and friends	
5.	Convenient to school for children	
6.	Availability of better public services	
7.	Access to Housing	
8.	Others	

We have come to the end of the questionnaire. **Thank you for your time**. Do you have any questions or additional comment about what we have discussed?

END OF INTERVIEW

Interviewer read this after the interview: Would you like to walk and talk with us about the key places that you think have changed or have come up because of the road being expanded (impacts of the road) in the coming days in your neighbourhood. (*Interviewer, take contacts of the respondent if he/she agrees to participate in the walking interview).*

Appendix 7: Walking Interview Guide

Interviewer: This part is about in-depth understanding of the resident's perception of impacts coming up as a result of road expansion/construction of bypass road. Go with the people who accept to continue with walking interview and probe their responses. Check for both positive and negative aspects that could have affected the resident's Quality of Life.

Interviewer read: I request for your permission/consent to record the interview. It will take approximately **45 minutes**. As we walk and talk, please feel free to point out some of the key areas that you think have changed following the construction of the bypass road and tell us about them (effects of the bypass).

Topic questions for walking interviews

1. How are you as residents benefitting from the expanded road?
2. Where do you observe/experience major changes in the neighbourhood following road construction in relation to access and satisfaction to facilities like Education, health, recreation church, market etc? How about in the other neighbourhood on the other side of the bypass, where are the changes observed?

3. In your opinion, where do you find the bypass road a physical barrier/beneficiary to your daily contact/communication/visitation with your neighbours in Tom Mboya/Obunga neighbourhood? *(Actual impacts of the expanded road on interaction)*
4. Where do you meet with your neighbours from Tom Mboya/Obunga? Where were you meeting before the construction of the bypass road? Are you able to visit/chat/assist/help each other as before? What has changed over time?
5. Where do you experience changes in regard to relationships between you and your neighbours in this neighbourhood? And in Tom Mboya/Obunga? What has changed?
6. Why are you satisfied/dissatisfied with access to facilities like schools, health, sports/playground, open/green space, housing, churches, market etc within the neighbourhoods after road construction? What has changed in access in relation to the construction of the bypass? *(Probing question from the respondent's questionnaire)*
7. Could you please tell me more about school attendance in the neighbourhood? Do many children go to school within the neighbourhood? To which school do most of the children go and Why? What about health facilities, recreation areas etc ? And in Tom Mboya/Obunga?
8. Has organization for social activities, chatting with friends, visiting and helping each other changed due to road expansion? What else has changed and where? How about in Tom Mboya/Obunga?
9. In your opinion, what is the general condition of life in this neighbourhood? What has changed in the QoL since the construction of the bypass road? Are there spatial differences within the neighbourhood?
10. Do you have anything else to tell me? What's your favourite spot in the neighbourhood and why?

Thank you so much for your time and contribution.

END OF INTERVIEW