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MSc Programme in Urban Management and Development

Rotterdam, The Netherlands

September, 2017

Thesis

Title: Basic Infrastructure Improvement and Livelihood Strategies of Female-headed Households of Swahili Informal Settlement in Machakos, Kenya

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UMD 13

MASTER'S PROGRAMME IN URBAN MANAGEMENT AND DEVELOPMENT

(October 2016 – September 2017)

Title

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UMD 13 Report number: 1066

Rotterdam, September 2017

Summary

Informal settlements in Kenya date back to the colonial era when segregation policies designated living areas according to race for European settlers, Asians and Africans with unbalanced resource allocations to these different segregation areas for infrastructure development and housing. African settlers were allowed to build shanties so long as they were not near the central business district. This, coupled with rapid urbanization, has seen informal settlements grow at an unprecedented rate. They are characterized by squalor conditions evident through dilapidated housing of poor quality building materials and the absence of basic infrastructure services. The lack of basic infrastructure weighs heavily on women due to their gendered roles of home maintenance. This burden is particularly felt more by women in female-headed households as they are more vulnerable. Women are charged with responsibilities such as fetching water, washing, cooking, looking for energy sources as well as taking care of children and the elderly. Proponents of infrastructure services postulate that improving infrastructure services, though it benefits men and women, it is bound to accord more benefits to the women.

The Government of Kenya is intent on improving the living and working conditions of the people in the informal settlements. In collaboration with the World Bank, French Agency for Development and Swedish International Development Cooperation Agency, it initiated an infrastructure improvement programme in Swahili Informal Settlement in Machakos, Kenya. The project commenced in June 2011. This project was part of Kenya Informal Settlements Improvement Project (KISIP) programmes. The objective of KISIP is to improve the lives of approximately 700,000 people living and working in fifteen preselected urban areas. It aims to benefit both men and women equally, but it purposes to ensure that women benefit fully. The initiative therefore, anticipated that women would benefit disproportionately in their favour with the installation of water and sanitation facilities.

The main objective of this study was therefore to examine the influence of gender sensitive basic infrastructure improvement on the livelihood strategies of female-headed households of Swahili Informal Settlement. The study sought to understand this through the exploration of the linkage between access to gender sensitive basic infrastructure improvement and the livelihood activities of female-headed households by comparing their livelihood strategies before and after the improvement project.

The study adopted a quasi-experiment research design. Two informal settlements were compared in order to effectively establish the influence of gender sensitive infrastructure improvement. Swahili Informal Settlement, the experiment group, with KISIP infrastructure improvements was compared to Kathemboni Village, the control group, with no infrastructure improvements on account of KISIP. These settlements were compared in two time periods. The pre-test period, 2011, representing the conditions in the settlement before infrastructure improvement. The post-test period, 2017, representing the post-test period, after the intervention. The study used both quantitative and qualitative data. Quantitative data were collected from the two settlements by administering questionnaires. Semi-structured interviews were conducted in the experiment group with key informants, targeting representatives of the Settlement Executive Committee and officials from KISIP, the implementers of the project. This information was supplemented by observations and further substantiated with secondary data from project reports.

Research findings indicate that investing in gender sensitive basic infrastructure does have an influence on the livelihood activities of the respondents. Notable is the significant increase in the perception of safety brought about by the installation of high mast flood lighting. This in

return has had ripple effects, for instance, enabling the residents to engage in business activities for extra time in the evening. Findings also show that the respondents had more time to carry out business activities as they had time saved from carrying out domestic chores such as fetching water. In addition, there was an improvement in accessibility of the settlement as well as within the settlement especially for residents on foot. On the contrary, there was no impact felt by the respondents with regards to disposal of solid waste.

The study concludes that access to gender sensitive basic infrastructure is indeed critical to the changes in livelihood strategies of women. There is evidence that the livelihoods activities of the female-headed households have transformed for the better albeit statistically not significant perhaps due to the small sample size and the vulnerability of the focus group in this study.

Keywords

Informal settlements, Improvement, Gender sensitive basic infrastructure, Female-headed households, Livelihood strategies.

Acknowledgements

I am grateful to IHS for the opportunity to be a participant in the master course and JJWBGSP for the scholarship.

I wish to acknowledge the support from the lecturers and staff of IHS. Profound gratitude to my thesis supervisor, Dr. Alonso Ayala for his valuable guidance that made this possible and to my second reader Dr. Hebe Verrest, for the constructive pointers to enrich the thesis.

Special thanks to my family back at home for your unconditional love, unwavering moral support and most of all, your prayers.

My friend Waithera, we shared the happiest of times and difficult ones too, in equal measure in the course of this study. I say thank you and wish you best of luck in your future career.

To the people who in one way or another helped me in this process: special admiration for Kiptoo, Nyanjui, Ngina, Kabu, Chela, Kimani, Martin and Korir, I say thank you for your support. May your kindness be replenished a thousand folds.

Above all, Glory to the Almighty God for his abundant blessings and good health to successfully complete the programme. Thank you!

Abbreviations

IHS	Institute for Housing and Urban Development
KENSUP	Kenya Slum Upgrading Programme
KISIP	Kenya Informal Settlements Improvement Project
SDG	Sustainable Development Goals
SIDA	Swedish International Development Cooperation Agency
AFD	French Agency for Development
SEC	Settlement Executive Committee
KSH	Kenya Shillings
CBO	Community Based Organization

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Chapter 1: Introduction

1.1 Background

The United Nations defines informal settlements as residential areas with no secure tenure located in precarious areas both geographically and environmentally, for instance on riparian land prone to floods. They are described as areas with limited access to infrastructure services necessary for transportation such as paved roads and footpaths, water and sanitation including access to piped water and sewage services and connection to energy sources. In addition, they are synonymous with squalor, manifested by dilapidated housing conditions and the use of low quality building materials that do not fulfil the requirements of acceptable building laws. Further, informal settlements are classified as squatter settlements on either private or government land that has been illegally subdivided (UN-Habitat, 2003).

The growth of informal settlements in Kenya goes back to the colonial time, when the country's segregation planning policies designated areas for Africans, Asians and European settlers. The growth of informal settlements was aggravated by unbalanced resource allocations for infrastructure development and housing to the different segregation areas. Additionally, rapid urbanisation as a result of rural-urban migration of people pursuing better opportunities in cities further entrenched the formation of informal settlements. After independence, people were allowed to build shanties on condition that they were not situated close to the central business district (UN-Habitat, 2003).

Informal settlements have been noted to provide affordable housing to poor urban households. Wekesa, Steyn, et al. (2011) acknowledge that informal settlements are homes to millions of urban poor populations who are not able to access formal housing. In 2016, the World Bank estimated the urbanization rate in Kenya at 4.4% and noted that the provision of formal housing had not kept pace with the urbanization rate leaving informal settlements as the only option available for the urban poor. Further, it estimated that 60% of Kenyan households in peri-urban and urban areas live in informal settlements. They attribute this to the compromise that households make to housing conditions so as to live closer to their source of employment (World Bank, 2016). In the same way, informal settlements are perceived to attract and retain poor households because they facilitate access to vibrant micro-economies (Pierce, 2015).

Poverty can be manifested through the growth of informal settlements. Indeed, Wekesa, Steyn, et al. (2011) note that a majority of the residents of informal settlements live in poverty and rely on informal sources of income, as well as self-employment whose proceeds can be inadequate, sporadic and uncertain. The UN-Habitat (2003) associates the low incomes of households living in informal settlements to the predominant nature of casual labour, which is often characterized by low level of skills. The World Bank report (2016) further indicates that the low and informal incomes of people in urban areas in Kenya hinders them from owning decent houses as they cannot access formal mortgage facilities.

Wekesa, Steyn, et al. (2011) associate the growth of informal settlements with market and policy failures. These include; lack of funds by governments to provide basic infrastructure, imperfect land markets leading to exorbitant land prices in the urban areas, high building standards prescribed in the building laws and regulations that make housing expensive and therefore inaccessible to many urban poor households, as well as lack of access to formal housing finance such as mortgages by the poor. In addition, rapid urbanization and lack of investment in low-income housing by the government have also been cited as significant factors that tend to exacerbate the growth of informal settlements.

The sector plan for population, urbanization and housing 2013-2017 (Government of Kenya, 2013) states that sustainable development of urban areas in Kenya has been restrained by poor planning, rapid growth of human settlements, unmitigated urban sprawl and inadequate delivery of infrastructure services to match the growth of the urban areas. This means that the infrastructure services in place have been stretched beyond capacity and in return resulted in the rapid increase in size and number of informal settlements. The status of infrastructure services according to Gulyani (2008) is appalling. From his study on infrastructure services in the informal settlements in Nairobi, only a quarter of the residents have access to garbage collection services, connection to electricity, water and sewer services.

After independence and in response to a universal plea for cities with no slums (UN-Habitat, 2003) the Kenyan Government employed forced evictions, especially on makeshift residences on government land, to curb further growth of informal settlements. However, Horen (2000) notes that there has been a change in policies from eradication of slums through forced evictions, to adopting policies that call for upgrading of informal settlement. Consequently, in the adoption of the Millennium Development Goals and the acknowledgement of the reality of slums, the Government of Kenya committed to improve the living conditions of informal settlement dwellers and has undertaken various initiatives. According to Syrjänen (2008) the various initiatives implemented by the Government of Kenya to tackle the expansion of informal settlements include; sites and services schemes, relocation and resettlement of informal settlement residents as well as in-situ slum upgrading programmes.

The United Nations report, The Challenge of Slums (UN-Habitat, 2003), recognizes the importance of investment in infrastructure as a prerequisite for the inclusion of the informal settlement dwellers to the larger economy. Consequently, the Kenyan Government embarked on improving the living conditions in the informal settlements in liaison with development partners, private sector parties and non-government organizations, through the institution of the Kenya Slum Upgrading Programme (KENSUP) in 2003. The programme was funded by the Kenyan Government with technical support from the UN-Habitat. The main aim of the programme was to address the substandard conditions in the slums and improve the living situations of 5.3 million urban informal settlement inhabitants by the year 2020 with an emphasis on improved shelter, infrastructure upgrade and enhanced security of tenure (Syrjänen, 2008).

To complement the activities of KENSUP, Kenya Informal Settlements Improvement Project (KISIP) was started in the year 2011. The programme was initially expected to run for five years. This initiative was funded through a repayable grant from the World Bank, French Agency for Development (AFD) and Swedish International Development Cooperation Agency (SIDA), while the Kenyan Government contributed a percentage of the project cost through counterpart financing. The main goal of KISIP was to improve the quality of life for people who work and reside in informal settlements in fifteen (15) preselected urban centres in Kenya. This was to be achieved through interventions aimed at strengthening tenure security in informal settlement and improving basic infrastructure services (World Bank, 2011).

1.2 Problem Statement

According to the World Bank (2010) many people in the developing countries have limited access to basic infrastructure services. In this regard, approximately 2.5 billion people have no access to sanitary facilities, 884 million have limited access to portable and safe water for drinking, 1 billion have no access to proper roads and 1.6 million have no electricity connection.

Although infrastructure is not gender specific, the burden of poor infrastructure bears heavily on women and girls because of gender inequalities that limit their access to opportunities and assets as well as their responsibilities as care givers and in household chores such as cooking and cleaning (Agénor and Canuto, 2012). In addition, the responsibility to draw water and look for energy sources necessary in the home is quintessentially the role of women. Lack of transport facilities constrains women from carrying out their daily activities and necessitates them to work for long hours, as exemplified by the necessity to travel by foot for long distances while carrying heavy loads. They also suffer the most from indoor air pollution that emanates from smoke produced while cooking using solid fuel, putting their health at risk. Moreover, lack of sanitation facilities increases the risk to personal safety of women, especially when they have to use the toilets in the night (Strachan, 2013).

Infrastructure improvement is important for economic development of any nation. However, since men and women have disparate responsibilities, it affects their economic opportunities equally differently (World Bank, 2010). The infrastructure projects funded under the Kenya Informal Settlements Improvement Project (KISIP) stipulated in the investment menu include; roads, cycling lanes and footpaths, street and security lights, solid waste management, storm drains, water and sewer systems, stalls for small businesses, electrification, recreational places such as public parks and green spaces (World Bank, 2011). In order to attain long term project sustainability, gender sensitive infrastructure projects that respond to the requirements of women and men need to be implemented. Therefore, the appreciation of the relation between gender and infrastructure improvement is a prominent component of these interventions due to the perceived synergies with women empowerment (World Bank, 2010). The World Bank in the Project Appraisal Document (World Bank, 2011), consequently recognizes that informal settlements are a home to many female-headed households and affirms that special efforts need to be employed to foster gender equity and ensure that women, as well as men, benefit from the infrastructure improvement projects. Indeed, SDG number 5 (United Nations, 2016), aims at achieving gender equality and empowerment of all women. Under this goal, one objective is the proportion of time spent on paid and unpaid work. It is noted that women spend up to four times as many hours on unpaid work compared to men in the developing countries. Improvement of basic infrastructure is therefore one way of ensuring the attainment of this goal.

KISIP initiated the infrastructure improvement project of Swahili Informal Settlement, in Machakos County in 2011. This involved the construction of access roads and footpaths, installation of high mast floodlights (security lights) and storm water drainage systems. In addition, it involved the rehabilitation of existing sewer line, construction of communal toilets (ablution block), solid waste management facilities and installation of water reticulation pipeline, installation of water tanks as well as connections to individual households.

Turley et al. (2013) noted that there are in general limited studies on the impacts of physical infrastructure upgrading to socio-economic outcomes. In their study, they observed mixed impacts on the levels of income and employment on strategies employed in physical environment and infrastructure upgrading. For instance, they observed cases of reduced expenditure on water services per month but no change in income levels following the improvement projects. With regard to employment, they observed a rise in the number of hours worked following the upgrading but noted that unemployment levels were not affected. Elsewhere, Oduro et al. (2015) in their study observed that there is limited information on how residents adjust their livelihood strategies to physical transformations in the peri-urban areas. They found that some households were able to utilize the various opportunities caused by urbanization while others were negatively affected and lost their livelihoods. Parikh et al. (2014) in their study on the correlation between poverty alleviation and provision of

infrastructure, report that women are more likely to benefit from the provision of infrastructure services given that they encounter more adversities in the absence of infrastructure services.

Despite the concerted efforts undertaken by the Government of Kenya, in liaison with development partners as well as with non-governmental organizations, to improve the lives of the inhabitants of informal settlements, particularly ensuring that women benefit fully, it is unclear to what extent these endeavours have met their objective. Against this backdrop therefore, this study seeks to examine the influence of improvement of gender sensitive basic infrastructure on the livelihood strategies of a more vulnerable category of women, female-headed households, living in Swahili Informal Settlement in Machakos.

1.3 Research Objective

The main objective of this study is to examine the influence of improvement of gender sensitive basic infrastructure on the livelihood strategies of female-headed households in Swahili Informal Settlement.

1.4 Main research question

To what extent has improvement of gender sensitive basic infrastructure influenced the livelihood strategies of female-headed households of Swahili Informal Settlement in Machakos?

1.5 Sub questions

i. Which are the gender sensitive basic infrastructure improvements employed in Swahili Informal Settlement?
ii. What livelihood strategies had female-headed households of Swahili Informal Settlement adopted before the improvement of gender sensitive basic infrastructure?
iii. What changes have female-headed households made to their livelihood strategies since the improvement of gender sensitive basic infrastructure?

1.6 Significance of the study

This study sought to find out to what extent improvement of basic infrastructure that ensures adequate access to potable water, proper sanitation and drainage, solid waste management, access roads as well as security lighting influences the livelihoods of the inhabitants of informal settlements. There has, in addition, been a notable increase in interest by governments and development partners to ensure that women, as well as men, benefit from infrastructure improvement as governments foster the attainment of gender equity (World Bank, 2010).

This study also aims at contributing to the existing knowledge on the impact of infrastructure improvements to the livelihoods of the inhabitants of informal settlements with particular reference to female-headed households.

The study will further serve to enable policy makers gain a better understanding of the implications elicited by improvements of basic physical infrastructure on the lives of people living and working in informal settlements. This can be input in future projects with a view to the optimization of infrastructure projects aimed at anticipating and planning for future population growth in order to control the formation and sprawl of informal settlements.

1.7 Scope and Limitations

This study paid particular attention to the influence of gender sensitive basic infrastructure improvement on the livelihood strategies of the female-headed households of Swahili Informal Settlement in Machakos.

The study employed a quasi-experiment research strategy to help evaluate the livelihood strategies of the respondents in the context of access to gender sensitive basic infrastructure services. For this, data was collected from the respondents with regards to their livelihood activities before the intervention as well as their current livelihood activities after the intervention. Data pertaining to the situation before infrastructure improvement was limited to how much the respondents could recall limiting the reliability of the information collected. In addition, in order to attribute the changes to the infrastructure improvement, there was need for a counterfactual situation. Identifying a similar group to the experiment group was a challenge as the observable characteristics had to be similar.

Another limitation to this study, concerns the time allocated for the data collection. It was too short to document the preferred information pertinent to the livelihood activities of the respondents. Recording more accurate observations and monitoring the patterns pertaining to the livelihood activities of the respondents would have required a longer period to document in order to come up with a more comprehensive research.

Chapter 2: Literature Review / Theory

2.1 Introduction

This chapter reviews the theoretical underpinning of the study. To begin with, a review of slum upgrading and infrastructure provision is discussed. Next, the chapter looks at the livelihood approach and relates it to female-headed households. The link between improvement of gender sensitive basic infrastructure and services to the livelihoods of female-headed households is then analyzed. In conclusion, theory reviewed provides an understanding useful to develop a conceptual framework that depicts the concepts discussed.

2.2 Slum upgrading and Infrastructure Provision

Informal settlements are seen to provide a relatively affordable housing option to many of the urban poor who are not in a position to access formal housing (Pierce, 2017). Informal settlements have also been regarded as a transition phenomenon that enables the poor to acquire opportunities to increase their economic status that is often associated with cities and urbanization (Wekesa, Steyn, et al., 2011). There have been concerted efforts from various stakeholders such as governments, non-governmental organizations and multilateral development partners to stop the growth of informal settlements. These organisations hold a common vision to improve the living conditions of the inhabitants of informal settlements as is envisioned by the Millennium Development Goals, a predecessor of the Sustainable Development Goals (SDGs). Notably, SDG 11 is geared towards making human settlements safe, inclusive and resilient (United Nations, 2016).

Governments across the world recognize that inhabitants of informal settlements encounter countless barriers on their everyday life associated to inadequate basic infrastructure as they strive to attain a sustainable livelihood (UN-Habitat, 2003). Mehta and Dastur (2008) emphasize on the need to address the daunting conditions faced by millions of informal settlements dwellers and propose a two pronged approach; one, adaptive approaches that try to solve the existing conditions and, two, proactive strategies that attenuate the formation of new slums and prevent the growth of existing ones in the future. The adaptive upgrading strategies, they assert, are aimed at ameliorating the conditions in existing informal settlements. These mechanisms entail the improvement of the physical, economic and social services in the informal settlements, as well as strategies to prevent the formation and growth of informal settlements in the future through planning. They affirm that management of future expansion of cities through development strategies is imperative as a response for both opportunities and challenges that informal settlements signify. In addition, they posit that proactive strategies may be affordable and easier to implement compared to the adaptive approaches.

Exemplary interventions to improve informal settlements as identified by Wekesa, Steyn, et al. (2011) include; “reduction of building standards, use of traditional indigenous low-cost technologies and materials, adopting self-help modes of housing delivery, and addressing market imperfections” (Wekesa, Steyn, et al., 2011, p. 241).

Slum upgrading relates to improving housing and infrastructure services in the informal settlements. It may in addition involve enhancing economic and social activities that induce the physical improvements (UN-Habitat, 2014). Subsequently, there are various interventions that have been adopted over time to deal with the poor living conditions in the informal settlements. These approaches vary from benign disregard of the existence of informal settlements, forced evictions with or without resettlement, to enabling interventions that aim at improving the lives of people who reside and work in informal settlements. In this regard, notable emphasis has been on implementation of approaches that deal with the underlying

causes of poverty in urban areas in addition to addressing the physical constraints that include limited housing stocks and lack of basic infrastructure services (UN-Habitat, 2003). Some of the slum upgrading interventions that have been adopted include the following:

2.2.1 Public housing

Initial attempts to dampen the growth of informal settlements and improve the living conditions of their inhabitants were through government funded public housing. Beneficiaries were allocated public houses which in most instances were located at the fringes of the urban centers. This was solely because of lack of cheap suitable land near the city centers coupled with the availability of affordable land further away from the city centers. As a consequence, these locations were also far from people's sources of employment. The public houses provided did not also sufficiently meet the requirements of the beneficiaries in that there were mismatches between the family size and size of the housing unit. In addition, in an attempt to make housing affordable, very basic services were often communally shared including toilets, laundry facilities and kitchens (Wekesa, Steyn, et al., 2011).

2.2.2 Sites and services schemes

John Turner contended that informal settlement dwellers were in the best position to determine their needs. He therefore argued for freedom from top down government interventions to address the needs of the urban poor (Frediani, 2009), limiting the governments' role to the provision of basic services and putting in place the necessary environmental measures (Werlin, 1999). His work greatly influenced the World Banks' sites and services approach to informal settlements upgrading that had been embraced and promoted through 'aided self-help' strategies (Jones, 2012).

Sites and services schemes are regarded as an indirect state intervention intended to provide affordable houses and address the perennial housing shortages in the urban areas (Wekesa, Steyn, et al., 2011). The UN-Habitat (2014) adds that sites and services schemes involved the provision of a plot of land by the government that had access to basic infrastructure and may or may not have included a core house. The beneficiaries of these sites and services plots were expected to improve their housing units over time and at their own pace. Moreover, the program may have included extension of credit facilities to the recipients as support to extend the core house.

This attempt was however faulted as a solution to the challenge posed by informal settlements due to its slow implementation and failure to meet the high demand. The high project costs that translated to unaffordable prices to households from the informal settlement meant that the housing needs of the poor were not met as they often got screened out during the selection process and the projects later allocated to more affluent households. In addition, the strategy failed to empower beneficiaries as it did not incorporate the social and economic components in addition to their location at the periphery of the urban areas (Wekesa, Steyn, et al., 2011).

2.2.3 In-situ upgrading

In situ slum upgrading involves upgrading existing informal settlements through; land tenure regularization, installation and/ or improvement of dilapidated basic infrastructure such as roads, footpaths, installation of street and security lighting, providing adequate water, connection to sewer and solid waste disposal mechanisms, all to acceptable standards. In addition, credit facilities may be advanced to enable residents uplift their economic profiles and enhance the sustainability of their livelihoods (UN-Habitat, 2003).

Governments realized that upgrading was financially more affordable compared to previous approaches including forceful evictions and resettlement. This approach was further seen as

socially acceptable because it did not disrupt the lives of the informal settlement dwellers nor result to loss of sources of livelihoods (Skinner, French, et al., 2014).

2.2.4 Integrated slum upgrading programs

Integrated slum upgrading strategies are utilized in order to embed the informal settlements with the cities at large. They offer the informal settlements opportunities to be part of the larger urban fabric. This strategy should therefore be part of a city's master plans forming part of the wider urbanization dialogue (UN-Habitat, 2014). Further, integrated interventions strive to ensure attainment of tenure security, participation of the community through capacity building, alleviation of poverty, environmental sustainability and gender equity (UN-Habitat, 2003).

Over time, emphasis on improving the housing structure and enhancing security of tenure through issuance of titles have reduced, and strategies have become oriented mainly towards infrastructure improvement that enhance the sense of secure tenure to the inhabitants of informal settlements (Gulyani and Bassett, 2007). Along with this argument, Mehta and Dastur (2008) highlight the improvements to physical services at both individual and communal level to be used by the residents of the informal settlements, in addition to provision of services that connect the informal settlement to the city. These services include upgrading of roads and footpaths, installation of water supply systems, sanitation and waste collection services as well as street and security lighting.

Citywide slum upgrading advocates for various concurrent interventions at the level of the informal settlement aiming to improve the living conditions of the residents. This is carried out through investment in basic infrastructure, planning of the informal settlement, as well as development of economic and social activities. It uses the streets as the key entry points to slum upgrading. It involves the participation of an array of stakeholders including the residents of the informal settlement, government institutions, academia as well as development partners who provide funding (UN-Habitat, 2014). This intervention is therefore a more holistic approach and a move from the unsystematic partial and piecemeal measures that have characterized previous approaches (Skinner, French, et al., 2014).

Street networks are therefore not only considered as roads along which basic infrastructure services such as water, sewer lines, drainage systems as well as lighting are put down but are an essential informal settlement intervention that integrate the informal settlement to the whole city. They enable the interaction of economic, social as well as cultural activities at the city level (Skinner, French, et al., 2014). Further, emphasis is laid on cooperative involvement of the community based organization, residents, national governments and city authorities (UN-Habitat, 2014).

Skinner, French et al. (2014) enumerate the benefits of this approach to include provision of opportunities to scale up slum upgrading processes and allow for greater savings to the services rendered to inhabitants of the informal settlements due to greater economies of scale realized. It also allows for improvements to infrastructure and basic services to be part of the activities that are the responsibilities of the cities, and it is a comprehensive process that allows for the integration of the informal settlements to the city. The approach also responds to the needs of the informal settlements and prioritizes them according to their preferences and it allows for participation of various stakeholders who are capable of providing advice to widespread issues.

On the other hand, it is can be limited by lack of political will to comprehensively improve the informal settlements, limited financing, difficulties in establishing and maintaining institutional, organizational and regulatory environment with the required human and technical capacity to implement the programme (Skinner, French, et al., 2014). In addition, Iweka et al. (2015) acknowledge that evaluation of the intended outcomes from this intervention may be

complex due to the wide range of expected results. They note that it would be difficult to ascertain which component of the intervention is most efficient in achieving the desired outcomes due to the assumed nature of their complementarities.

Horen (2000) argues that comprehensive informal settlements upgrading should assimilate the physical services improvements to the economic and social components to enable the informal settlement dwellers improve their wellbeing. Similarly, Wekesa, Steyn, et al. (2011) affirm that informal settlements improvements have progressed from their primary emphasis on upgrading the physical aspects of slums to their combination with social and economic aspects. In addition, Frediani (2009) noted that informal settlements upgrading strategies adopted by the World Bank moved from strategies solely aimed at improving infrastructure to also resolve the complex dimensions of poverty.

Evidence indicates that informal settlements dwellers make considerable contributions to the economy. Therefore, resources expended in making the conditions in informal settlements better and hence improving the lives of the inhabitants would stimulate investments and increase the growth of the global economy (Mehta and Dastur, 2008). In agreement, Wekesa, Steyn, et al. (2011) emphasizes the need to support informal settlements as they are an essential component for the growth of cities.

This study focuses on the infrastructure improvements that are responsive to gendered roles with particular interest on women and especially those of female-headed households who are more vulnerable compared to women in a nuclear family. The following section discusses these unique aspects that are associated to women.

2.3 Women and basic infrastructure services

Women are disadvantaged in many societies, enjoying fewer rights and privileges, coupled with less power compared to men (Strachan, 2013). Their ability to empower themselves according to Grown, Gupta, et al. (2005) is further curtailed by their responsibilities in household maintenance activities. This burden is even greater where there is absence of infrastructure services. Asian Development Bank recognize that time allocated by women to undertake unpaid domestic chores also contributes to improved lives and therefore infrastructure services would contribute to reduce time poverty for women (Asian Development Bank, 2017).

The absence of basic infrastructure services negatively affects all the residents of informal settlements, both men and women, but has greater impact on women because of their principle gendered roles as caregivers and homemakers (Strachan, 2013). Consequently, emphasis has been placed on the need for basic services interventions that foster gender equality and women empowerment, in short, gender sensitive basic infrastructure services. In essence, gender sensitive infrastructure refers to the basic infrastructure services that are responsive to the responsibilities of women and go into reducing poverty. The essential basic services include; energy provision, transport services, potable water supply and sanitation facilities and they enable households to achieve their basic needs and respond to gender roles. These facilities are crucial in supporting the right to adequate health, safety and well-being and their absence has a greater impact on women than on men due to their gendered responsibilities of household maintenance (Strachan, 2013). In this regard, investment in gender sensitive basic infrastructure can relieve women's time spent on routine domestic chores (Grown, Gupta, et al., 2005). Further, Grown, Gupta, et al. (2005) acknowledge that underinvestment in energy, transportation systems, water and sanitation will continue to burden women in their everyday survival activities.

According to Strachan (2013) demand for energy remains largely unmet and a high proportion of the population of informal settlements households lack access to clean energy. They therefore depend on solid fuel for cooking. This leads to a high proportion of women being exposed to smoke pollution that may lead to an adverse effect on their health. In addition, she argues that inadequate energy provision has become increasingly prohibitive to their informal sector activities that are energy intensive especially those related to food processing. Moreover, lack of lighting may mean that women fear for their safety and can therefore not undertake productive activities after dark (Asian Development Bank, 2017).

The urban poor spend disproportionate amount of time and money due to poor road infrastructure and inadequate transport facilities. Although transport plays a major role in perpetuating women in the community, there have been few attempts to incorporate their perspectives. Consequently, this has a negative effect on women mobility and reduces their access to livelihood opportunities. As such, lack of transport facilities increases vulnerability of women to harassment, and hinders their personal safety. In addition, women, particularly due to the nature of their roles that necessitates them to take more stops, incur more transport costs curtailing their mobility (Strachan, 2013).

Access to water and sanitation facilities is essential for the survival of people. A majority of people in the developing countries still lack access to adequate water sources. Women bear the burden of hauling water, which consumes a great deal of their time that could have otherwise been used in other activities be it leisure, income generation, taking care of their children or improving their education and building their skills (Strachan, 2013).

Sanitation facilities in dismal state pose a great public health risk especially to women in relation to personal hygiene and waterborne diseases. This increases the burden of care on women reducing their time to take up productive livelihood opportunities. In addition, where sanitation facilities have been provided, they in most instances do not take into consideration the specific needs of women. For instance, if toilet facilities are constructed far away from peoples' houses and no lighting is provided, women will not use them in the night for fear of personal safety (Strachan, 2013).

As highlighted in the literature, the livelihood of inhabitants in informal settlements is a crucial component to peoples' lives that upgrading inherently tries to improve. Livelihood aspect is discussed in the next section.

2.4 Households Livelihoods

2.4.1 Introduction

The main challenge facing human settlements in developing countries is rapid urbanization caused by rural to urban areas migration of people pursuing employment opportunities to better their lives. Cities have however not been able to adequately provide basic services such as roads, water and sanitation facilities at a pace equal to the urbanization rate. This has led to the many people aggregating in urban areas causing 'urbanization of poverty' (UN-Habitat, 2003). Anna Tibaijuka as quoted in Jones (2012) asserts that a majority of urban dwellers reside in informal settlements and that policy makers have not done enough to avert the urbanization of poverty. It is claimed that without the concerted efforts from governments and development partners, informal settlements will keep on being the only options for the ever increasing poor urban population (Wekesa, Steyn, et al., 2011).

It is essential that the different levels of poverty in the informal settlements are distinguished. This is because the inhabitants are heterogeneous in nature and therefore have different needs. Women, children, unemployed youth as well as persons living with disabilities are seen to be the most vulnerable groups amongst the informal settlement dwellers. These categories of

people it is presumed, suffer the most in instances where there is inadequate transportation infrastructure coupled with poor basic service provision (UN-Habitat, 2003).

Various interventions have been implemented to not only improve the physical conditions in the informal settlements but also deal with the inherent causes of impoverishment in the informal settlements (UN-Habitat, 2003). However, despite the overwhelming justification for improving the living standards in the informal settlements, different approaches emanating from different interpretations of the concept of poverty have been advanced. These interventions have resulted in different poverty measurements leading to different implications on the livelihoods of the people to whom these interventions are intended to empower (Laderchi, Saith, et al., 2003).

Laderchi, Saith, et al. (2003) identified poverty dimensions that result in different interpretations and measurement criteria. They mention the fundamental issues that underlie the definition of poverty as; the space, universality of the application of the definition of poverty, use of poverty lines, whether poverty should be considered at the level of individuals or households and their regional locations, the multidimensional nature of poverty owing to heterogeneous nature of individuals and households as well as the determination of period of time that poverty has been experienced. They maintain that it is imperative to understand the nature of poverty in order to implement interventions necessary to mitigate its spread.

Insight into the dimensions of poverty is therefore key. Laderchi, Saith, et al. (2003) review different alternatives of appreciating and evaluating poverty. First, the monetary approach which associates poverty with the shortage of income as measured by the poverty line. They also analyze the capability approach as advance by Amartya Sen which rejects monetary measures as indicators for poverty and advocates for human capabilities. In addition, they examine the social exclusion approach which explores the processes through which individuals or groups experience instances of exclusion from participating in society. They however fault these three approaches for failing to incorporate the multidimensional aspects of poverty. Further, they argue that the approaches put emphasis on external factors that cause poverty. Finally, the participatory model, they posit, considers poverty from the perspective of the people and is therefore advocated for.

Further to the above, Rakodi (1999) observes that the analysis of poverty has broaden from the money-metric perspectives of analyzing income and expenditure to the examination of livelihood activities. In order to appreciate the processes of well-being and ill-being, and observe how households respond to opportunities and susceptibilities in any given context, the livelihood approach is utilized.

The definition of livelihood as per Chambers and Conway (1992) include "… capabilities, assets (stores, resources, claims and access) and activities required for a means of living…" (Chambers and Conway, 1992, p. 6). They further consider livelihoods to be sustainable if it "…can cope with and recover from stress and shocks, maintain or enhance its capabilities and assets, and provide sustainable livelihood opportunities for the next generation; and which contributes net benefits to other livelihoods at the local and global levels and in the short and long term" (Chambers and Conway, 1992, p. 6). Principally, the sustainability of households' livelihoods is premised on their access to assets that enable them to fulfil their basic needs as well as their ability to weather shocks and stresses (Olajide, 2013).

According to Rakodi (2002) the livelihood approach exceeds the income-expenditure perception of poverty and incorporates the multi-pronged nature of poverty. It enables one to assess the different trajectories of households' assets in the process of either impoverishment or improved well-being. It depicts how households respond to changes in context of the

external environment that may improve or hinder their livelihood opportunities. Further, she argues that poor households pursue multiple and diverse sources of livelihoods in order to achieve their livelihood ambitions. This concept as advanced by Rakodi is therefore the main focus for purposes of this study.

2.4.2 Livelihood Framework

Drawing on Carney 1998 as cited in Rakodi (2002) the livelihoods approach utilizes a conceptual framework which aids in comprehensively understanding the complexity of households livelihoods, enabling the analysis of complementarities and trade-offs between different livelihood alternatives. In analyzing the livelihoods of the inhabitants of informal settlements, the livelihoods framework will enable one to understand the relationship between the different components that affect households' welfare. These components range from the assets they possess, obstacles encountered while obtaining these assets to how and who controls the assets as well as the expected outcomes (Olajide, 2013).

2.4.2.1 Livelihood Assets

Central to the livelihoods framework is the pentagon of assets identified as physical, natural, human, financial and social assets. The assets that households possess represent items that enhance and supplement their incomes, that is, a stock of capital that is not entirely consumed in use. This stock of capital maybe accumulated, stored, exchanged or depleted and might be used to produce more income as well as garner other benefits. Households, especially those in the informal settlements, may not necessarily be endowed with monetary income but may have in their possession other non-monetary assets such as natural resources, relations including family, friends and acquaintances, their competencies and skills as well as be in good health and are capable to work (Rakodi, 2002). These assets are individually discussed hereunder.

Human capital embraces both qualitative and quantitative aspects of labour which are crucial to the attainment of both productive and reproductive roles (Rakodi, 1999). The use of human capital to take advantage of opportunities available to the households is largely influenced by number of working household members, their competencies as dictated by the level of education and skills, health conditions in addition to the maintenance demands of the household (Rakodi, 2002). Further, gender of the head of the household may influence the capacity to generate income depending on their level of education and skills and the opportunities available (Olajide, 2013). Moreover, the availability of household members to carry out income generating activities is determined by their life-cycle stage and access to household supplies such as water and energy sources (Rakodi, 1999).

Social capital includes obligations, rules, norms, networks of trust and reciprocities for mutual support that enable households to attain their individual as well as collective aspirations (Rakodi, 2002). According to Putnam cited in DeFilippis (2001) social capital comprises of norms, networks and ties of trust that people establish to enable them carry out communal actions for mutual benefits. Besides time, the ability to utilize social capital is dependent on space for interaction. This is because it is affected by the vulnerabilities individuals and households are susceptible to, such as shocks, incidences of crime and economic crisis. Social capital is therefore considered vulnerable in urban areas given the diverse nature of urban households (Rakodi, 1999). Social capital exists between households, their extended family relations, neighbours and acquaintances within the community (Moser, 1998).

Physical capital has been described as the produced capital which allows households to pursue livelihood opportunities. Basic infrastructure and production equipment are vital aspects of strategies to alleviate poverty for households. Similarly, improved access to infrastructure services which enables people to access revenue generating activities can be used to enhance

productivity of labour leading to escalation of incomes not only at the household level but also for the national economy (Rakodi, 1999). On the contrary, inadequate supply to water services is associated with a great deal of time particularly to women and children in search of water in addition to the poor quality and additional costs posed by the water vendors (Olajide, 2013). According to Moser (1998) housing is a major physical asset for urban households. She argues that it may not only be used as a place for shelter, but also as a productive space, that is, it can be used for home based enterprises or may be sublet to acquire more income.

Monetary incomes such as cash savings, remittances and retirement benefits constitute **financial capital** and enables households to make choices between various livelihood options (Rakodi, 1999). Financial capital is vital for households as it facilitates them not only to thrive but also smooth their consumption enabling them to weather insecurities. In addition, financial capital is necessary for the production of other assets through investments in more productive ventures as well as allows households to access credit (Rakodi, 2002).

Natural capital denotes land, water and other natural resources. This capital directly impacts on the rural livelihoods although urban households are indirectly dependent on it. This is because most of the supplies that city residents depend on, especially adequate supply of clean and adequate water, food provisions and source of energy emanate from the natural capital (Rakodi, 1999).

The combinations of assets that households have in their possession directly impacts their ability to improve their lives as well as allows them to recover when faced by adversities (Rakodi, 2002). As a consequence, the activities households undertake to achieve their livelihood goals are greatly influenced by their asset endowments and these are discussed in the next section.

2.4.2.2 Household livelihood Strategies

Households aspire to achieve a livelihood that is resilient to changes in the external environment such as shocks and stresses. A households' response to livelihood opportunities and productive activities though dependent on assets in their possession is not a predetermined strategy but a reaction to vulnerabilities faced as well as to take up opportunities presented. Strategies households engage in to optimize their livelihoods include; investment to earn more incomes as well as ensure a secure future, substituting one asset for another to compensate for a decline in another asset, disposing of assets to smooth consumption or to realize funds for more productive investments and sacrificing for example children's education to involve them in income generating activities (Rakodi, 1999).

Livelihood strategies are therefore the activities that households use to combine the assets they have in their possession as a means of acquiring their livelihood. The decision on how to make use of these assets depends on their capabilities to draw on the opportunities available to them. Households employ these activities targeting to weather from the vulnerabilities including shocks and stresses, maintain their capabilities and to safeguard a sustainable livelihood for future generations. As a result, many households do not depend on a single source of livelihood. Instead, they mobilize and combine assets and opportunities such as employment, savings, productive as well as reproductive enterprises in addition to calling on social networks to achieve their livelihood ambitions (Rakodi, 2002). Similarly, Farrington, Ramasut, et al. (2002) argue that diversifying sources of livelihood opportunities reduces a households' dependence on one source and therefore reduces its insecurities to shocks and stresses. As a consequence, livelihood strategies adopted by households result into a livelihood outcome. If the livelihood outcome is positive, it leads to increased well-being, improved incomes and reduced vulnerability (Rakodi, 2002).

Bebbington cited in Rakodi (2002) observes that assets can be used either as a way of seeking a living, a means to survive, or they can give significance to an individual's life, that is, they can be accumulated and used to build households' or individuals' livelihoods enabling them to thrive. Correspondingly, Farrington, Ramasut, et al. (2002) classify livelihood strategies into two. One, coping strategies which they assert are intended to address short-term shocks and two, adaptive strategies that are meant to improve the livelihoods circumstances in the future due to a long-term shock or to amass an asset base.

Households resort to numerous strategies in order to fulfil their livelihood outcomes. The strategies that inhabitants of informal settlements adopt depend on their immediate circumstances and will vary from time to time because they experience different trajectories of poverty and well-being (Rakodi 1999).

Moser (1998) found that in circumstances where households are faced by shocks declining their household income, they respond by increasing the number of household members in the labour force. She argues that in most instances, households increase the number of women in productive activities. The opportunities available to them depend on their education level and skills as well as their ability to balance domestic roles and employment. In addition, she notes that households increasingly rely on child labour to improve the household incomes. However, this she asserts, keeps children out of school sacrificing their future ability to earn better income and perpetuates the cycle of poverty.

Farrington, Ramasut, et al. (2002) mention that households may resort to household consolidation. This they argue enables households to change their household size, composition and even location as they weather livelihood insecurities. According to Rakodi (1999) this involves a number of strategies that range from sending children to live elsewhere with their relatives to accommodating elderly women so as to assist with caregiving to small children while the women in the household engage in employment or other economic activities. In agreement, Moser (1998) concludes that households may also accommodate children of working age as well as young single mothers so that they can avoid to head a household. In addition, households encourage migration with the prospective of finding better opportunities and thus an increase in remittances.

Housing has been identified as an important physical asset (Moser, 1998). In her study, Moser found that households use their houses as income generating assets by way of renting out some rooms. Others use some rooms as working spaces for households' home based enterprises. She further established that physical assets were used to accommodate households' adult children to reduce vulnerability, a processes she terms as 'nesting'.

According to Rakodi (1999) households may engage in strategies that reduce their levels of consumption including reducing the number of meals per day, expenses on school fees, clothing and luxurious items as well as defer medical treatment. Similarly, Moser (1998), reports that when households are faced by vulnerabilities, they resort to substituting private medical services for cheaper public health care services. In addition, she notes that households may tap into the public services illegally such as electricity connection to reduce their expenses.

As pertains to social capital, Moser (1998) emphasizes on the increased reliance of households on informal loan engagements. In the same way, Rakodi (1999) points out that households resort to borrowing from their social relations. Another strategy identified by Moser (1998) drawing on social capital is the mobilization of childcare and space through informal support networks enabling women to engage in more productive economic activities. In addition, she shows that the community may enlist households to participate in activities such as school repairs and in construction of public latrines.

Therefore, some households may be forced to adopt survival strategies that only help them to barely survive. Other households may be in a position to cope by diversifying their sources of livelihoods. This includes increasing the number of household members in productive activities, calling on their social capital through borrowing and reducing their expenditures by way of reduction in spending on luxury items, reducing the number of meals per day as well as sale of assets. Still, other households have the capability to achieve and increase their well-being. These households adopt strategies of economic diversification to reduce risks to their amassed incomes (Rakodi, 1999). Further to this, Berner et al. (2012) differentiate households as either growth oriented entrepreneurs or survivalists. Entrepreneurial households are viewed as those that invest their capital in full view of the risks they are faced with but whose main objective is to accumulate profits. The survivalist households on the other hand seek to spread their risks in multiple enterprises rather than expand one business venture. Survivalist households seek to smooth their consumption but not accumulate profits. They posit that most survivalist households are women attributing this to the nature of the activities that survivalist oriented households participate in. These ventures have a relative ease of entry as by nature, they require less capital, low level of technical skills and lower educational qualifications. These enterprises can also enable women to balance their reproductive and productive roles, since they can also be carried out at the comfort of their residences.

Ability of households to make choices and take advantage of opportunities available to them does not only depend on the assets held but is also influenced by delegation of different tasks between men and women and the lifecycle stage of the household members. This in turn influences the time that household members can devote to productive activities. In addition, the physical location of the household members also determines the availability of economic activities and opportunities that inhabitants of informal settlements would engage in. Furthermore, inadequate access to basic infrastructure services and poor environmental conditions often deprive households from accessing livelihood opportunities. A variation in the external environment necessitates households to alter their livelihood strategies in an effort of either to cope, survive or increase their well-being (Rakodi, 1999).

This study focuses on the livelihoods of inhabitants of the informal settlement through a gender lens. Studies indicate that women and men have different roles and responsibilities. Due to the gender role disaggregation between them, there continues to be disparities between women and men with unequal access to assets being constrained for women and particularly vulnerable are the female-headed households. This typical view is discussed in the next section.

2.5 Female-headed households

UN-Habitat (2004) defines a female-headed household as a household that is headed by a woman who has the principle responsibility and authority to the affairs of the household. Further, it is noted that in many countries, women are considered household heads only if they are leaving alone or in instances where they are living with no male adult in the household. For the purpose of this study, the general view of a single female-headed household as a household where the male adult is not present will apply.

Female-headed households have become an increasingly common phenomenon in the urban areas. It is noted that they constitute approximately thirty percent of the households in the informal settlements. Further, propositions upheld are that female-headed households tend to be poorer compared to male-headed households by virtue of their disposition to fewer income earning opportunities. This is majorly ascribed to the competition between their reproductive roles that restrict mobility for women and the productive roles that are inhibited by the low levels of education that necessitate women to work for longer hours (UN-Habitat, 2003).

Women are commonly paid less compared to men because they typically have lower education levels and technical skills. They are engaged in low paying informal work which can be precarious and insecure. In addition, they continue to undertake unpaid care work necessitating them to work for longer hours and in turn limits the quality of employment they can be involved in (UN-Habitat, 2014). Further, their mobility is regarded as more restrained compared to that of men because of their reproductive roles and care taking responsibilities to children and the elderly (UN-Habitat, 2003).

Culture and traditional norms vest the ownership of land to male members and essentially exclude women from secure land tenure since they can only access land through their male partners or their fathers. This restricts female-headed households from proportionate access to assets in the form of land and housing. This essentially makes single-women vulnerable especially when they are widowed, divorced or disowned. In addition, due to lack of economic power, women are not able to access credit facilities to secure their property rights further impoverishing them (UN-Habitat, 2014).

From the foregoing, it has been established that access to assets is critical to empowering women. McCleery et al. (2005) argue that infrastructure is important for poverty reduction by enabling people access to opportunities of income generation and productivity. He further recognizes that there is need to ensure that men and women receive equal opportunities and that productive and reproductive roles are addressed. The following section links infrastructure improvement to the livelihoods of households with particular reference to women as heads of households.

2.6 The effect of basic infrastructure improvement on livelihoods

Horen (2000) argues that holistic informal settlements improvement should incorporate economic and social development aspects to the physical improvements. UN-Habitat echoes these sentiments and adds that informal settlements upgrading should take into account livelihoods, health, education in addition to gender aspects (UN-Habitat, 2003).

The World Development Report on Infrastructure (1994) affirms that inhabitants of informal settlements who have inadequate access to basic infrastructure such as roads, water supply and sanitation services would benefit more directly from the installation of proper infrastructure. The benefits can be categorized as direct and indirect socio-economic benefits. These include employment opportunities related to the construction sector, growth in business enterprises and improved productivity at work. World Bank (2010), in addition notes that the benefits in resource distribution as well as economic opportunities are different for men and women essentially because they have different roles and responsibilities and therefore advocates for gender responsive infrastructure. Consequently, it is postulated that women would suffer more in the absence of infrastructure and are particularly likely to benefit more if the basic infrastructure services are provided (Bond, 1999), (Parikh, Fu, et al., 2015).

Proponents of infrastructure improvements argue that investing in infrastructure in informal settlements triggers a wide range of developments from all fronts. It is argued that improvement of infrastructure confers security of tenure to the inhabitants and in turn motivates the inhabitants in gradual physical development on the informal settlements (Gulyani and Bassett, 2007). Gulyani and Talukdar (2008) affirm these observations and note that a government's action in improving infrastructure in informal settlements enhances tenure security and inspires residents to invest.

World Bank (2012) links a thriving economy to infrastructure. It indicates that investment in infrastructure fuels economic growth and productivity and argues that a ten percent increase in infrastructure investments promotes a one percent growth in the overall economy. The world

development report on infrastructure (World Bank, 1994) underscores the importance of adequate infrastructure to spur economic growth. Increase in infrastructure services, it is noted, reduces the costs of production and subsequently increases productivity. In addition, physical infrastructure such as roads and electrification projects provides alternative opportunities for diversifying economic generating activities (Rakodi, 1999). Similarly, Priti et al. (2013) emphasize the importance of the provision of basic infrastructure services in the informal settlements as a leverage for investment by the community in order to improve their lives.

McCleery et al. (2005) observe that infrastructure improvement has the potential to subsequently increase incomes by reducing the vulnerabilities and income insecurities for households. In their study, they indicate that households had opportunities of employment in the construction and maintenance activities. This significantly reduced their periods of unemployment and potentially improved their incomes. In addition, they noted that residents were able to change from daily labour to investment in micro-enterprises. Further, increased mobility of women facilitated them to take up employment and allowed them to have time for socio-economic activities.

Mohun and Biswas (2016) found that women establish and run home based enterprises in the informal settlements whose returns are enhanced by access to water, energy, and sanitation. In addition, access to roads and footpaths increased demand for their products as well as reduced their input costs. Parikh et al. (2013) show that improving the living conditions in informal settlements through integrated household-level infrastructure for example ensuring steady supply of water, installation of storm water drainage and sewer systems, construction of roads in addition to solid waste management mechanisms results in notable improvement of incomes, education and skills levels and health conditions among the residents.

Improving water supply is a labour saving intervention that particularly assists female-headed households (Rakodi, 1999). Berner et al. (2012) claim that improvements to basic infrastructure reduces the time burden women have to shoulder in their absence to fetch water in addition to disposal of liquid and solid waste. It frees up time from domestic work that can be used for productive economic activities (Mohun and Biswas, 2016). Parikh et al. (2015) concurs that basic infrastructure improvement is imperative to the well-being of the residents in informal settlements and especially women who bear the responsibility of fetching water for domestic use as well as dispose of waste. They assert that time saved through improvement of infrastructure services can offer women an opportunity to engage in reproductive and productive activities in society. In agreement, Pierce (2015) notes that improved access to water increases productivity. Still, proper infrastructure ensures that households are not charged more for the water services by vendors who otherwise provide the service at a premium (Pierce, 2015).

Environment sustainability through reduction of environmental hazards can also be achieved through provision of clean water, proper sanitation and disposal of solid waste which trickles down to all income groups (World Bank, 1994). Good health is associated with access to clean water and proper sanitation services and enhances households' abilities to engage in activities that improve their well-being (Pierce, 2015), (Bond, 1999). Further, Crow and Mcpike (2009) document the associated health benefits of improved access to water and sanitation. They found that there were significant reductions in diarrheal disease as a result of women's access to improved water supply and sanitation facilities.

Enhanced security through provision of street and security lights is another impact associated with infrastructure improvement. Perceived and actual risks to gender-related violence limit women participation in economic activities. Pierce (2015) argues that improved lighting would be more beneficial to women who have no access to toilet facilities in their houses. This is

because women are exposed to the risks of physical abuse and harassment especially when they have to relieve themselves in the night. According to McCleery, et al. (2005) infrastructure improvements also provide a quick way to seek legal redress in the face of crime and can therefore improve security.

Improvements in transport according to Mohun and Biswas (2016) lead to improved mobility for women enhancing their social, training and economic opportunities that may translate to more incomes. In their study, McCleery et al. (2005) indicate that with improved roads, transport costs were lower. This contributed to a reduction in dropout rates from school especially for girls. Further, Agénor and Agénor (2009) found that transportation networks make it easier for women to access health care facilities thereby contributing to a reduction in maternal mortality rate.

Enhanced education and employment opportunities allow for integration of the urban community (Bond, 1999). In addition, McCleery et al. (2005) indicate that infrastructure improvement contributes to social capital. In their study, they observed a change in social bonding as members increasingly cared about each other's well-being, collectively mobilized resources for community initiatives and women went ahead to open a day care in one home so that they could leave their children while they worked.

On the other hand, improving gender sensitive basic infrastructure services in the informal settlements transforms them to desirable real estate promoting displacement of the residents of the informal settlements by better off individuals through gentrification (Gulyani and Bassett, 2007). Similarly, gender sensitive basic infrastructure improvement may lead to increases in rent levels in the informal settlement due to speculation (Huchzermeyer, 2008).

2.7 Conceptual Framework

According to Rakodi (2002) livelihoods assessment takes into consideration the different components that affect peoples' lives. These go beyond the money-metric measure of poverty and improved lives. The components as discussed in the literature include assets that people draw on and the livelihood strategies that they employ in order to attain their sustenance goals. Due to gender roles and responsibilities, women and especially female-headed households, are constrained in accessing these assets and in taking up opportunities. Literature shows that women's access to assets and responsibilities can be enhanced by improving basic infrastructure services. However, in order to attain gender equality as envisioned by goal five of the SDG, scholars suggest that infrastructure improvement be gender sensitive. This means that basic infrastructure services have to meet the needs of both women and men proportionately but in addition be responsive to the responsibilities of women leading to a reduction in their poverty. Proponents further argue that gender sensitive basic infrastructure improvement should therefore benefit women more than men. As highlighted in literature, women gain numerous benefits that include; better health, increased mobility, reduced incidences of personal threats and risks of insecurity and above all, they have more time released from undertaking unpaid work that includes domestic chores and care giving to children and the elderly. This translates to women being more productive, be in a position to engage in social activities in their neighbourhoods as well as undertake employment opportunities and other economic activities to improve their lives.

The primary focus of this study is to demonstrate how gender sensitive basic infrastructure improvement influences the livelihood strategies of female-headed households in Swahili Informal Settlement in Machakos. Drawing from the literature reviewed, the conceptual framework below (figure 1) depicts these relations.

Conceptual Framework

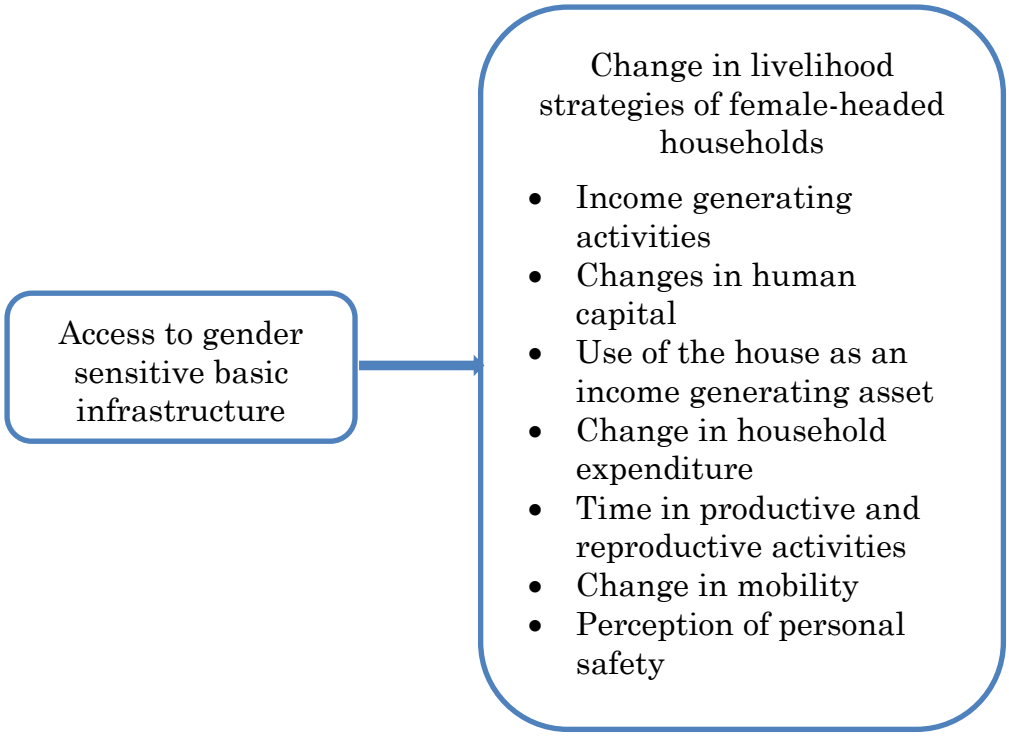

Figure 1: Conceptual Framework

Chapter 3: Research Design and Methods

3.1 Introduction

This chapter describes the improvement project, focuses on the research strategy that was adopted, methods and techniques used to adequately answer the research question. It defines the concepts used through operationalization of variables and indicators. It outlines the data collection method and sampling procedure employed to identify the respondents. It further highlights how the researcher ensured reliability and validity of the study. In the conclusion, data analysis methods are discussed and the experience from data collection outlined.

3.2 Description of the project

Kenya Informal Settlement Improvements Project (KISIP) whose main objective is to improve the livelihoods of households in informal settlements in Kenya (World Bank, 2011), initiated the improvement of basic infrastructure services in Swahili Informal Settlement in Machakos County from the year 2011. The infrastructure components improved were; access roads, footpaths and sidewalks, storm water drainage system, sanitation systems (sewer line), water, solid waste management facilities and security lighting.

3.3 Research objective

This study sought to examine how improvement of gender sensitive basic infrastructure influenced the livelihood strategies of female-headed households in Swahili Informal Settlement.

Through review of literature and existing theories, concepts to answer the research questions were discussed. To measure the identified concepts, variables and indicators were established and defined as indicated in the next section.

3.4 Operationalization of variables and indicators

The indicators and variables used in this study are defined and summarized in the table below.

Concept	Definition	Variable	Indicators
Change in livelihood strategies of female-headed households	Livelihood strategies are the activities that households use to combine the assets they have in their possession to generate a means of survival or to improve their well-being (Rakodi, 2002), (Tolossa, 2010).	Income generating activities	• Number of female-headed households engaged in formal/informal employment • Number of female-headed households who are unemployed • Number of female-headed households engaged in business enterprises ✓ Retail shops(Kiosk) ✓ Groceries stand ✓ Food kiosks ✓ Charcoal dealers ✓ Hairdressing/ barber shops ✓ Tailoring ✓ Washing and cleaning services ✓ Others – Casual labour etc
		Change in human capital (quality and	• Frequency of seeking medical attention – change in number of visits to the doctor

		quantity of human labour)	• Morbidity of household members(health Status) • Percentage change in incidences of illness in the household • Number of household members engaged in income generation activities
		Use of the house as an income generating asset	• Percentage of households Subletting rooms • Percentage of households with home based enterprises
		Change in household expenditure	• Households' expenditure utilized in the payment of; ✓ Rent ✓ Water ✓ Electricity ✓ Medical expenses ✓ Garbage disposal services
		Perception of personal safety	• Proportion of female-headed household who feel secure to go outside of their homes in the night • Proportion of female-headed households who feel secure to use toilet facilities at night
		Time utilized in productive work and reproductive activities	• Proportion of time female-headed households engage in productive activities per day (paid work) • Proportion of time female-headed households engage in reproductive activities per day (domestic chores including, fetching water, cooking, cleaning, care giving to children, elderly, sick, etc)
		Change in mobility	• Change in time spent to go to hospital, market, place of work • Change in transport cost to take children to school • Change in mode of transport to: take children to school; place of work; health facility; market
Access to gender sensitive basic infrastructure	Basic infrastructure improvement that is responsive to the responsibilities of women and	Access to potable water	• Percentage of households who mainly use the following sources of water; ✓ Individual piped connection to the house ✓ Shared piped connection to the compound ✓ Individual borehole ✓ Shared borehole

	go into reducing poverty and towards women's empowerment (Strachan, 2013)		✓ Water Kiosk ✓ Water vendors • Average cost of water per month from the main source of water
		Access to sanitation facilities	• Percentage of female-headed households with individual access to toilet facilities in the house/compound • Percentage of households using outdoor shared toilet facilities • Average time it takes to reach the toilet facility if not within the house
		Access to solid waste disposal systems	• Percentage of households with access to garbage disposal facilities • Distance from the house to garbage disposal facility
		Availability of security lighting	• Number of households who indicate there is an increase in time for productive activities – ability to extend their business activities into the night
		Access roads	• Average time to the place of work, nearest market/shops, health facilities

Table 1: Operationalization of variables and indicators

3.5 Research Strategy

Theil (2014) refers to research strategies as the logical procedure followed when undertaking a research. In addition, the choice of a research strategy, depends on the nature of the research questions, the number of research units and the number of study variables influenced by existing knowledge. Further, depending on the research strategy chosen, different techniques of collecting empirical data can be employed.

In this study, quasi-experiment strategy was employed. Quasi-experiment research strategy is useful when the research aims to test, explain or evaluate a problem. This strategy illustrates the effect that an independent variable has on the dependent variable, that is to mean the causal relationship between one independent variable and one or more dependent variables. Quasi-experiments involve a relatively large number of research units and a small number of variables. In this strategy, quantitative data collection method is usually applied (Thiel, 2014).

This study sought to describe the causal relation between gender sensitive infrastructure improvement (independent variable) and the livelihood strategies of female-headed households (dependent variable). In a quasi-experiment, the independent variable should be able to take different values so that the effect can be observed on the dependent variables. A change in the independent variable leads to a change in the dependent variable in isolation of the context, that is, the researcher should be able to control contextual factors (Thiel, 2014). In this case therefore, improvement in basic infrastructure should essentially cause a change in the livelihood strategies of female-headed households.

To measure the effect of the improvement of gender sensitive basic infrastructure on the livelihood strategies of female-headed households, the difference between the factual results with the intervention and the counterfactual outcomes for the same settlement without the intervention were considered. However, since it was not possible to observe the counterfactual results, outcomes from an appropriate comparison group without the interventions were used

(Hoang, 2009). This study therefore made a comparison between two informal settlements; Swahili Informal Settlement, where infrastructure improvements were implemented and Kathemboni Village, where no upgrading of basic infrastructure had taken place. Swahili Informal Settlement in this study was the experiment group, representing the factual situation. Kathemboni Village on the other hand, represented the control group, the counterfactual situation. A comparison of the factual and counterfactual situation helped to explain whether improvement of basic infrastructure indeed had an influence on the livelihood strategies of female-headed households of Swahili informal settlement thus eliminating the possibility of other causes.

For purposes of this study, a pre-test and post-test conditions were established. The pre-test condition represents the baseline data, year 2011. It represents the period before the intervention, making the two groups comparable on observable characteristics. The post-test condition represents the current situation, year 2017. A comparison of the information from the two groups across the two conditions (pre-test and post-test), helps determine the influence of the intervention on the dependent variable (livelihood strategies).

The limitations of adopting quasi-experiment research strategy is the attribution problem. As Thiel (2014) mentions, a researcher should be in a position to control all possible interferences in order to isolate the effect of the intervention. This is to mean that the changes in livelihood strategies of female-headed households in Swahili informal settlement may not be ascribed solely to the improvement of basic infrastructure, the economy may also play a part in this influence. Therefore, approaching a counterfactual situation as closely as possible was a challenge. To overcome this, an informal settlement with similar observable characteristics (Hoang, 2009), to Swahili Informal Settlement the factual situation, was selected for the study.

Swahili Informal settlement and Kathemboni village are located within Machakos County. Kathemboni village is approximately 2KM from Swahili Informal Settlement.

Figure 2: Map of Swahili Informal Settlement and Kathemboni Village

Source: Google maps

It is estimated that Machakos County has 249,235 households and approximately 32.9% of these are female-headed households (Government of Kenya, 2015). Other observable characteristics of the two groups are as outlined in the table below;

Observable characteristics	Swahili Informal Settlement (before improvement)	Kathemboni Village
Economic activities	Majority are self-employed in small-scale businesses	Majority are self-employed in small-scale businesses
Main source of water	Mainly Water Kiosks	Mainly Water Kiosks
Sanitation facilities	Ordinary Pit Latrine – majority used shared public latrines	Ordinary Pit Latrine/ polythene bags (flying toilets)
Electricity connection	Less than half of the households had individual connections	Less than half of the households have individual connections
Access roads	Earth/Un-paved and encroached	Earth/Un-paved
Dominant roof Material for the houses	Iron sheet/tin sheets	Tin sheets and grass thatch
Dominant wall material for the houses	Predominantly mud walls	Split between mud and tin walls

Table 2: Observable characteristics

Another challenge was related to recall data. Since no baseline data was available, the researcher relied on the information that the respondents gave. This was limited to what the respondents could remember with regards to their situations several years back related to their livelihood activities. To tackle this limitation, the research drew a larger sample from the counterfactual situation.

3.6 Sample size and selection

Thiel (2014) defines a sample as the selection of possible research units from the total population. In order to identify the respondents, the sampling procedure adopted for this study was in two stages. First, with the help of the Settlement Executive Committee (SEC) in the experiment group, female-headed households were identified. In the control group, the researcher relied on the help of the area chief and a village elder to identify female-headed households. Second, from the identified population of female-headed households, simple random sampling was used to select respondents for the study. Random sampling would enable the researcher to draw conclusions that generalize the results of the influence of infrastructure improvement to a larger population. Respondent were drawn from the two groups as it was important to compare the findings while controlling for contextual factors that may have had an influence on the livelihood strategies of female-headed households.

The researcher aimed have a sample size of 30 female-headed households from the experiment group. Additionally, a larger sample from the control group would enable the researcher tackle the selection bias. With this in mind, a sample size of 45 female-headed households was intended. To arrive at this numbers, the researcher over sampled. Therefore, 45 questionnaires were administered in the experiment group and 60 questionnaires in the control group. In the end, a total of 100 respondents were attained, 42 in the experiment group and 58 in the control group.

Purposive sampling targeting key informants was also used in order to gather more information from the treatment group. This targeted the SEC members and KISIP officials.

3.7 Data collection methods

The researcher intended to obtain information as appertains to the livelihood strategies of female-headed households in Swahili informal settlement. Data relating to before and after basic infrastructure improvements was collected in order to assess how improvement of basic infrastructure had influenced the changes in livelihood strategies. In order to sufficiently assess this influence, primary quantitative data was collected in Swahili Informal Settlement, experiment group, and Kathemboni Village, the control group. Data was collected through administration of questionnaires with the help of four research assistants. Respondents chose responses from the alternatives provided in the questionnaire, and where possible gave additional information. In addition, observation of the presence of improvements to basic infrastructure and the conditions thereof was recorded through photographic evidence.

In order to complement information gathered through the questionnaires, semi-structured interviews were conducted with four key informants, to get more information for the experiment group. For this purposes, semi structured interviews were conducted with two representatives of the SEC and two KISIP officials. Further, the researcher had informal conversations with the residents to get a grasp of their perceptions on the influence of improvement to basic infrastructure to their livelihoods activities.

Secondary data was also analysed in order to better understand the improvement project. This involved the exploration of project documents sourced from KISIP department, under the Ministry of Transport, Infrastructure, Housing and Urban Development.

3.8 Validity

Validity verifies whether the researcher has measured what they set out to measure and also determines whether the proposed relationship between the identified variables exists (Thiel, 2014). In order to ascertain the influence of basic infrastructure improvement on the livelihood strategies of female-headed households, a control group with similar observable characteristics was identified. In addition, triangulation of data sources including information from semi-structures interviews with key informant, assessment of secondary data mainly obtained from the project reports and observations were utilized.

3.9 Reliability

Reliability of a study according to Thiel (2014) is concerned about the accuracy and consistency of the variables measured. This means that the variables should be expressly stated and that the study can be repeated and same results be achieved. Therefore, to ensure reliability in this study, the questionnaire was pre-tested in both groups. This ensured that the questions were clear to the respondents. In addition, it enabled the researcher get a feel of how long it would take to administer each questionnaire. Data collected with regard to the situation before infrastructure improvement, in the case of the experiment group, as well as several years back, for the control group, were based on recall data which may also affect the reliability of the data collected. In order to deal with this challenge, the period between the two conditions were not too far apart especially for the control group. Moreover, any incomplete questionnaires were discarded and hence disregarded in the data analysis.

3.10 Data Analysis Methods

Quantitative data collected was analysed using statistical analysis tool, SPSS. The researcher first developed a code book from the questionnaire with all the variables and indicators

included in the study and their assigned values. Then, data was explored by carrying out statistical tests. These enabled the research arrive at descriptive statistics that helped explain the characteristics of the dataset. This further helped discuss the relations that exists between the variables. The next step was carrying out inferential statistics to explain if the relations described were consistent. Independent t-test was used to measure whether the pre-test and post-test observations were systematic by comparing their mean scores (Thiel, 2014). This indicated if the means were relatively equal or significantly different. This enabled the researcher investigate whether first the experiment group and the control group could be compared. Second, to determine if the differences observed between the experiment group and the control group were due to chance or purely random or that they could be attributed to the intervention. Linear regression was ultimately used to determine if there is a causal relationship between the independent and dependent variables. Excel was then used to present the results obtained from SPSS in form of frequency tables, bar-graphs and pie charts and hence draw the comparisons more clearly.

Qualitative data from semi-structured interviews were first transcribed. This information was then used to reinforce and give additional information to the findings of the quantitative data analysis.

3.11 Field Experience

The data collection coincided with the campaign period for the general elections in Kenya. It was anticipated that the respondents would be sceptical about volunteering information or mistake the data collection for a campaign tactic. In order to dispel these doubts, the researcher sought a research permit from the National Commission for Science, Technology and Innovation, Nairobi. This served as an assurance to the respondents and eliminated any political association. The area chief together with a village elder, introduced the researcher to the respondents in the study. This further help reduce the scepticism from the respondents and it essentially became easier to collect data.

However, the researcher encountered language barriers especially with the elderly as they could neither speak English nor Swahili. In these cases, the researcher relied on the help of an interpreter, a village elder or a SEC representative. In the end, this made the survey exercise take longer. Moreover, in some instances, responses were lost in translation despite the interpreters' prowess and were therefore discarded and not used in the final analysis.

3.12 Limitations of the study

This study is limited to female-headed households in the study area as it intended to make it more focused. It therefore excludes the influence that improvement of gender sensitive basic infrastructure service has on the livelihood strategies of women in a two parent household. The study sought to illuminate the impact of improvement of gender sensitive infrastructure services on the livelihood strategies of a more vulnerable category of women, specifically, the female-headed households. As such, this group may not have been in a position to take up the opportunities that presented themselves with the infrastructure improvement project. This is evidenced through the analysis of data collected that indicates that for most livelihood strategies studied, there was no significant difference between the pre and post-test conditions.

Another limitation associated with this study relates to the identification of the respondents. It is imperative that the sample obtained be random and as representative as possible in order to be able to generalize results to a larger population. With this in mind, the researcher relied on the assistance of the chief and a village elder, in the case of the control group, and a SEC representative, in the experiment group. However, the respondents were well known to either the village elder or the SEC representative and this may have contributed to a potentially biased

category of respondents. In addition, due to the presence of the village elder or the SEC representative during the surveys, respondents may have felt intimidated and therefore may have tended to romanticize the situation. Nevertheless, the findings of this study reflect the livelihood strategies of most of the female-headed households in the study area.

Consequently, in order to dispel the above limitation, it would have been prudent for a researcher to have ample time to monitor livelihood activities more closely and build trust relationship with the respondents before embarking on full throttle data collection.

Chapter 4: Research Findings

4.1 Introduction

This chapter of the report presents the research findings. The findings are based on the analysis of primary data collected through questionnaires from both the experiment group and the control group. Data from semi-structured interviews in the experiment group with KISIP officials and members of the SEC has also been used. Secondary data from various sources and documents related to the project have been incorporated to support the primary data. The analysis of the findings were carried out using statistical analysis tool, SPSS and excel where necessary per sub question. The information gathered is used to help understand how improvement to gender sensitive basic infrastructure has influenced the livelihood strategies of female-headed households of Swahili Informal Settlement.

4.2 General characteristics

The survey was conducted in July 2017 in two informal settlements that are in close proximity to each other in Machakos County. The households covered in the study consisted of 58 female-headed households in the control group (Kathemboni Village) and 42 female-headed households in the experiment group (Swahili Informal Settlement) that were randomly identified. The summary of the general characteristics for the two groups is presented in Table 1, Annex 4

4.2.1 Age profile of the respondents

The average age of the respondents in the experiment group was found to be 49 years with a majority (43%) in the 38 to 55 years age cohort. In the control group, average age of the respondents was 56 years with majority of the respondents (35%) in the 67 years and above age cohort (Annex 4, Table 1).

4.2.2 Period lived in the settlements

Table 1 (Annex 4) shows that on average, majority of the respondents had resided in the settlements for more than sixteen years, that is, 86% of the respondents in the experiment group and 88% of the respondents in the control group.

4.2.3 Education profile of the respondents

In the experiment group, approximately 14% of the respondents had no formal education and barely 5% have obtained a university/college certificate. A majority, 52% had completed primary education and close to 29% had attained secondary school education (Annex 4, Table 1).

In the control group, 24% of the respondents had no formal education, only 3% had obtained university/college education. Further, half (50%), of the respondents had primary education and about 22% had attained secondary school education (Annex 4, Table 1).

4.2.4 Comparison between experiment group and control group

In order to assess whether the experiment and the control groups are comparable and have similar characteristics, a t-test was computed.

The t-test results 0.918, 0.270 and 0.060 (Annex 4, Table 2) indicate that there is no significant difference between the experiment and control groups in terms of number of years lived in the settlement, highest level of education attained and age of respondents respectively as the p value is greater than 0.05. As such, the experiment group and control group are indeed comparable.

4.3 Project overview

The Kenya Informal Settlements Improvement Project (KISIP) is a government of Kenya initiative under the Kenya Slum Upgrading Programme (KENSUP). This initiative is a collaboration between the World Bank, French Agency for development, Swedish International Development Cooperation Agency and the Government of Kenya. It aims at improving the living conditions of people who live and work in informal settlements in fifteen (15) preselected urban areas in Kenya. It was initially a five year project and it anticipated to benefit more than 700,000 people residing in informal settlements. The project objective indicators include (World Bank, 2011, p. 10);

- ✓ Number of direct project beneficiaries, and what proportion is female
- ✓ Number of people living in the informal settlement who have access to improved drainage under the project
- ✓ Number of people in the informal settlement provided with access to all reason roads within a five hundred (500) meter radius
- ✓ Number of people in the informal settlement provided with access to potable water sources

The initiative was anchored on a consultative process with the residents of the informal settlements to develop the infrastructure plans. To fulfil this, the project was managed by a project coordination team that comprised of officials from the then Ministry of Housing. These officials were to work closely with the communities who are represented by a Settlement Executive Committee (SEC). The members of the SEC are wholly elected by the residents of the informal settlement. This is the first step that is undertaken following introduction of the redevelopment projects to the communities. The officials of KISIP therefore only provide the roles of the SEC and the guidelines for persons who are eligible to the community. These are; persons elected must be able to read and write and that the in committee, either gender must be equally represented. Irrespective of the informal settlement, the SEC comprises of eighteen members and emphasis is given to gender representation. The categories forming the Settlement Executive Committee are; landlords, representing structure owners; tenants, representing persons renting or leasing property; youth; persons with disabilities, widows and widowers and Non-Governmental Organizations (NGOs). For each of these categories, a man and a woman must be elected. In addition, local leadership is represented in the committee. These include; area chief, member of the county assembly and ward administrators. Further, the leadership of the SEC must also be gender representative, meaning that if the chair is male, he must be deputised by a female and vis versa.

Investment menu

The infrastructure components that fall under the scope of KISIP projects include "…roads, bicycle paths, pedestrian walk ways, street and security lighting, vending platforms, solid waste management, storm water drainage, water and sanitation systems, electrification, public parks and green spaces" (World Bank, 2011, p. 39). From the interview with officials of KISIP, it was noted that funds allocated for the programme were not sufficient to cover all the infrastructure needs of the identified informal settlements. Therefore, there was need for prioritization of the infrastructure components to be improved. Consequently, the community in Swahili Informal Settlement prioritized the infrastructure components to be improved. The basic infrastructure components that were improved that are gender sensitive as classified in literature reviewed included;

a) Two (2) kilometres of access roads upgraded (to bitumen standards)
b) 0.14 kilometres of footpaths constructed within the settlement
c) Construction of two (2) thirty meter high mast flood lighting

d) One (1) ablution block constructed
e) 8.7 kilometres of water pipeline together with rehabilitation of a borehole with a capacity of 10.3 cubic meters per hour and water tank.
f) 90 individual water connections
g) 6.1 kilometres the existing sewer was rehabilitated and connected to main sewer
h) Approximately half a kilometre of storm water drains constructed

These infrastructure services are further analyzed in the following subsequent sections.

4.4 Which are the gender sensitive basic infrastructure improvements employed in Swahili Informal Settlement?

4.4.1 Access to potable water

The objective of the infrastructure improvement project with regards to access to clean water was to provide improved water supply to the residents. This was the through construction of a water reticulation pipeline, rehabilitation of a borehole which was intended to supplement water supply from Machakos Water and Sewerage Company, as well as connecting individual households to water supply. Firstly, water sources in the pre-test condition for both the experiment group and control group were identified. A comparison between the two groups was then done to find out if they were similar. In addition, the current situation (post-test) was also compared between the two groups to establish if any differences had occurred. Table 3 below gives a summary of the water sources in 2011.

	Experiment group		**Control group**	
Source	**Frequency**	**Percentage**	**Frequency**	**Percentage**
Individual piped connection	1	2.4	-	-
Water kiosk	22	52.4	16	27.6
Individual borehole	-	-	-	-
Shared pipe connection	5	11.9	6	10.3
Water vendor	10	23.8	6	10.3
Shared borehole	3	7.1	18	31
Other	-	-	11	19
Missing	1	2.4	1	1.7
Total	**42**	**100**	**58**	**100**

Table 3: Main source of water before 2011

From the table 3 above, majority of the respondents from the experiment group (52%) drew their water from water kiosks[1]. The second most popular source of water in this group was water vendors (24%), followed by shared boreholes (7%). Only one respondent indicated they had an individual connection. In the control group, it is noted that majority (31%) of the respondents fetched water from a shared borehole, followed by water kiosks with 28%, then other sources (19%) which included fetching water from the river. Shared pipe connections and water vendors had equal representation of around 10% of the respondents. This information is then compared to the current situation presented in table 4 below.

[1] Water kiosks are an initiative of Machakos Water and Sewerage Company. The standard fee across the two groups for a 20 litre jerrycan of water is KSH 2

	Experiment group		Control group	
Source	**Frequency**	**Percentage**	**Frequency**	**Percentage**
Individual piped connection	6	14.3	-	-
Water kiosk	11	26.2	42	72.4
Individual borehole	-	-	-	-
Shared pipe connection	18	42.9	1	1.7
Water vendor	4	9.5	8	13.8
Shared borehole	2	4.8	7	12.1
Other	1	2.4	-	-
Total	**42**	**100**	**58**	**100**

Table 4: Main source of water in 2017

Scholars have argued that inhabitants in informal settlements are poorly served with basic infrastructure services and especially when it comes to water supply. Table 4 above presents the sources of water in the post-test condition. Results indicate that in the experiment group, there is an increase in the proportion of respondents with individual connection from about 2% in 2011 to only 14% in 2017 despite the improvement project. These connections are metred and charged by Machakos Water and Sewerage Company using the number of units consumed. However, majority of the respondents, 43%, draw water from a shared pipe connection and around 26% rely on water kiosks. The other source of water stated by respondents in the experiment group was buying water from neighbours who had an individual water connection. Therefore, we can conclude that access to potable water is still remarkably low.

In the control group, the prevalent source of water is water kiosks. Approximately 72% of the respondents rely on this source of water from which they buy using "jerrycans" of 20 litres that costs them KSH 2 per jerrycan. This price may go up to about KSH 15 per jerrycan depending on whether the household has hired help to deliver the water from the water kiosk to their houses. Thus the cost of water becomes high. Despite this observation, in this group, there was recorded drastic rise in the proportion of respondents who draw water from the water kiosks when you compare pre and post-test conditions. Moreover, approximately 26% of the respondents in this group rely on water vendors and shared boreholes.

An independent t-test was further computed to determine if the two groups were comparable with regard to the main source of water in the pre-test condition. The result p =0.000 (Annex 4, Table 3) indicates a significant difference between the two groups. This means that the two groups were different and were therefore not comparable. This result is consistent with the evident differences in the water sources between the two groups as discussed under tables 3 and 4 above. We see that the respondents in the experiment group were 'better off' if compared to the control group given that more respondents had access to water kiosks which were considered as a 'better' option second to pipe connections.

The current situation shows that water sources have changed in the two groups. To evaluate if there was a difference in the post-test condition between the two groups, a t-test was carried out. The result, p = 0.232 (Annex 4, Table 3) shows there is no significant difference between the two groups. In this case, it can therefore be concluded that it is remains difficult to attribute the change in the water sources in the experiment group solely to KISIP infrastructure improvement project. However, as discussed in sections below, accessibility and reliability of water supply in the control group is still in dire condition. As mentioned earlier, both groups remain underserved when it comes to potable water supply.

Regarding the perception of respondents on access to water in the post-test condition compared to the pre-test period, respondents were given choices from strongly agree to not applicable with regards to; whether they could afford to pay for water connections, monthly bills, their ease of access to water sources, consistency of water supply and their ability to store water. First, to determine whether the indicators measuring their opinion on improved access to water can be combined, Cronbach's alpha was computed. The result p=0.748 (Annex 4, Table 4) indicates that the data was reliable and that the indicators could be combined. Table 5 below presents the summary of the responses with regards to the respondents overall opinion on access to improved water supply.

	Experiment group		**Control group**	
Source	**Frequency**	**Percentage**	**Frequency**	**Percentage**
Strongly agree	3	7.1	8	13.8
Agree	34	81	36	62.1
Neutral	3	7.1	4	6.9
Disagree	2	4.8	8	13.8
Strongly disagree			1	1.7
Don't know				
Not applicable			1	1.7
Total	**42**	**100**	**58**	**100**

Table 5: Opinion on improved access to water

The results from table 5 above indicate that nearly 89% of the respondents in the experiment group indicated from strongly agree to agree that water was easily accessible in the post-test condition compared to before the commencement of infrastructure improvement project. Similarly, 76% in the control group also indicated from strongly agree to agree that water is more accessible now compared to the pre-test condition. These results reveal that there has been an improvement with regards to access to water in the two groups. However, there exists a difference in the proportion of respondents with improved access to water in favour of the experiment group. This can be attributed to a more reliable supply of water brought about by the rehabilitation of a borehole and construction of a water tank (seen in photograph 1 below) that is used to supplement the public water supply in the experiment group.

Photograph 1: Water tank in the experiment group

Further, these results are corroborated by statements from the respondents of the two groups who indicated that in general, access to water had improved. However, respondents in the control group noted that water supplied from the water kiosks by Machakos Water and Sewerage Company was not reliable as it was only available at best for a few hours in the

morning. They therefore still have to wake up and queue for water from as early as 6am and oftentimes, water gets diminished before all the households get a chance to fetch. As noted by one respondent: *"…like today, I woke up and queued from 9am. When it reached my turn, water got finished, and that was only 11am"*.

Photograph 2 and 3 below illustrate and reinforce the statement from the respondent on the situation of water in the control group.

Photograph 2: Residents queuing for water

Photograph 3: Deserted water kiosk when there is no water

4.4.2 Access to sanitation facilities

Sanitation was improved by rehabilitating the existing sewer line and connecting it to the main sewer line and construction of an ablution block. This was aimed at according proper sanitation facilities to the inhabitants of Swahili Informal Settlement. Data on the type of sanitation facility in the two groups was collected and compared across the pre and post-test conditions to find out if there were any differences. Table 6 below summarises the type of facility used before 2011.

	Experiment group		Control group	
Type of toilet facility	**Frequency**	**Percentage**	**Frequency**	**Percentage**
Own WC/Flush toilet	10	23.8	1	1.7
Individual pit latrine	2	4.8	17	29.3
Shared pit latrine	25	59.5	34	58.6
No facility (Flying toilets)			5	8.6
Other	4	9.5		
Missing	1	2.4	1	1.7
Total	**42**	**100**	**58**	**100**

Table 6: Type of sanitation facility used in 2011

Results in Table 6 above indicate that respondents had no adequate sanitation facilities resulting to use of shared pit latrines in the pre-test condition. This was reported by nearly 60% of the respondents in the experiment group and close to 59% in the control group. Approximately 24% of the respondents in the experiment group said that they used own flush toilets while in the control group, 29% indicated that they used individual pit latrines. Other facilities used by the respondents in the experiment group included institutional facilities such as those of the mosque while other residents who are worse off had no facilities of their own and resulted to the use of their neighbours' facilities.

A t-test was computed to assess whether the two groups were comparable before the infrastructure improvement project. The result p=0.632 (Annex 4, table 5) indicate no significant difference between the experiment group and the control group. The two groups were therefore comparable on this indicator in the pre-test condition and therefore generally similar in terms of the type of sanitation facility used.

Further, data on the type of facility used in the post-test condition was collected and is presented in table 7 below.

	Experiment group		**Control group**	
Type of toilet facility	**Frequency**	**Percentage**	**Frequency**	**Percentage**
Own WC/Flush toilet	13	31	1	1.7
Individual pit latrine	2	4.8	25	43.1
Shared pit latrine	21	50	32	55.2
No facility (Flying toilets)				
Other	6	14.3		
Missing				
Total	**42**	**100**	**58**	**100**

Table 7: Type of sanitation facility used in 2017

Table 7 above shows that in the experiment group, there was an increase in the proportion of respondents with own flush toilet from 24% to 31%. In addition, there was a decline in percentage of respondents using shared pit latrines from roughly 60% to 50%. As a result of the rehabilitation of the sewer line, we find that approximately 14% of the respondents indicated that they have access to shared flush toilets. In the control group, respondents using individual pit latrines rose from 29% to 43%. The majority (55%) of the respondents still rely on shared pit latrines which continue to be used by a considerably large number of people. In one instance, it was reported that up to twenty (20) people use one pit latrine. In addition, shared pit latrines are poorly constructed and are not well maintained as seen in photograph 4 below. This not only contributes to health concerns of the respondents but mainly respondents reported security issues that contribute to their discomfort and failure to use these facilities at night.

Photograph 4: Shared pit latrines in the control group

To determine if the two groups are comparable in the post-test condition, a t-test was done. The result p=0.697 (Annex 4, Table 5) indicate that there is no significant difference between the experiment group and the control group. This therefore means that the increase in access to own flush toilet and a reduction in proportion of respondents using shared pit latrines in the experiment cannot entirely be associated with the improvement project. In other words, it cannot be conclusively deduced that the improvement project was the only cause for the noted differences.

Moreover, the study sought to understand the perception of the respondents towards access to sanitation facilities in the post-test condition compared to the pre-test situation. Respondents were asked about their use of toilet facilities at night as well as during the day; time it takes them from their houses to the facilities as well as on the queue to use these facilities. First, the indicators were recorded to run in the same direction. After this step and similar to the analysis of access to water, Cronbach's alpha was then computed to see if the variables could be combined. The result p=0.676 (Annex 4, Table 6) indicates that the indicators were reliable and they could therefore be combined. Table 7 (Annex 4) presents the statistics for the combined indicator for access to improved sanitation facilities. The results show that in the experiment group, close to 88% of the respondents reported from strongly agree to agree to improved access to sanitation facilities. Additionally, 76% in the control group indicated from strongly agree to agree to improved access to sanitation facilities. Generally, respondents in the experiment group cited that with the rehabilitation of the sewer line, they have had access to cleaner sanitation facilities for their use.

4.4.3 Access to solid waste disposal system

An integrated solid waste management system was constructed in the experiment group. In this, a bio-digester system was incorporated with the aim of managing biodegradable waste from the settlement and especially that from the farmers market adjacent to the settlement. In this regard, decomposable solid waste would be collected from the adjacent market and from within the settlement then be used to produce biogas for use by the residents of the experiment group. One KISIP official noted:

"…this one now, the impact is that it makes the settlements clean and healthy. Environment is sustainable. And also, because we have done a big solid waste bio-digester, it will offer some employment, because it is what we called integrated solid waste management. Where we have on one side the bio-digester, then the product that comes from burning the wastes…"

Data was collected to ascertain where the respondents disposed of waste from their households. This information was compared for the two groups across pre and post-test conditions. Table 8 below summaries the methods of waste disposal in the pre-test condition for the two groups.

	Experiment group		Control group	
Method of waste disposal	**Frequency**	**Percentage**	**Frequency**	**Percentage**
County collection services	31	73.8	2	3.4
Dump anywhere in the settlement	8	19	17	29.3
Own compound (Compost pit/burn)	1	2.4	36	62.1
Organized private collection	1	2.4	1	1.7
Other			2	3.4
Missing	1	2.4		
Total	**42**	**100**	**58**	**100**

Table 8: Method of garbage disposal in 2011

Data from table 8 above shows that 74% of the respondents from the experiment group relied on county collection services as the predominant method of waste disposal. This was followed by 19% of respondents who indicated that they dumped waste anywhere in the settlement. Only 2% of the respondents said they disposed of waste in their compounds. In the control group, 62% of the respondents disposed of waste in their compounds which included burning and digging compost pits. Another 29% of the respondents indicated that they dumped waste anywhere in the compound and only 3% said they relied on county collection services. This data was compared to the current situation (table 9 below).

	Experiment group		Control group	
Method of waste disposal	**Frequency**	**Percentage**	**Frequency**	**Percentage**
County collection services	31	73.8	4	6.9
Dump anywhere in the settlement	8	19	14	24.1
Own compound (Compost pit/burn)	1	2.4	37	63.8
Organized private collection	2	2.4	1	1.7
Other			2	3.4
Total	**42**	**100**	**58**	**100**

Table 9: Method of garbage disposal in 2017

Table 9 above shows that there was no change in the solid waste disposal methods in the experiment group meaning there is no difference in the pre and post-test conditions. Similarly, only a slight change was recorded in the control group in which there is a reduction in the proportion of respondents dumping waste anywhere in the settlement by about 5%. This indicates that there is hardly a proper way for waste disposal in the study area.

An independent t-test was conducted to find out if the differences recorded between the two groups were significant. In the pre-test condition, the result, $p = 0.000$ (Annex 4, Table 8) shows there was a significant difference between the two groups with regards to the method of waste disposal. This means that the experiment and control groups were not comparable on this indicator.

Likewise, in the post-test condition, t test result, $p=0.000$ (Annex 4, table 8) shows there is a significant difference between the experiment group and the control group as regards to how the residents dispose of their waste. This can be seen from tables 8 and 9 above that depicts differences in the methods of waste disposal in the two groups; respondents from the experiment group rely mainly on county collection services whereas respondents in the control group reported that they dispose of waste in their own compounds. However, dumping in the

neighbour in both groups was prevalent. Findings indicate that there is not a huge difference between the proportions of respondents who indicated that they dumped waste anywhere in the settlement between the two groups. Respondents also noted the lack of a proper dumping site and delays by county collection services as contributing to their woes in waste disposal. As noted in the interview with one KISIP official:

"… they have no waste dumping site… maybe a receptacle, where they collect all the dirt… the county had no allocation for land for waste management…".

Photographs 5 and 6 below clearly illustrate the insufficiency of waste disposal facilities in the settlements in this study. The continued dumping in the neighbourhood has seen to the growth of garbage heaps strewn all over, which are not only an eyesore but also pose health hazards to the residents.

Photograph 5: Garbage heap in the experiment group

Photograph 6: Garbage heap in the control group

In support of the statistical results in table 9 above, respondents in the experiment group reiterated that despite the successful construction of an integrated solid waste management system, there had been no improvement in waste disposal methods. This was tested by asking the respondents their perception with regards to frequency of waste collection services, cost of waste disposal and time it takes to dispose waste in designated places in the post-test condition compared to the pre-test situation. Approximately 33% of the respondents indicated that these changes were not applicable and over half (52%), stated from disagree to strongly disagree on improvement to solid waste disposal systems (Annex 4, table 9).

These results are further backed by the realisation that at the time of data collection for this study, the integrated solid waste management system was not operational. The importance of

sustainability of the system being key was emphasized and thus its operation by the community itself important as noted in the interview with one KISIP official:

"…the community will run the bio-digester. Money collected will go to the community's prioritized projects. …the community, selected… one Community Based Organization, which is well known to them, to run the bio-digester. In an open process, they balloted, they elected democratically…"

This information was corroborated during an interview with one SEC representative who said:

"…the community started a group, a CBO, whereby they could run that bio-gas digester so that it can generate some income to help the community…"

However, there exists technicalities with the Community Based Organisation and this has resulted in the delayed operation of the integrated solid waste management system. Effectively therefore, the two groups are similar in that there is currently no conventional way to dispose of household waste.

4.4.4 Availability of security lighting

Two high mast floods lights were installed within the experiment group to enhance security. Data was collected pertaining to availability or lack thereof, of security lighting in the two groups and compared in the pre and post-test conditions (Figure 3).

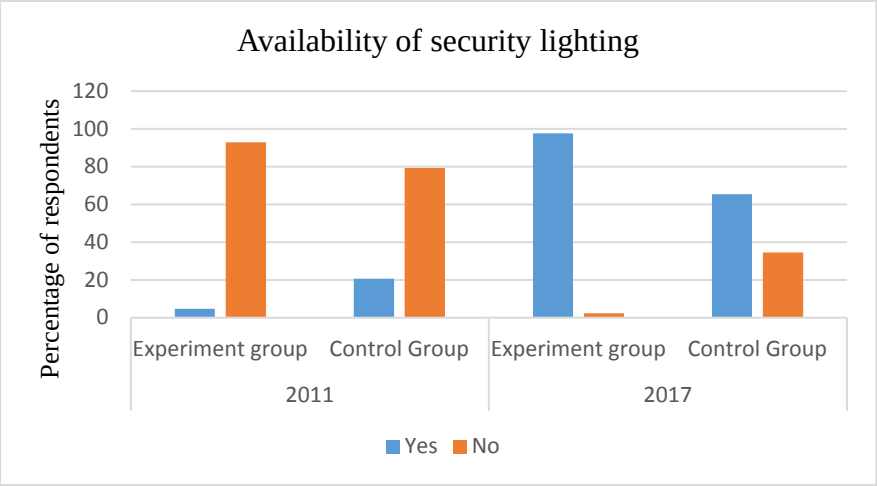

Figure 3: Availability of security lighting

From the figure 3 above, almost 5% of respondents in experiment group and about 21% of the respondents in control group indicated that there were security lights in the pre-test condition. The situation in post-test situation has however greatly changed, and we find that there is elaborate security lighting infrastructure. 98% of the respondents in the experiment group and about 66% of the respondents in the control group reported that security lighting was availability. These results therefore indicate a great improvement in the availability of security lighting in both groups. What should be noted however is that respondents in the control group reported that security lighting had been installed in the settlement by the county government in the recent past, approximately a month prior to this survey.

An independent t-test was computed to establish whether the two groups were comparable on this indicator. The result p= 0.015 and p=0.000 (Annex 4, Table 10) in 2011(pre-test) and 2017(post-test) respectively show a significant difference in the availability of security lighting in the two groups across the pre and post-test conditions. From figure five 5 above, in the pre-test condition, the control group had a higher proportion of respondents indicating access to security lighting compared to the proportion of respondents in the experiment group. Contrary

to this, in the post-test condition, the experiment group has a higher representation of respondents who say that there is security lighting. Since the difference is significant, the increment in the proportion of respondents who reported increase in availability of security lighting in the experiment group can be safely attributed to the improvement project.

Another aspect that was explored was how often the security lights worked (Annex 4, Table 11). This involved further disaggregation of data from the respondents in the experiment group who indicated that security lighting was available in the pre-test condition. Half of the respondents indicated that security lights almost always worked while the other half noted that it worked only on occasions. Although the control group when compared to the experiment group had a more extensive security lighting network, it was not maintained. Hence, results show that 25% of the respondents indicated that security lights worked most of the time, 33% indicated they worked sometimes and the majority, approximately 42%, said that the security lights rarely worked.

In the post-test situation, 76% of the respondents in the experiment group indicated that the security lights worked most of the time and 24% reported that the lights worked on seldom occasions. During the survey, the respondents stated that one of the high mast flood light, seen in photograph 7 below, had not worked for nearly three months prior to the survey. During the interview, it was explained that KISIP, the implementers of the project, had handed over the management of the infrastructure services to the County Government of Machakos who are then responsible for its repair and maintenance.

Photograph 7: High mast flood light in the experiment group

4.4.5 Access roads

The investment menu of the experiment group included paving of access roads, construction of footpaths and construction of a storm water drainage system alongside the road network. This was aimed at easing accessibility in the settlement, allowing for ease of access by emergency rescue vehicles including firefighters and ambulances. It also aimed at opening up the settlement and linking it to the larger Machakos County. In addition, by the incorporation of the storm water drainage system, it undertook to reduce the risk of floods whenever it rained as the settlements topography is relatively hilly and the lower parts of the settlement were susceptible to flooding. Moreover, proper roads and transportation systems contribute to ease of access to health care facilities for the inhabitants. Data pertaining to the pre and post-test condition for the experiment group as well as control group were collected and are illustrated in figure 4 below.

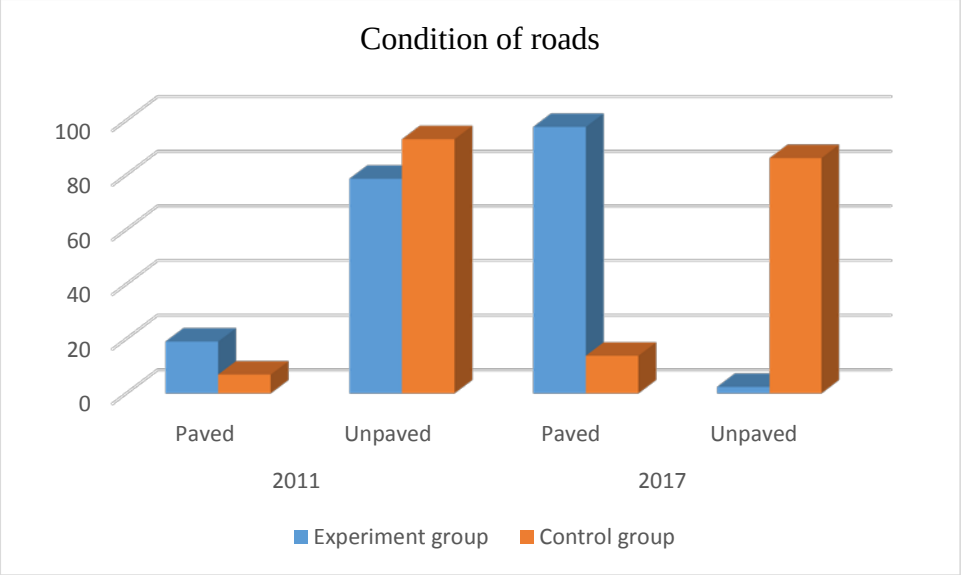

Figure 4: Condition of access roads

From figure 4 above, the condition of roads in the experiment and control groups were relatively similar in the pre-test condition. Approximately 79% and 93% of respondents in the experiment group and control group respectively said that roads were unpaved. However, we find that the conditions are no longer the same in the post-test condition. Findings indicate that roughly 98% of the respondents in the experiment group reported that roads were paved and only 14% of the respondents in the control group. This can be seen in photographs 8 and 9 below that depict the conditions of the access roads in the post-test condition for the two groups.

Photograph 8: Condition of roads in the control group

Photograph 9: Condition of roads and footpaths in the experiment group

Independent t-test result, p = 0.059 (Annex 4, Table12) in the pre-test condition indicate no significant difference between the two groups regarding the condition of the access roads. Therefore, the experiment group and control group were comparable on this variable.

In order to find out if the difference noted in post-test condition in the statistical test are significant, another t-test was conducted. The result p = 0.000 (Annex 4, Table 12) indicates that there is a significant difference between the two groups concerning the condition of the roads. As earlier noted, results show a significant increase in the proportion of respondents in the experiment group who indicated that access roads were paved if compared to proportion of respondents in the control group. This difference can therefore be ascribed to the improvement project.

From the foregoing discussion, it is evident that the gender sensitive basic infrastructure components that were incorporated in Swahili Informal Settlement included; accessibility to potable water sources, upgrading of the existing sewer line for subsequent uptake by the inhabitants to improve their sanitation facilities, improving accessibility within the settlement through paving of roads and laying of footpaths, and most importantly, the installation of security lighting in the settlement. It is however noted that the provision of solid waste management system has had no impact on the respondents. The influence that these infrastructure services have on the livelihood activities of the respondents is analyzed in the following subsequent sections.

4.5 What livelihood strategies had female-headed households of Swahili Informal Settlement adopted before the improvement of basic infrastructure?

The following section looks at the livelihood strategies that respondents had adopted before the improvement of the gender sensitive basic infrastructure.

4.5.1 Income generation activities

Households combine the various assets they have in their possession in order to acquire their livelihoods. These activities depends on their capabilities and the opportunities available to them. Data on the income generation activities that households were engaged in in the pre-test condition was compared between the two groups and the summary is tabulated in table 10 below;

Source of income in 2011		
	Experiment group	**Control Group**
Employment	14.3	8.6
General retail shop	14.3	1.7
Groceries stand	2.4	15.5
Road side food hawking	9.5	1.7
Food kiosk	9.5	5.2
Tailoring		1.7
Hairdressing	2.4	1.7
Charcoal dealer	7.1	
Washing/Cleaning Services	11.9	6.9
Government support		1.7
Assistance (Family/well-wishers)	11.9	29.3
Other	14.3	24.1
Missing	2.4	1.7

Table 10: Source of income in 2011

The results in table 10 above indicate that the highest proportion of respondents in the experiment group were either in employment (14%), general retail (14%) and in other income

generating activities (14%) such as casual labour that earned them a daily wage. Nearly 12% of the respondents reported that they were involved in cleaning services. An equal proportion (12%) stated that they relied on family assistance. On the other hand, about 29% of the respondents in the control group indicated that they relied on assistance from government, 24% reported to be in other income generating activities for example casual labour earning a daily wage including working on the farms or in the quarry. Still, other respondents sold items, mostly second hand clothing, while others hawked cooked food items, such as porridge. Moreover, almost 16% of the respondents sold their wares in grocery stands which is a little higher than in the experiment group. To sum up, results show that there is an indication of a larger proportion of respondents who are in own business[2] in the experiment group (57%) compared to the proportion in control group (34%). The results interestingly indicate that roughly 31% of the respondents in the control group dependent on support from either the government or family members. This is presumably because of the age profile of the majority of respondents in this group.

To examine if there were significant differences between the experiment group and the control group in the pre-test condition, a t-test was conducted. The result, $p = 0.029$ (Annex 4, Table 14) indicate a significant difference between the two groups. This implies that the two groups were different with regards to the sources of income in the pre-test condition as indicated in table 10 above where disparities are noted with regards to proportion of respondents in various income generation activities when the two groups are compared.

4.5.2 Human capital of household members

Morbidity of household members is one of the indicators used to assess the quality of human capital. The researcher assessed the disease incidences in the experiment and control groups as the proxy for the health status. In addition, data on the number of household members engaged in economic activities was also collected and compared between the two groups. Table 11 below summaries the diseases incidences in both groups.

	Experiment group		Control group	
	Number	Percentage	Number	Percentage
Malaria	20	47.6	35	60.3
Diarrhoea	8	19	12	20.7
Cholera	0	0	0	0
Tuberculosis	0	0	4	6.9
Typhoid	1	2.4	1	1.7
Respiratory Problems	17	40.5	8	13.8
STI's	0	0	0	0
Other	7	16.7	18	31

Table 11: Incidences of disease in 2011

The predominant disease identified in the two groups was malaria. Nearly 48% of the respondents in the experiment group and 60% in the control group indicated that someone in their household had suffered from malaria. This is followed by the proportion of respondents who experienced respiratory problems, 41% and 14% in the experiment group and control

[2] Aggregate proportion of respondents who reported that they are engaged in general retail shops, groceries stand, road side food hawking, food kiosks, tailoring, hairdressing, charcoal dealers and washing/cleaning services.

group respectively. The respondents also identified diarrhoea disease, 19% in the experiment group and 21% in the control group. Other ailments that respondents indicated to have suffered from included flu/common cold, high blood pressure and arthritis, 17% in the experiment group and 31% in the control group. It can be safely inferred that the quality of household labour before the improvement project in both groups was appalling as a majority of the respondents reported to have suffered from one or more ailments that are commonly associated with poor drainage and unhealthy sanitary living conditions.

An independent t-test was carried out to determine if disease incidences were comparable in the experiment and control groups. The results 0.259, 0.887, 0.088, 0.806, and 0.118 (Annex 4, Table 16) indicate no significant difference between the two groups with regards to incidences of malaria, diarrhoea, tuberculosis, typhoid and other ailments respectively. This means that the two groups were comparable in the pre-test condition. However, there was a significant difference in the results for the respiratory problems, p=0.002 (Annex 4 Table 16), implying that the two groups were different and hence were not comparable on the incidence of this problem in the pre-test condition.

Household members engaged in income generating activities

As earlier noted, depending on the circumstances of the households, they may change the number of household members engaged in income generating activities in order to stay out of poverty. Data was therefore collected on the number of household members engaged in economic activities and compared between the two groups as presented in table 12 below.

		Frequency	**Percentage**
Experiment group	Yes	9	21.4
	No	33	78.6
Total		**42**	**100**
Control group	Yes	15	27.8
	No	39	72.2
Total		**54**	**100**

Table 12: Household members in income generating activities in 2011

The results above show that the proportion of other household members engaged in income generating activities in the experiment group was 21%. The proportion was however slightly higher in the control group at nearly 28%.

4.5.3 Housing as an income generating asset

Housing is physical asset that can be used by households to generate rental income or as a premise for business in what is commonly dubbed us homebased enterprises. It is argued that women are likely to be engaged in homebased enterprises as they endeavour to balance their productive and reproductive roles. In addition, these enterprises are oftentimes commensurate with their skill levels, available capital and are therefore easy to establish. In this study, the proportion of respondents using their homes to carry out business related activities was compared between the experiment and control groups. The results are presented in figure 5 below.

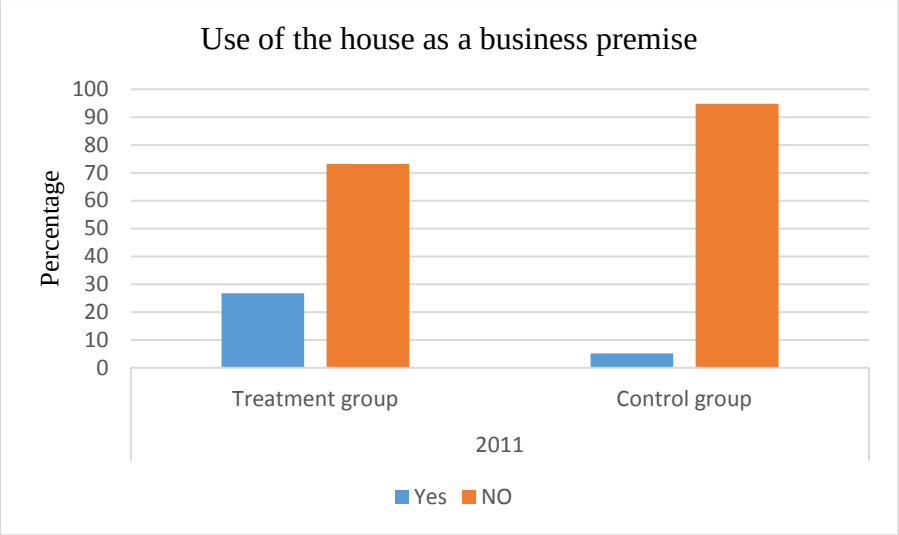

Figure 5: Use of the house as a business premise in 2011

Figure 5 above reveals that a higher proportion of respondents, close to 27%, in the experiment group carried out a business activity in their homes when compared to only 5% of the respondents in the control group who indicated that they had a business in their homes in pre-test condition.

With regards to the proportion of respondents who had sublet rooms in their homes, the results are displayed in figure 6 below.

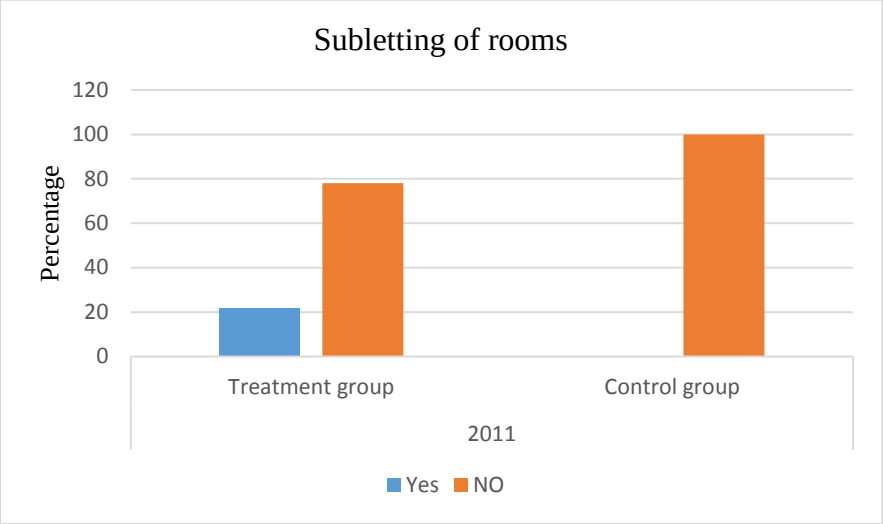

Figure 6: Subletting of rooms in 2011

Figure 6 above shows that about 21% of the respondents in the experiment group had sublet their rooms in the pre-test condition. By contrast, no respondent indicated that they had sublet any rooms in the control group.

Although housing has been identified as an important physical asset that households possess and that they be use productively to smooth consumption, it is noted that only a minority of the respondents have undertaken its use in both groups. These findings necessitate the need for further research as to what motivates households to start microenterprises within their homes.

To determine whether having a home based enterprise and subletting of rooms are comparable indicators in the pre-test condition between the experiment and control groups, a t-test was

carried out. The result 0.002 and 0.000 (Annex 4, Table 21) pertaining to having a homebased enterprise and subletting of rooms respectively, indicated a significant difference. Therefore, the two groups were not comparable on this variable.

4.5.4 Household expenditures

Data on average monthly expenditure for rent, water, electricity, medical expenses and garbage collection services was collected. It is noted that life in the urban areas is mainly commoditized and therefore households have to pay for most of the services they need. Pursuant to this, expenditures can be used to analyze a households' consumption trends to help better understand their livelihood strategies. This indicator was analyzed for the two groups and is summarized in figure 7 below.

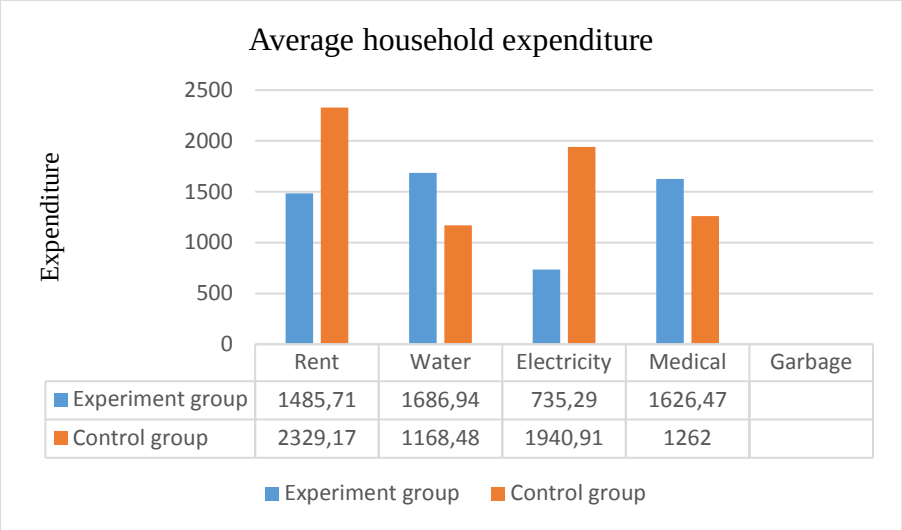

Figure 7: Average household expenditure in 2011

The results in figure 7 above show respondents in the experiment group spent more with regards to water and medical expenses when compared to the average spent for the same categories in the control group. However, total average spent was slightly higher in the control group, KSH 6700 compared to average monthly expenditure for above listed items in the experiment group of KSH 5,534. Respondents noted that in order to reduce the expenses for water, they sometimes resorted to drawing water from the river (table 3), which is free.

To determine whether there were differences in the pre-test condition between the two groups with regards to household expenditures, a t-test was carried out. The results (Annex 4, Table 26) show p values of 0.055, 0.058, 0.117 and 0.449 with regards to rent, water, electricity and medical services. This indicates a no significant difference in the listed expenses between the two groups and these indicators are therefore comparable.

4.5.6 Time spent in productive and reproductive activities

Data on the time of day that the respondents carried out various reproductive activities that involved domestic chores and productive activities that are associated with generation of income was collected. This indicator was compared in the two groups (table 13 below) to find out the proportion of time that the respondents allocated to reproductive activities as compared to productive activities.

	Experiment group			Control group		
	Morning	**Afternoon**	**Evening**	**Morning**	**Afternoon**	**Evening**
Activities						
Domestic chores						
Fetching water	92.7	4.9	2.4	92.9	3.6	3.6
Cooking	17.1	22	61	5.4	5.4	89.3
Cleaning the house	90.2	2.4	7.3	90.9	5.5	3.6
Laundry	90.2	7.3	2.4	87.3	10.9	1.8
Taking care of children	72		28	47.8	8.7	12.5
Income generation						
Employed/wage work	60	20	20	85.7	14.3	
Business activities	43.8	34.4	21.9	57.7	42.3	

Table 13: Time in productive and reproductive activities in 2011

The results from table 13 above indicate that in the pre-test situation most of the respondents from the two groups carried out reproductive activities (domestic chores) in the morning with the sole exception of cooking, that was mostly undertaken in the evening. As noted in the interview with one KISIP official explaining on the water situation before the improvement project:

"So, initially, they had no accessible water source. They had to wake up very early, and to go and queue. Because queuing now, means the one who has come first, will get the water. Because the water situation was dire. …. because of the water point being far away from the settlement, they spent more time going to fetch water. … (…). Women spent more time looking for, as a result of lack of infrastructure, looking for services and facilities, like water, latrines or toilets, shops. So, economically, they were losing valuable time. …they are almost, all the time away fetching water, even they can't see when a child has dysentery, or a child has minor ailments."

T-test results (Annex 4, Table 24) computed to find out if there was a difference between the two groups indicate that there was no significant difference in the pre-test condition with regards to the time of day respondents undertake various productive and reproductive activities as enumerated in the table 13 above save for cooking. Cooking has a p value of 0.005 (Annex 4, Table 24) indicating a significant difference between the experiment group and the control group. As such, the two groups were not comparable on this activity in the pre-test condition.

4.5.7 Mobility of household members

Data was collected on the transportation modes used by the respondents from their houses to either their place of work, to take children to school, to seek medical services at the nearest health facility or going to the market. The results are portrayed in figure 8 below.

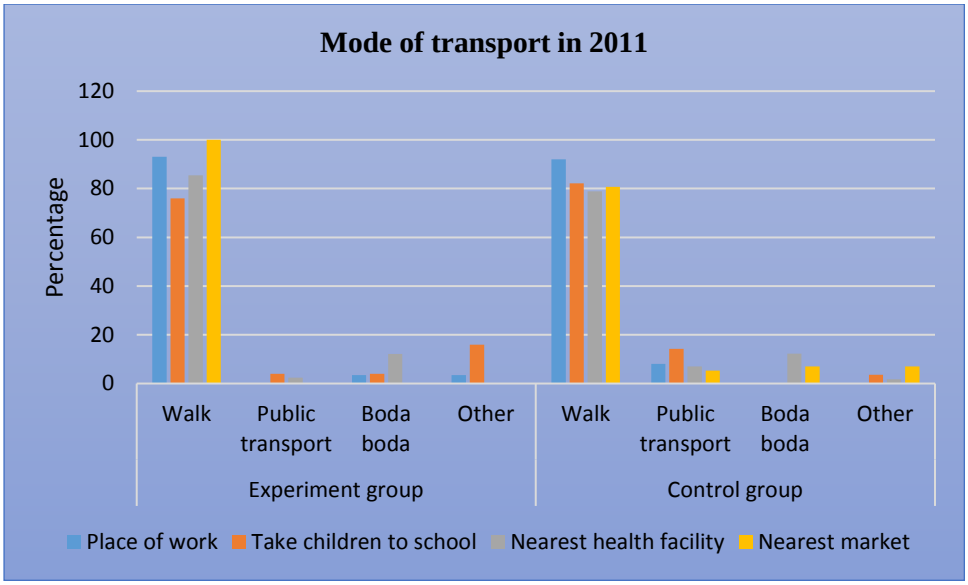

Figure 8: Mode of transport in 2011

Results indicate that use public transportation was very low in both groups. Over 76% of the respondents in both groups reported that they walked to their place of work, to the nearest health facility as well as to the market in addition to taking their children to school. Some of the respondents indicated that their children were in boarding school and hence the choice of other in the transportation mode.

Independent t-test results; 0.517, 0.173 and 0.505, (Annex 4, Table 25), indicate that in the pre-test condition, there was no significant difference between the two groups in the modes of transport to place of work, taking children to school and to visit the nearest health facility respectively. This means that the two groups were comparable on these indicators. There was however noted a significant difference $p = 0.005$ (Annex 4, Table 25) in the mode of transport to the nearest market and therefore the two groups were not comparable on this indicator. This could be explained by the observation that the experiment group boarders the farmers market on one side. This made its accessibility by respondents from the experiment group easier compared to its accessibility by respondents from the control group.

4.6 What changes have female-headed households made to their livelihood strategies since the improvement of gender sensitive basic infrastructure

General information of the composition of the respondents regarding the post-test employment status was collected. The data was then compared between the experiment and control groups. Table 14 below presents the summary of the current employment status of the respondents in the two groups.

	Experiment group	Control group
Employed	14.3	5.2
Unemployed	31.0	55.2
Self-employed	54.8	39.7

Table 14: Employment status

Results (table 14) indicate that respondents are predominately self-employed in the experiment group. More than half (55%) of the respondents are self-employed, 31% are unemployed and only 14% are employed. In the control group, a substantial proportion of respondents 55%, are unemployed, nearly 40% are in self-employment and merely 5% are employed. Further

disaggregation indicates that of those in employment from the two groups, approximately 67% are in the informal sector and 33% are employed formally (Annex 4, Table 13). Moreover, the proportion of the respondents in self-employment is much higher in both groups compared to those in employment. This can be attributed a variety of reasons, but specifically, it could be the age profile of the respondents, lack of jobs given the education level of the respondents leaving them no choice but to operate their own businesses and the attraction due to ability of the respondents to balance their productive and domestic chores when engaged in self-employment. This study however did not measure what influences the respondents to choose self-employment.

To determine whether the improvement in gender sensitive basic infrastructure improvement has had any influence on the livelihood strategies of female-headed households, data was collected for the post-test condition in both groups and is analysed below.

4.6.1 Change in income generating activities

The sources of income in the post-test condition are tabulated in table 15 below.

Source of income in 2017		
	Experiment group	**Control group**
Employment	11.9	5.2
General retail shop	11.9	1.7
Groceries stand	11.9	17.2
Road side food hawking	9.5	
Food kiosk	11.9	5.2
Tailoring		1.7
Hairdressing	2.4	1.7
Charcoal dealer	7.1	
Washing/Cleaning Services	7.1	6.9
Government support		3.4
Assistance (Family/well-wishers)	14.3	34.5
Other	11.9	22.4
Missing	0	0
Total	**100**	**100**

Table 15: Source of income in 2017

Results indicate that there was a decline in the experiment group of the proportion of respondents in employment from 14% to 12% (Table 15) partly due to retirement as mentioned by one respondent. On the other hand, it is noted that the proportion of respondents with groceries stands has increased in both groups and a higher margin recorded in the experiment group when compared to the control group. Similarly, there is an increase in the proportion of respondents engaged in food kiosks in the experiment group but there was no change in the control group. To sum up, the proportion of respondents in the experiment group engaged in own businesses has increase to nearly 62%, while in the control group it has remained relatively the same (34%).

Examples of economic activities that respondents are engaged in are illustrated in photograph 10 below.

Photograph 10: Examples of income generating activities

To examine if the differences noted in the economic activities between the two groups are significant, an independent t-test was conducted. The result p = 0.002 (Annex 4, Table 14) show a significant difference between the two groups. This can be attributed to the substantial increase in the proportion of respondents in the experiment group involved in groceries stand businesses from about 2% to 12% (Table 14), an almost a fourfold increase. It can therefore be concluded that there is a relationship between own businesses and the improvement project. However, it should be noted that due to the small sample size and the vulnerability of the group that is the focus of this study, the results should be interpreted with caution.

In addition, respondents in the experiment group were asked their perception about employment opportunities, customers for their businesses as well as starting new business ventures as indirect measures of the impact of the basic infrastructure improvement project. The results (Annex 4, table 15) show that majority of the respondents (43%) indicated that they got more employment opportunities, 33% said that they agree to having started their business after the improvement project and roughly 43% reported from strongly agree to agree that they got more customers for their businesses after the improvement project. In support of these findings, one SEC representative claimed in the interview that:

"…besides those roads, that is where they have small, small businesses. Like for cooking at night some viazi (potatoes), chopping mboga (vegetables) and all that, it has really helped them…"

To reinforce the above sentiments, one KISIP official noted that the roads had improved accessibility and the business environment in the settlement:

"Access roads, it has opened up the settlement for service delivery. And for shops, restaurants, and, eh, other modern facilities to be established because now people can access the settlement, for business activities."

Additionally, respondents were asked their perception on the influence of security lighting to their businesses. The results are as illustrated in the figure 9 and 10 below.

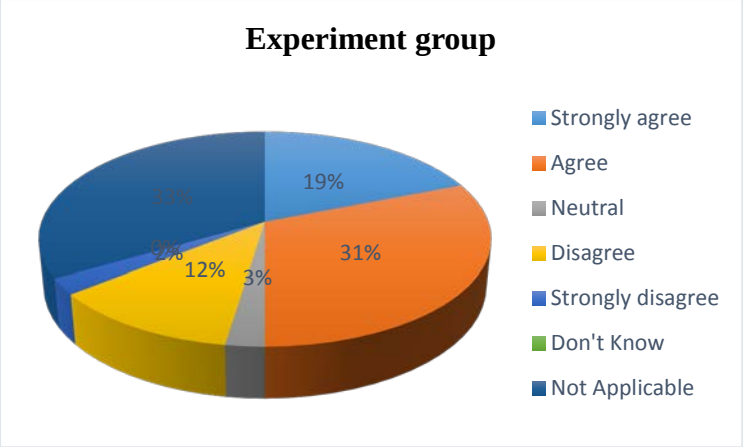

Figure 9: Security lighting has increased the number of hours I carry out business activities now compared to 2011

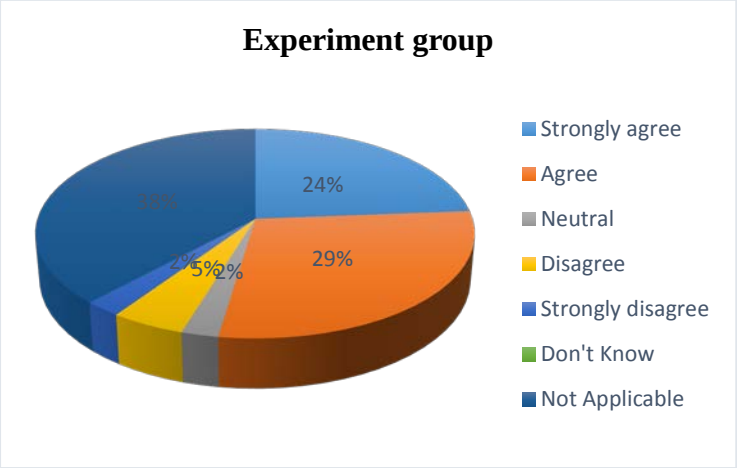

Figure 10: I feel safe to work extra time in my business in the evening now compared to 2011

It is anticipated that provision of street lighting enhances security and therefore has an effect on extra time worked in the evening as well as the feeling of safety to carry on business activities in the evening. In figure 9 above, 50% of the respondents reported from agree to strongly agree to increased business hours in the post-test period compared to the pre-test period. Figure 10 shows that more than half (52%) of the respondents indicated from strongly agree to agree that they felt safe to carry on business activities for longer in the evening in the post-test period as a result of the installation of security lighting compared to the pre-test period.

Additionally, one SEC representative during the interview noted:

"When it comes to business, like the security lights, those women can work even at night, because they are single-handedly, they are not expecting anybody to bring them unga, (referring to money for daily subsistence), they'll have to work for, an extra mile. So, if the close business at six…, they will have to extend until eight because there is light."

Further, the interview with one KISIP official revealed that:

"See now like the security high mast lighting, it has extended business hours. Initially, people could do business up to 6pm. But now because of the high mast lighting, people have done business up to 11pm."

The above results were further supported by sentiments from respondents in the experiment group who noted that they could work from early in the morning without fear. This they attributed to the availability of security lights which in their opinion would deter any

adversaries intending to attack them. At the very least, they noted that in case one is attacked, they would be able to identify the attacker.

4.6.2 Change in human capital of household members

The pre-test disease incidences results were compared to the post-test situation tabulated in table 16 below;

	Experiment group		Control group	
	Number	Percentage	Number	Percentage
Malaria	14	33.3	37	63.8
Diarrhoea	2	4.8	7	12.1
Cholera	0	0	0	0
Tuberculosis	0	0	2	3.4
Typhoid	1	2.4	2	3.4
Respiratory Problems	16	38.1	11	19
STI's	0	0	0	0
Other	10	23.8	23	39.7

Table 16: Disease incidences in 2017

Table 16 shows that by comparison there was a decrease in disease incidences among respondents in the experiment group for malaria, diarrhoea and respiratory problems. These findings may indicate an improvement in the general health of the respondents in the experiment group. This observation is however in contrast to the not surprising disease incidences in the control group where the study recorded an increase in incidences of malaria.

In order to understand if there is a significant difference between the two groups in the post-test condition, a t-test was done. The result $p = 0.02$ (Annex 4, Table 17) for malaria indicates a significant difference between the two groups. This is consistent with the noted decrease in the incidence for malaria in the experiment group when compared the proportion of respondents in the control group who indicated an increase in the incidence of malaria. There was however no notable significant result for disease incidences of the other diseases (Annex 4, Table 19).

Regarding the general health in the post-test condition as compared to the pre-test condition, the study sought to capture respondents' number of visits made to the doctor, how much they spent on healthcare and if they missed work as a result of illness. Table 18 (Annex 4) presents the summary of the choices respondents' made with regard to improved health status. As expected, majority of the respondents indicated that their households were healthier (86%), they visited the doctor less often (79%), they spent less on healthcare expenses (79%) and that they did not miss work on account of illness (67%). These indicators were combined into one to measure the overall change in the health status of the respondents (Annex 4, Table 19) and as illustrated in figure 11 below. As envisioned, it can safely concluded that the general health of the respondents had improved.

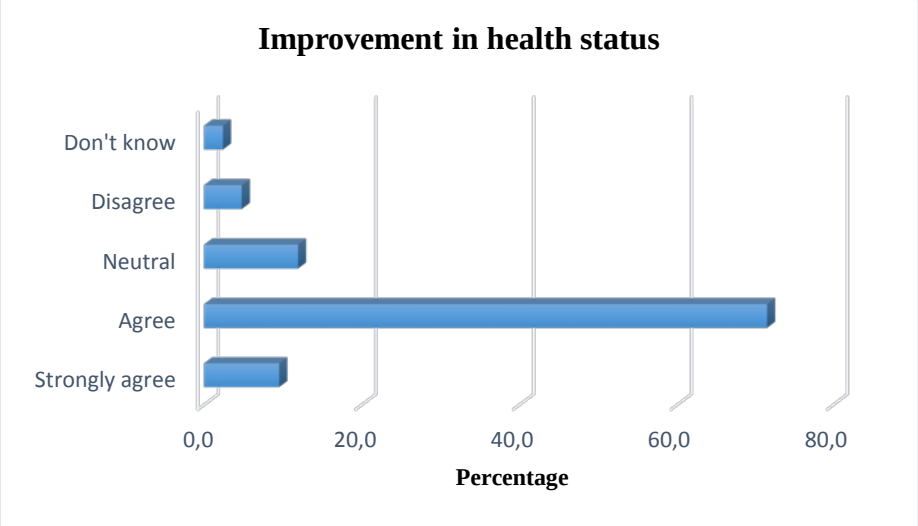

Figure 11: Improvement in health status

Literature presupposes that construction of roads and installation of water drainage systems results in notable changes in the health status of the inhabitants. The above results (Figure 11) support this claim and are consistent with the views of one KISIP official who noted during the interview that the construction of the drainage system "*has now reduced the incidences of water borne diseases.*" It can further be presumed that the health status of the household members was influenced by the availability of paved roads together with footpaths and storm water drainage system. These results are also substantiated by a statement in the interview with one SEC representative who stated that:

"…no sick children, because when a kid is sick, most of the time, it is the mother who is to take them to hospital."

In addition to the quality of the household labour, the quantity of household members engaged in income generating activities was also explored. In an attempt to stay out of poverty, households' may endeavour not to rely on one breadwinner. Table 17 below summaries the post-test condition of other household members' in income generating activities.

		2017	
		Frequency	Percentage
Experiment group	Yes	13	31
	No	29	69
Total		**42**	**100**
Control group	Yes	27	50
	No	27	50
Total		**54**	**100**

Table 17: Household members in income generating activities in 2017

Results indicate that there are clear differences between the experiment and the control groups regarding the proportion of household members in income generating activities. The proportion of other household members engaged in income generating activities in the control group is higher by close to 20% (Table 17 above) to that in the experiment group. In addition, results show that the increase in household members engaged in business activities in the control group increased by a larger margin compared to that of the experiment group when we compare the pre and post-test conditions. Further probing revealed that these household members were either employed formally or undertook casual jobs and still others operated their own business.

This validates theory that proposes that when households are facing changes in their external environment, they respond by changing the number of household members in the labour force and this depends on their different trajectories of poverty and well-being.

4.6.3 Use of the house as an income generating asset

The proportion of respondents in the experiment group with homebased enterprises has reduced to around 21% while in the control group, it has increased to 7% when compared to the pre-test condition. The proportion of respondents using the house as an income generating asset in the post test period are as seen in figure 12 below.

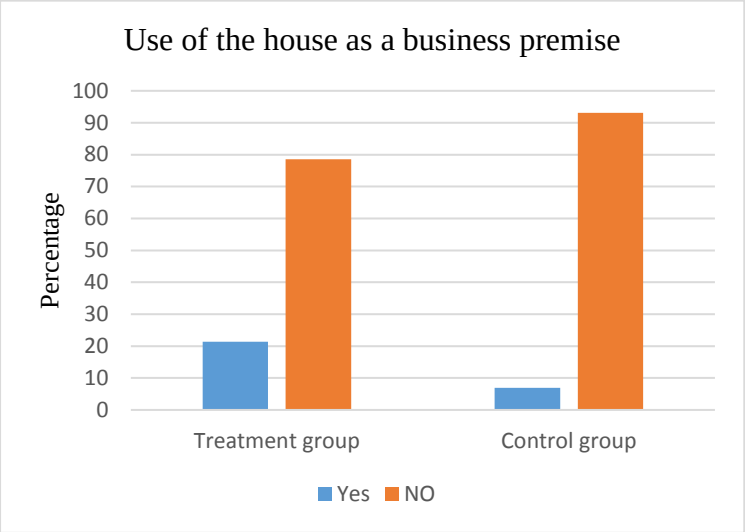

Figure 12: Use of the house as a business premise in 2017

By comparison, the percentage of respondents with homebased enterprises is higher in the experiment group. Further examination shows that of the respondents with a homebased enterprises, half were involved in selling food (Annex 4, Table 20). Other homebased enterprises identified by respondents were weaving mats and sale of charcoal. By nature, these homebased enterprises are microenterprises which are relatively easy to establish. As such, these results may suggest that the decision to operate a homebased enterprise may not only be associated with the infrastructure improvement but also to a larger extent by other external factors.

With regards to subletting of rooms, it was found that no difference had occurred in the experiment group. Conversely, there is a negligible change in the control group where one respondent said that they had sublet a room in their house in the post-test condition.

4.6.4 Change in household expenditures

Results as illustrated in figure 13 below indicate that in the experiment group, there was a reduction in the average expenditure for water, electricity and medical services expenses. However, we find that there was an increase in expenditure for rent and garbage collection. It is stipulated that improvements of infrastructure services make informal settlements more desirable real estate and may lead to increase in rental values. With regards to garbage collection expenses, the statistical findings are supported by statements from the respondents who indicated that they previously did not pay for garbage collection services. However, in the post-test condition, the results show that there were two respondents who paid for waste disposal services and hence the increase in the expenditure.

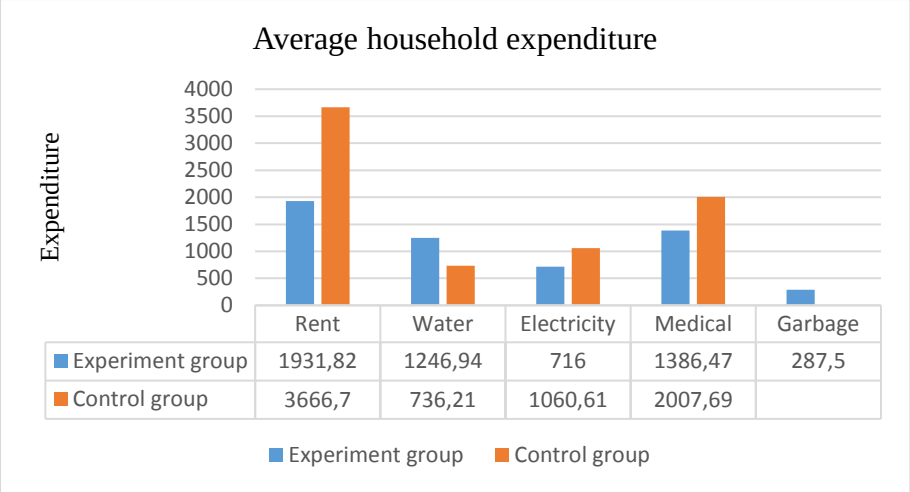

Figure 13: Average household expenditure in 2017

In the control group, the results (Figure 13 above) indicate similar trends. There is a reduction in expenditure for water and electricity charges. This is supported by previous results of access to water which indicated that there was a marked improvement in accessibility to potable water. Not surprisingly however, the results clearly indicate an increase in medical services expenses.

To assess whether there are significant differences between the experiment group and the control group as regards household expenditure, a t-test was conducted. The results (Annex 4, Table 22) 0.000 and 0.020 attributed to expenditure on rent and water respectively, show there is a significant difference between the two groups. This is supported by the notable differences in the reduction of expenditure on water which is greater in the experiment group when compared to the reduction noted in the control group. Also, there is an increase in the expenditure for rent in the experiment group when compared to the control group. In the case of expenditure for medical services and electricity expenses, t-test values (Annex 4, Table 26) of 0.226 and 0.537, indicate there is no significant difference between the two groups.

Theory postulates that lack of infrastructure services may result to households being charged more for the services, for instance water vendors may end up charging a premium for provision of water. This claim is supported by reports from the respondents in the control group who indicated that sometimes they hired help to transport water, in 20 litre jerrycans as illustrated in photograph 11 below, from the water kiosk to their house. According to these respondents, this service cost them more, KSH 15, if compared to the cost of water KSH 2 when they fetch and transport it themselves.

Photograph 11: Water transportation using jerrycans

4.5.5 Perception of personal safety

The relationship between infrastructure improvement through provision of street and security lighting and the perception of safety was studied. According to literature, street lighting enhance security. Information on the respondents' opinion pertaining to their security in the post-test condition compared to the pre-test condition was collected and is depicted in figure 14 and 15 below.

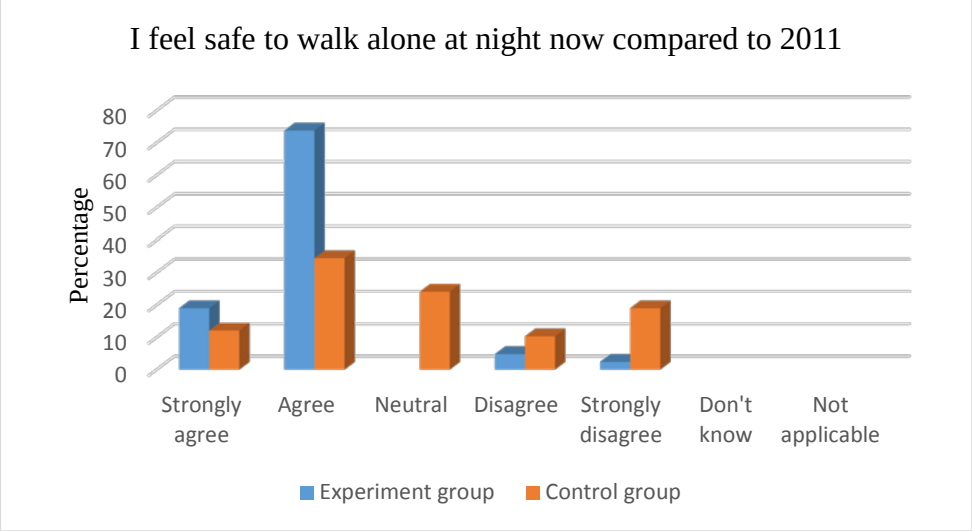

Figure 14: I feel safe to walk alone at night now compared to 2011

Figure 15: I feel safe to walk in the neighbourhood during the day now compared to 2011

The results above indicate that there are striking differences between the two groups regarding respondents' perception of security at night. The average opinion on the improvement of security at night has increased more in the experiment group if compared to the control group. Similarly, opinion on safety in the neighbourhood during the day has also increased more in the experiment group when compared to the control group.

To examine if the two groups are comparable with regards to the perception of safety, a t-test was conducted. The result (Annex 4, Table 23), p=0.000 indicate a significant difference between the two groups related to the respondents feeling safe to walk alone outside the house at night. These results were also confirmed during the interview with one KISIP official noting:

"Initially they did not have any security lighting. Women reported many cases of rapes, many cases of …petty theft, pick pockets. … the major impact is that it has reduced crime, in the settlement."

The above statement was confirmed during the interview with one SEC representative who stated:

"People being mugged, whereby women could not do their business for long hours. Because they are afraid, they could run home mapema (early)."

Further exploration of the link between perception of safety during the day between the experiment group and the control group through a t-test, p=0.115 (Annex 4, Table 23), shows no significant difference between two groups.

4.5.6 Change in time spent in productive and reproductive activities

In the literature reviewed, women disproportionately devote more time to reproductive activities, mainly household chores. Findings on the time of day that the respondents dedicated either productive or reproductive activities in the post-test condition are tabulate in table 18 below.

	Experiment group			**Control group**		
	Morning	**Afternoon**	**Evening**	**Morning**	**Afternoon**	**Evening**
Activities						
Domestic chores						
Fetching water	97.5	2.5		96.4	3.6	
Cooking	16.7	19	64.3	5.4	7.1	87.5
Cleaning the house	92.9		7.1	94.6	3.6	1.8
Laundry	92.9	4.8	2.4	87.3	10.9	1.8
Taking care of children	69.2	3.8	23.1	58.3	12.5	29.2
Income generation						
Employed/wage work	20	20	20	75	25	
Business activities	41.9	35.5	22.6	58.3	41.7	

Table 18: Time in productive and reproductive activities in 2017

The above findings when compared to the pre-test condition, show that the trend has not changed very much with regards to reproductive activities. We find that generally respondents in the two groups undertook their business activities fairly equally throughout the day. This is also reflected through a response from one of the respondents in the control group elaborating on their daily schedule. It starts in the morning with preparing children that also incorporates walking them to school. On her way back, she passes by the market to buy supplies for her grocery stand business. Thereafter, she fetches water for her household, and on laundry days, she then wash clothes followed by cleaning the house. She only opens the business once all the domestic chores are completed. This narrative reflects the schedule of most respondents in the two groups. Subsequently, this translates to keeping irregular business hours as on some days when the household chores are minimal, businesses are opened early.

T-test result (Annex 4, Table 24) 0.009 and 0.040 regarding time of day spent cooking and undertaking business activities respectively, reveals that there is a significant difference between the two groups. These result were verified by the respondents from the experiment group who indicated that they carried out businesses activities for extra time in the evening as well as that they started earlier in the morning. Further, in the interview with one KISIP official, it was claimed that:

"…getting supplies or getting businesses to settle, it will reduce the time for women to go and buy, and getting the potable water makes women to concentrate on other businesses."

In order to find out if there had been change in the experiment group regarding time allocated by the respondents to productive and reproductive activities, the study sought the opinion of the respondents regarding change in time allocated to these activities. The results are tabulated in the table 19 below.

	Percentage						
Statement	Strongly agree	Agree	Neutral	Disagree	Strongly disagree	Don't now	Not applicable
I now have more free time for myself	11.9	47.6	26.2	9.5			4.8
I spend more time now taking care of my children	7.1	31	14.3	9.5		2.4	35.7
I now have more time to carry out my business activities	2.4	61.9	4.8	9.5	2.4		19
I use less time now to carry out domestic chores	4.8	81	7.1	2.4	2.4	2.4	

Table 19: Perception of influence of infrastructure improvement on allocation of time

From the above, more than half of the respondents agree to have had more time to themselves, more time in productive activities and that they invested less time in reproductive duties. This suggests that basic infrastructure improvement had freed time for the respondents from domestic chores to carry out economic activities and to take care of themselves. Interestingly, less than half indicated that they had more time to nurture their children. This perhaps can be attributed to an almost equal proportion of respondents who noted 'not applicable' with regard to this indicator, meaning they did not have children living with them.

4.5.7 Change in mobility

Availability of transportation networks according to literature, enhances the mobility of women. Further, improved roads raise school attendance, lower transportation costs and ease access to health facilities. The transportation modes in use in the post-test condition are displayed in figure 14 below.

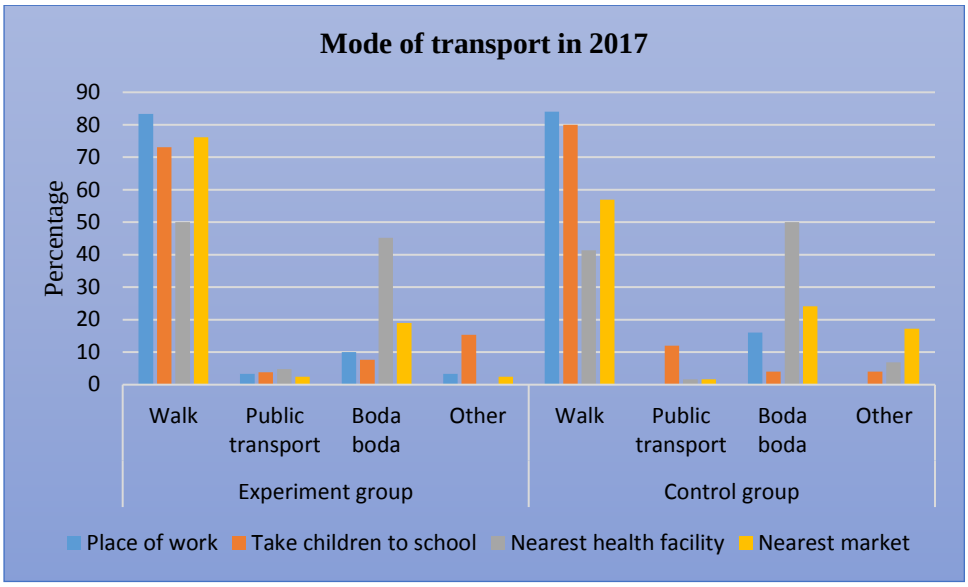

Figure 16: Mode of transport in 2017

As was noted in the pre-test condition, the predominant mode of transport is through walking. Still, a relatively low proportion of the respondents have adopted the use of public transport. From figure 16 above, we see that majority of the respondents (above 73%) in the experiment group indicated that they walked to their place of work, to the market as well as to take their children to school. In addition, half, (50%) of the respondents indicated that they walk to the nearest health facility. In the control group, more than 80% walk to their place of work and to take their children to school. In addition, 57% of the respondents reported that they walk to the market and roughly 41% of the respondents stated that they walked to the nearest health facility. The other modes of transport indicated were use of tuk tuk and some respondents said that oftentimes they sent other family members to the market to buy groceries on their behalf. However, there is noted an increase, of nearly 33% in the experiment group and 38% in the control group of respondents who use motorized means of transportation, notably use of boda boda (motorcycle taxi), to access health facilities when the post-test condition is compared to the pre-test condition.

Independent t-test result 0.950, 0.228 and 0.200 (Annex 4, Table 25) with regard to mode of transport to work, taking children to school and to seek medical services from the nearest health facility respectively, show no significant difference between the two groups. On the account of mode of transport to the market, there is a significant difference between the two groups 0.012 (Annex 4, Table 25), indicating that the two groups are noticeably different on this indicator.

Further, results in figure 16 above indicate that on average, a higher proportion of respondents from the experiment group walk to the various places identified if compared to the proportion of respondents in the control group. This is also supported by the pronouncements from respondents of the experiment group who indicate that they found it easier to walk in the post-test condition compared to before the intervention. They cited that the construction of footpaths meant that they no longer experienced muddy paths when it rained. This is also confirmed by a statement from one SEC representative in the interview reflecting the difficulties that residents experienced before the improvement project:

"…when it is raining…people would have difficulties in using the roads because of mud…"

The relationship between improvement of the roads and respondents perception on cost of taking children to school, time it took them to get to their places of work as well as the market in addition to accessibility of their residences by an ambulance in case of an emergency was also assessed. The results are as tabulated in table 20 below;

	Percentage						
Statement	Strongly agree	Agree	Neutral	Disagree	Strongly disagree	Don't now	Not applicable
I pay less to take my children to school now compared to before 2011		4.8		14.3	2.4		78.6
I take less time to get to my place of work now compared to before 2011	4.8	23.8	28.6	7.1		2.4	33.3
The ambulance can easily access my house now in case of an emergency compared to before 2011	26.2	73.8					
I take less time to go to the market now compared to before 2011	11.9	42.9	40.5	4.8			

Table 20: Opinion on influence of paving of roads on mobility

The above results indicate that for a majority (77%) of the respondents, transportation cost to take their children to school did not apply. This is supported by the fact majority of the children walk to school. The other reason could be that respondents were not living with children of school going age as seen in the previous analysis. Also, 14% of the respondents disagree to the reduction in cost of taking their children to school. Further, the proportion of respondents who agree to a reduction in transport costs incurred in taking children to school is strikingly low, roughly 5%. As regards the time it takes to the place of work, nearly 29% of the respondents indicated that they took less time. As expected, nearly all the respondents indicated that in case of an emergency, the ambulance would be able to reach their homes. Similarly, slightly more than half, 55%, of the respondents indicated that they can easily get to the market in the post-test condition compared to the pre-test condition despite the fact that there has not been a major change in the mode of transport (Figure 16 above).

The results suggest that though the mode of transport has not changed when we compare the post-test condition to the pre-test, there has been a notable increase in accessibility within the experiment group.

4.7 Summary of findings

Figure 17 below presents a summary of the gender sensitive basic infrastructure components improved in Swahili Informal Settlement and the perceived effect they had on the livelihood activities of the respondents.

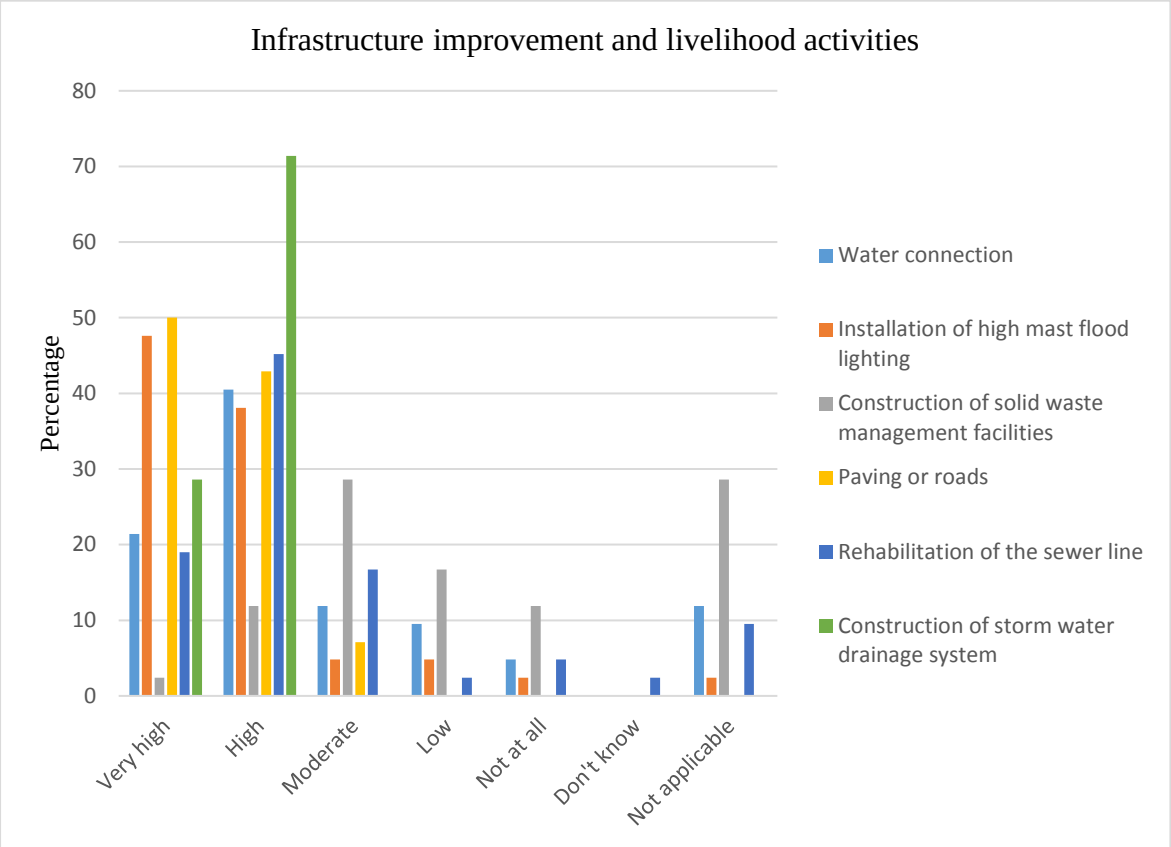

Figure 17: Infrastructure improvement and livelihood activities

The basic infrastructure improvement component that has had the greatest impact on the livelihood activities of female-headed households as perceived by the respondents is the construction of storm water drainage system. The other infrastructure components that influenced livelihood activities ranked from the highest are paving of roads, installation of high mast flood lighting, rehabilitation of existing sewer line and water reticulation and individual

connections. The component with the least influence to the livelihood activities of the respondents was construction of solid waste management facilities.

In order to assess whether there is any causality between gender sensitive basic infrastructure components and livelihood activities which were found to have a significant difference in the experiment group compared to the control group, linear regression was computed. The results are as follows;

a. Effect of paving of roads on income generation activities

A simple linear regression was calculated to determine whether paving of roads influenced income generation activities. A regression equation of the following form was found:

$$y = \beta_0 + \beta_x + e$$

where y is the dependent variable (income generation activities) and x is the independent variable (paving of roads) and e is the error term between predicted and observed value.

The result (Annex 4, Table 26), $F(1,40) = 0.126$, $p = 0.725$ with an R^2 of 0.003 shows a linear relationship with a non-significant result. In addition, there is a weak relationship between paving of roads and income generating activities. In this case, the result suggests that increase in income generating activities cannot be explained entirely by the improvement of roads within the experiment group.

b. Effect of security lighting on time utilized in the evening for business activities

A simple linear regression was calculated to determine whether security lighting has affected the in time to carry out business activities in the evening. A regression equation of the following form was found:

$$y = \beta_0 + \beta_x + e$$

where y is the dependent variable (extra time in the evening to carry on business) and x is the independent variable (security lighting) and e is the error term between predicted and observed value.

The result (Annex 4, table 27), $F(1, 40) = 1.131$, $p = 0.294$ with R^2 of 0.028 indicate a linear relationship with a non-significant result. Furthermore, there is a weak correlation between security lighting and extra time utilized in the evenings for business activities. As such, security lighting has slightly influenced the time utilized in the evening for business activities.

c. Effect of paving of roads on improved health status

A simple linear regression was calculated to determine whether paving of roads has an impact on the health status of the respondents. A regression equation of the following form was found:

$$y = \beta_0 + \beta_x + e$$

where y is the dependent variable (improved health) and x is the independent variable (paving of roads) and e is the error term between predicted and observed value.

The result (Annex 4, Table 28), $F(1,40) = 0.656$, $p = 0.423$ with an R^2 of 0.016 shows linear relationship with a not significant result. This suggests that improvement in health status is weakly linked to paving of roads and associated works including construction of storm water drains.

d. Effect of improved access to water and household expenditure on water

A simple linear regression was calculated to test whether improved access to water has an impact on households' expenditure on water for the respondents. A regression equation of the following form was found:

$$y = \beta_0 + \beta_x + e$$

where y is the dependent variable (expenditure on water) and x is the independent variable (improved access to water) and e is the error term between predicted and observed value.

The result (Annex 4, Table 29), $F(1,34) = 0.048$, $p = 0.828$ with an R^2 of 0.001 shows linear relationship with a not significant result. The relationship between the two indicators is also weak. This therefore suggests that reduction in the household expenditure on water remains largely unaffected by access to potable water sources provided by the infrastructure improvement project.

e. Effect of availability of security lighting on perception of safety

A simple linear regression was calculated to determine whether availability of security lighting has an impact on personal safety of the respondents. A regression equation of the following form was found:

$$y = \beta_0 + \beta_x + e$$

where y is the dependent variable (personal safety) and x is the independent variable (availability of security lighting) and e is the error term between predicted and observed value.

The result (Annex 4, Table 30), $F(1,40) = 60.948$, $p = 0.000$ with an R^2 of 0.604 shows linear relationship with a significant result and a strong association between availability of security lighting and the perception of safety. This means approximately 60% of the change in the perception of personal safety can be explained by availability of security lighting.

Therefore, personal safety is equal to 1.06 + 0.489 (availability of security lighting). In this case, perception of personal safety increased by 0.489 for each unit of security lighting.

f. Effect of water connections on time in business activities

A simple linear regression was calculated to determine whether improved access to water has an impact on time utilized in business activities by the respondents. A regression equation of the following form was found:

$$y = \beta_0 + \beta_x + e$$

where y is the dependent variable (time in business activities) and x is the independent variable (improved access to water) and e is the error term between predicted and observed value.

The result (Annex 4, Table 31), $F(1,40) = 0.538$, $p = 0.468$ with an R^2 of 0.013 shows a linear relationship with a non-significant result. Further, this result confirms that the increase in the time to carry out business activities has a weak relation to access to potable water.

Chapter 5: Conclusions and recommendations

5.1 Introduction

This chapter draws conclusions based on the study findings. The aim of the study was to identify the gender sensitive basic infrastructure improvements that were implemented in Swahili Informal Settlement and to show how they had influenced the livelihood strategies of female-headed households. Evidence was collected on the basic infrastructure components that were improved, the livelihood strategies employed by the respondents before infrastructure improvement as well as the livelihood strategies after the intervention. These finds and analysis are presented in the following sections. A summary of the same forms the basis of the conclusion with the aim of answering the main research question.

5.2 Gender sensitive basic infrastructure improvement

This study reveals that there were gender sensitive basic infrastructure components physically available in the experiment group. These included; improved accessibility of water through rehabilitation of a borehole, water pipeline reticulation as well as individual water connections. Another component improved was sanitation facilities, through rehabilitation of the existing sewer line. In addition, the improvement project incorporated the construction of an ablution block (communal toilets and bathrooms) to be utilized by the residents of the settlement. This also included an integrated solid waste management system whose intent was to enable the residents deal with bio-degradable waste from their households as well as from the adjacent famers market. Furthermore, installation of security lighting through the construction of two high mast flood lights was also noted. The roads within the settlement were also upgraded to bitumen standards. Storm water drains were in addition incorporated beside the roads to enhance drainage especially when it rains. Footpaths were also laid out within the settlement to ease foot transportation mode. These components are considered gender sensitive in this study as they are in line with proportions by Strachan (2013) and Grown, Gupta, et al. (2005) who identify gender responsive infrastructure services to include basic infrastructure services that assist in meeting the responsibilities of women such as access to potable water supply, sanitation facilities, transport services, street lighting and sources of energy.

5.3 Changes in livelihood strategies

There is empirical evidence from the study that some aspects of the respondents' livelihood strategies have changed as a result of the infrastructure improvements. However, as earlier stated, due to the small sample size and the vulnerability of the group under study, the results should be interpreted cautiously. With this in mind, the study findings are linked to the postulations in the theoretical framework central to this study.

Rakodi (1999) notes that physical infrastructure accords households alternatives for diversifying income generating activities. Findings from the study indicate that there was an increase in income generation opportunities especially as regards own business ventures. This was demonstrated by the increase in proportion of respondents involved in grocery stands and food kiosk businesses. These businesses require low level of skill and lower capital to start (Berner, Gomez, et al., 2012). Further, evidence shows that there is a relationship, though linear regression indicates its weak, between how long the respondents could carry out their businesses in the evening as a result of the installation of security lighting. In addition, respondents noted that they felt safe to carry on their businesses in the evening as well as that they felt confident to start earlier in the morning compared to before the intervention.

Moser (1998) found that whenever there is a change in the external environment, households' respond by changing the number of household members in the labour force. The opportunities available depend on their health and skills. From the study, findings show that the number of household members engaged in income generation activities has increased. This is perhaps due households' realization that they cannot rely on a one income earner to either smooth consumption or get out of poverty. In addition, the study highlights improved health of the respondents. More specifically, there is a reduction in incidences of malaria that is associated with contaminated open pulls of water. Moreover, medical expenditures have reduced in the after the infrastructure improvement. Different from the experiment group, medical expenses increased for the counterfactual situation in the same period. However, when a regression analysis was carried out to find out if there is a causal relation between paving of roads, that incorporated the construction of storm water drains, and the general health of the respondents, there was found to be non-significant result. Further, the strength of the relationship was weak. This therefore means that improvement of roads had not played a significant role in the reduction of medical expenses.

Moser (1998) also identifies housing as one of the physical assets that households resort to, to generate income by way of renting out rooms and as workspaces for homebased enterprises. From the study, findings indicate that the proportion of respondents with homebased enterprises has reduced when you compare the post-test condition to the pre-test. There was also no observed change in the proportion of respondents renting out rooms. Moreover, findings show that the average rent expense in the experiment group in comparison to the average rent in the control group is higher. As expected, the average amount that respondents pay for rent has also increased from the pre-test when compared to the post-test condition in the experiment. As Huchzermeyer (2008) asserts, infrastructure improvement make informal settlements attractive real estate and this leads to an increase in the rent levels attributed to speculation.

Households according to Rakodi (1999) may engage in livelihood strategies that reduce their expenses. In addition, Pierce (2015) found that proper infrastructure guarantees that households are not charged extra fees to access the basic services. For example, households may be charged premiums by water vendors in the absence of proper water supply services. In this study, findings shows that there was a reduction in the monthly expenses for water. Nevertheless, a linear regression carried out shows no significant result to predict that increased accessibility to potable water had led to a reduction in expenses for water. In contrast, respondents in the counterfactual situation indicated that they paid more per 20 litre jerrycan of water. This findings reiterate the remarks by Pierce (2015), in that respondents indicated that they paid a premium to have water delivered to their homes.

Pierce (2015) notes that security lighting enhances security. Findings from the study show that availability of security lighting through the installation of high mast flood lighting had dramatically enhanced the respondents' perception of personal safety. A linear regression analysis carried out confirms a significant association between availability of security lighting and the perception of personal safety. The strength of this relationship is also highly pronounced. Respondents in addition clearly noted that they felt safe to use the sanitation facilities (pit latrines outside their houses), in the night as well as ability to walk outside their houses at night without fear.

Berner, et al. (2012) asserts that improvement in infrastructure reduces the time burden on women that they would have to shoulder if the same were absent. This may lead to allocation of a significant amount of time to reproductive activities which may result in adverse effects on their productive activities. This study established that the respondents had acquired more

time to carry out their business activities, that they used less time to carry out domestic chores and those with children had more time to nurture them as well as to take care of themselves. The findings therefore reinforce the propositions in literature that infrastructure improvement results in reallocation of time from non-paying domestic chores to be utilized in productive activities that generate income for the households.

Improvement in transportation networks as documented by Agénor and Agénor (2009) make it easier for women to access health facilities not only for themselves, but also for their children. As predicted in literature, the study finds that with improved roads, emergency vehicles such as ambulances can now access the settlement more easily. Further, there is noted an increase in the use of motorized transportation, specifically the use of motorcycle taxi to access the health facilities.

5.4 Conclusion

Amidst the availability of gender sensitive infrastructure improvement services, households continue to pursue their livelihood activities in order to fulfil their livelihood objectives. From the findings, the following conclusion can made; availability of access roads, sanitation facilities and potable water sources have not played a major role in influencing the livelihood activities of the respondents. Similarly, solid waste management facilities has no influence on the livelihood activities of the respondents. On the other hand, availability of security lighting is the most influential gender sensitive basic infrastructure component to the livelihood activities of the respondents. We find that improved security has a ripple effect on income generating activities especially in own businesses. Respondents are now in a position to start new ventures, operate them from dawn to late evening without fear of personal safety. This perhaps has led to increases in incomes for the respondents and improved lives.

From the aforementioned, infrastructure improvements that are responsive to the needs and requirements of women potentially influence their livelihood activities positively. This may lead to greater productivity and eventually to improved livelihoods.

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Annexes

Annex 1: Questionnaire for Treatment Group

BASIC INFRASTRUCTURE IMPROVEMENT AND LIVELIHOOD STRATEGIES OF FEMALE-HEADED HOUSEHOLDS OF SWAHILI INFORMAL SETTLEMENT IN MACHAKOS, KENYA

Questionnaire for the treatment group (Swahili)

Questionnaire No.	

This questionnaire is part of an academic survey conducted by Caroline Nduta, pursing a Master Degree in Urban Management and Development at IHS, Erasmus University. The goal of the study is to gain more insight on the influence of improvement to basic infrastructure on the livelihoods of female-headed households. The information you provide will be treated anonymously and the results will be used solely for academic purposes. I take this opportunity to thank you in advance for your cooperation.

SECTION I: GENERAL INFORMATION

1. Age ……. Years

2. How long have you lived in Swahili settlement?

0 – 5 years		6 – 10 Years		11 – 15 Years		More than 16 years	

3. Marital status

Widowed		Never married		Divorced		Separated	

4. What is your highest level of education

No formal education		Vocational training	
Primary school		College/University	
Secondary school			

5. What is your employment status?

Employed		Unemployed		Self-employed	

6. If employed, what type of employment?

Formal		Informal	

SECTION II: GENDER SENSITIVE INFRASTRUCTURE

a. Access to potable water

7. Kindly **tick (√)** the main source of water for your household?

Source of water	**Before project commencement**	**After project completion**
Individual piped connection		
Water Kiosk		
Individual borehole		
Shared piped connection		
Water vendor		
Shared borehole		
Other (Specify)		

8. Whose responsibility is it for fetching water?

Person responsible	Before project commencement	After project completion
Yourself		
Your daughter		
Your son		
Yourself and your children		
Employed/Hired help		
Relative		
Other (specify)		

9. In your opinion, please indicate your level of agreement or disagreement with each of the following statements that reflect your access to clean water?

Statement	Strongly agree	Agree	Neutral	Disagree	Strongly disagree	Don't Know	Not Applicable
I can afford to pay the fee for a new water connection now compared to before project commencement							
I can afford to pay the monthly water bills now compared to before project commencement							
I can access the water points easily now compared to before project commencement							
There is reliable supply of water for my household now compared to before project commencement							
I can store water for several days now compared to before project commencement							
I pay less for water now compared to before project commencement							
I take less time to access available water supply now compared to before project commencement							

10. Apart from the above, please indicate what else explains your situation of access to clean water.

……...

……...

b. Access to sanitation

11. Kindly **tick (√)** the type of toilet facility used by your household?

Type	Before project commencement	After project completion
Own WC/flush toilet		
Individual pit latrine		
Shared pit latrine		
No facility (Flying toilets)		
Other (specify)		

12. In your opinion, please indicate by ticking (√) your level of agreement or disagreement with each of the following statements that reflect your access to sanitation facilities by comparing the situation that was before the commencement of the project and the current situation

Statement	Strongly agree	Agree	Neutral	Disagree	Strongly disagree	Don't Know	Not Applicable
I never used the toilet facilities at night before project commencement							
I never walked alone to the toilet facilities during the day before project commencement							
I feel safe now to use the toilet facilities at night							
I feel safe now to use the toilet facilities during the day							
I feel safe to walk alone now to the toilet facilities during the day							
I take less time to walk from my house to the toilet facilities now							
I do not have to wait on the queue to use the toilet facilities now compared to before project completion							

13. Apart from the above, please indicate what else explains your situation of access to sanitation facilities.

……...
……...

c. Waste collection

14. Kindly **tick (√)** how your household mainly disposes of waste/garbage?

Method of disposal	Before project commencement	After project completion
County collection services		
Dump anywhere in the settlement		

Own compound (compost pit/burn)		
Organized private collection		
Other (specify)		

15. In your opinion, please indicate by ticking (√) your level of agreement or disagreement with each of the following statements that reflect the situation that was before the commencement of the project and the current situation on solid waste disposal

Statement	**Strongly agree**	**Agree**	**Neutral**	**Disagree**	**Strongly disagree**	**Don't know**	**Not Applicable**
Waste from my household is collected more often now compared to before project commencement							
I pay more now for waste disposal compared to before project commencement							
I now take less time to dispose of garbage at the designated points							

16. Apart from the above, please indicate what else explains your situation of garbage disposal services.

……...
……...

d. Access roads and footpaths

17. Kindly **tick (√)** the condition of the access roads to your house?

	Before project commencement	After project completion
Paved		
Un-paved		

18. What main mode of transport do you use to move from your house to:

	Before project commencement				**After project completion**			
Place	Walk	Public Transport	Boda Boda	Other (Specify)	Walk	Public Transport	Boda Boda	Other (Specify)
Place of work								
Take children to school								
Nearest health facility								
Nearest market								

19. In your opinion, please indicate by ticking (√) your level of agreement or disagreement with each of the following statements that reflect the situation that was before the commencement of the project and the current situation on mobility

Statement	**Strongly agree**	**Agree**	**Neutral**	**Disagree**	**Strongly disagree**	**Don't know**	**Not Applicable**
I pay less to take my children to school now							

compared to before project commencement							
I take less time to get to my place of work now compared to before project commencement							
The ambulance can easily access my house now in case of an emergency compared to before project commencement							
I take less time to go to the market now compared to before project commencement							

20. Apart from the above, please indicate what else explains your situation of access to paved roads.
……...
……...

e. Security lighting

21. Kindly indicate the availability of security lights /high mast flood lights in the settlement;

	Yes	**No**
Before Project commencement		
After project completion		

22. If yes, how often do they work?

	Almost always	Often	Sometimes	Seldom	Never
Before project commencement					
After project completion					

23. In your opinion, please indicate by ticking (√) your level of agreement or disagreement with each of the following statements

Statement	**Strongly agree**	**Agree**	**Neutral**	**Disagree**	**Strongly disagree**	**Don't know**	**Not applicable**
Security lighting has increased the number of hours I can carry out my business in the evening now compared to before project commencement							
I feel safe to work extra time in my business in the evening now compared to before project commencement							

I feel safe to walk alone outside my house at night now compared to before project commencement							
I feel safe to walk in my neighbourhood during the day now compared to before project commencement							

24. Apart from the above, please indicate what else explains your situation of access to security lighting.

……...

……...

25. In your opinion, please indicate by ticking (√) the extent to which the following basic infrastructure improvements have influenced your household activities.

Basic infrastructure	**Very high**	**High**	**Moderate**	**Low**	**Not at all**	**Don't know**	**Not applicable**
Water connection							
Installation of high mast flood lighting							
Solid waste management facilities							
Paving of access roads							
Rehabilitation of the sewer line							
Construction of storm water drainage system							

26. In your opinion kindly indicate to what extent you agree or disagree with the following statements on how basic infrastructure improvement has influenced your household activities.

Statements	**Strongly agree**	**Agree**	**Neutral**	**Disagree**	**Strongly disagree**	**Don't know**	**Not applicable**
I have access to more employment opportunities from the improvement projects							
I got more customers for my business							
I now have more free time for myself							
I spend more time now taking care of my children							
I saw an opportunity to start my business after the project commencement							
I have more time now to carry out my business activities							

I use less time now to carry out domestic chores							
I have not experienced any change after the improvement projects							

27. Please indicate what other influence basic infrastructure improvement has had on your household activities.

……...

……...

SECTION III: LIVELIHOOD ACTIVITIES OF FEMALE-HEADED HOUSEHOLDS

a. Income Generation

28. What is your source of income?

Source of income	Before project commencement	After project completion
Employment		
General retail shop		
Groceries stand		
Road side food hawking		
Food Kiosk		
Tailoring		
Hairdressing/barbershop		
Charcoal dealer		
Washing/ cleaning services		
Government support		
Assistance (Family/Well-wishers)		
Other (Specify)		

b. Change in human capital

29. Number of household members living with you

Household members	Before project commencement	After project completion
Own children above18 years		
Own children below 18 years		
Relatives		
Friends		

30. Are the household members involved in income generating activities?

	Yes	No
Before Project commencement		
After project completion		

31. If yes, please specify the kind of income generating activities they are engaged in?

……...

……...

32. Do your children of school going age attend school?

	Yes	No
Before Project commencement		
After project completion		

33. If yes, in your opinion, kindly indicate by ticking (√) to what extent you agree or disagree with the following statements on the influence of infrastructure improvement on education

Statements	Strongly agree	Agree	Neutral	Disagree	Strongly disagree	Don't know	Not applicable
My children have more time to study now that they do not fetch water							
My children have more time to study now that there are security lights							
My children are safer walking to school now because of the paved roads							

34. Have you or any of your household members suffered from any of the following ailments? Tick (√) whichever that applies.

Ailments	Before project commencement	After project completion
Malaria		
Diarrhoea		
Cholera		
Tuberculosis		
Typhoid		
Respiratory problems		
STI's		
Other (specify)		

35. In your opinion, kindly indicate by ticking (√) to what extent you agree or disagree with the following statement on the influence of infrastructure improvement on the general health of your household

Statements	Strongly agree	Agree	Neutral	Disagree	Strongly disagree	Don't know	Not applicable
My family and I are healthier now as compared to before project commencement							
My family and I spend less now on healthcare compared to before project commencement							
My household members visit the doctor less often as compared to before project commencement							
I do not miss work now due to illness compared to before							

the project commencement							

c. Use of the house for income generation

36. How many habitable rooms does the house you live in have?

Before project commencement		After project completion	

37. Have you sublet any of the rooms in your house to tenants?

	Yes	**No**
Before Project commencement		
After project completion		

38. If yes, indicate the rent per month?

	Kshs.
Before project commencement	
After project completion	

39. Have you used your house as a business premise?

	Yes	**No**
Before Project commencement		
After project completion		

40. If yes, what kind of business?

	Before project commencement	**After project completion**
General Retail Shop		
Groceries Shop		
Hairdressing/ Barber shop		
Food shop		
Tailoring business		
Other (Specify)		

d. Change in financial capital

41. On average, please indicate your monthly household expenditure on the following items.

Item	**Before project commencement**	**After project completion**
Rent		
Water		
Electricity		
Medical expenses		
Garbage collection services		

e. Time in income generation activities and domestic chores

42. Please indicate the time of day that you undertake the following activities?

	Before project commencement			**After project completion**		
Activities	**Morning**	**Afternoon**	**Evening**	**Morning**	**Afternoon**	**Evening**
Domestic chores						
Fetching water						
Cooking						
Cleaning the house						
Laundry						
Taking care of children						
Income generation						

Employed/wage work						
Business activities						

43. Any other comments

……...
……...
……...

Thank you so much for your time.

Annex 2: Questionnaire for Control Group

BASIC INFRASTRUCTURE IMPROVEMENT AND WELL-BEING OF FEMALE-HEADED HOUSEHOLDS OF SWAHILI INFORMAL SETTLEMENT IN MACHAKOS, KENYA

Questionnaire for the control group (Kathemboni)

Questionnaire No.	

This questionnaire is part of an academic survey conducted by Caroline Nduta, pursing a Master Degree in Urban Management and Development at IHS, Erasmus University. The goal of the study is to gain more insight on the influence of improvement to basic infrastructure on the livelihoods of female-headed households. The information you provide will be treated anonymously and the results will be used solely for academic purposes. I take this opportunity to thank you in advance for your cooperation.

SECTION I: GENERAL INFORMATION

1. Age …… Years

2. How long have you lived in Kathemboni?

0 – 5 years		6 – 10 Years		11 – 15 Years		More than 16 years	

3. Marital status

Widowed		Never married		Divorced		Separated	

4. What is your highest level of education

No formal education		Vocational training	
Primary school		College/University	
Secondary school			

5. What is your employment status?

Employed		Unemployed		Self-employed	

6. If employed, what type of employment?

Formal		Informal	

SECTION II: GENDER SENSITIVE INFRASTRUCTURE

a. Access to potable water

7. Kindly **tick (√)** the main source of water for your household?

Source of water	**2011**	**2017**
Individual piped connection		
Water Kiosk		
Individual borehole		
Shared piped connection		
Water vendor		
Shared borehole		
Other (Specify)		

8. In your opinion, please indicate your level of agreement or disagreement with each of the following statements that reflect your access to clean water?

Statement	Strongly agree	Agree	Neutral	Disagree	Strongly disagree	Don't Know	Not Applicable
I can afford to pay the fee for a new water connection now compared to before 2011							
I can afford to pay the monthly water bills now compared to before 2011							
I can access the water points easily now compared to before 2011							
There is reliable supply of water for my household now compared to before 2011							
I can store water for several days now compared to before 2011							
I pay less for water now compared to before 2011							
I take less time to access available water supply now compared to before 2011							

9. Apart from the above, please indicate what else explains your situation of access to clean water.
……
……

10. Whose responsibility is it for fetching water?

Person responsible	2011	2017
Yourself		
Your daughter		
Your son		
Yourself and your children		
Employed/Hired help		
Relative		
Other (specify)		

b. Access to sanitation

11. Kindly **tick (√)** the type of toilet facility used by your household?

	2011	2017
Own WC/flush toilet		
Individual pit latrine		
Shared pit latrine		
No facility (Flying toilets)		

Other (specify)		

12. In your opinion, please indicate by ticking (√) your level of agreement or disagreement with each of the following statements that reflect your access to sanitation facilities by comparing the situation that was before 2011 and now;

Statement	**Strongly agree**	**Agree**	**Neutral**	**Disagree**	**Strongly disagree**	**Don't Know**	**Not Applicable**
I never used the toilet facilities at night before 2011							
I never walked alone to the toilet facilities during the day before 2011							
I feel safe now to use the toilet facilities at night							
I feel safe now to use the toilet facilities during the day							
I feel safe to walk alone now to the toilet facilities during the day							
I take less time to walk from my house to the toilet facilities now							
I do not have to wait on the queue to use the toilet facilities now compared to before 2011							

13. Apart from the above, please indicate what else explains your situation of access to sanitation facilities.

    ……
    ……

c. Waste collection

14. Kindly **tick (√)** how your household mainly disposes of waste/garbage?

Method of disposal	**2011**	**2017**
County collection services		
Dump anywhere in the settlement		
Own compound (compost pit/burn)		
Organized private collection		
Other (specify)		

15. In your opinion, please indicate by ticking (√) your level of agreement or disagreement with each of the following statements that reflect the situation that was before 2011 and the current situation on solid waste disposal

Statement	**Strongly agree**	**Agree**	**Neutral**	**Disagree**	**Strongly disagree**	**Don't know**	**Not Applicable**
Waste from my household is collected more often now compared to before 2011							
I pay more now for waste disposal compared to before 2011							
I now take less time to dispose of garbage at the designated points							

16. Apart from the above, please indicate what else explains your situation of garbage disposal services.

……

……

d. Access Roads

17. Kindly **tick (√)** the condition of the access roads to your house?

	2011	**2017**
Paved		
Un-paved		

18. What is the main mode of transport that you use to move from your house to;

	2011				**2017**			
Place	Walk	Public Transport	Boda Boda	Other (Specify)	Walk	Public Transport	Boda Boda	Other (Specify)
Place of work								
Take children to school								
Nearest health facility								
Nearest market								

19. In your opinion, please indicate by ticking (√) your level of agreement or disagreement with each of the following statements that reflect the situation that was before 2011 and the current situation on mobility

Statement	**Strongly agree**	**Agree**	**Neutral**	**Disagree**	**Strongly disagree**	**Don't know**	**Not Applicable**
I pay less to take my children to school now compared to before 2011							
I take less time to get to my place of work now compared to before 2011							

The ambulance can easily access my house now in case of an emergency compared to before2011							
I take less time to go to the market now compared to before 2011							

20. Apart from the above, please indicate what else explains your situation of access to paved roads.
……

e. Security lighting

21. Kindly indicate the availability of security lights /high mast flood lights in the settlement;

	Yes	**No**
2011		
2017		

22. If yes, how often do they work?

	Almost always	Often	Sometimes	Seldom	Never
2011					
2017					

23. In your opinion, please indicate by ticking (√) your level of agreement or disagreement with each of the following statements

Statement	**Strongly agree**	**Agree**	**Neutral**	**Disagree**	**Strongly disagree**	**Don't know**	**Not applicable**
Security lighting has increased the number of hours I can carry out my business in the evening now compared to before 2011							
I feel safe to work extra time in my business in the evening now compared to before 2011							
I feel safe to walk alone outside my house at night now compared to before 2011							
I feel safe to walk in my neighbourhood during the day now compared to before 2011							

24. Apart from the above, please indicate what else explains your situation of access to security lighting.
……
……

SECTION III: LIVELIHOOD ACTIVITIES OF FEMALE-HEADED HOUSEHOLDS

a. Income Generation

25. What is the source of income for your household?

Source of income	2011	2017
Employment		
General retail shop		
Groceries stand		
Road side food hawking		
Food Kiosk		
Tailoring		
Hairdressing/barbershop		
Charcoal dealer		
Washing/ cleaning services		
Government support		
Assistance (Family/Well-wishers)		
Other (Specify)		

b. Change in human capital

26. Number of household members living with you

Household members	2011	2017
Own children above18 years		
Own children below 18 years		
Relatives		
Friends		

27. Are the household members involved in income generating activities?

	Yes	No
2011		
2017		

28. If yes, please specify the kind of income generating activities they are engaged in?
……..

29. Do your children of school going age attend school?

	Yes	No
2011		
2017		

30. Have you or any of your household members suffered from any of the following ailments? Tick (√) whichever applies.

Ailments	2011	2017
Malaria		
Diarrhoea		
Cholera		
Tuberculosis		
Typhoid		

Respiratory problems		
STI's		
Other (specify)		

c. Use of the house for income generation

31. How many habitable rooms does the house you live in have?

2011		2017	

32. Have you sublet any of the rooms in your house to tenants?

	Yes	**No**
2011		
2017		

33. If yes, indicate the rent per month?

	2011	**2017**
Kshs.		

34. Have you used your house as a business premise?

	Yes	**No**
2011		
2017		

35. If yes, what kind of business? If no go to question 36.

	2011	**2017**
General Retail Shop		
Groceries Shop		
Hairdressing		
Food shop		
Tailoring business		
Other (Specify)		

d. Change in financial capital

36. On average, please indicate your monthly household expenditure on the following items.

Item	**2011**	**2017**
Rent		
Water		
Electricity		
Medical expenses		
Garbage collection services		

e. Time in productive and reproductive activities

37. Please indicate the time of day that you undertake the following activities?

	2011			**2017**		
Activities	**Morning**	**Afternoon**	**Evening**	**Morning**	**Afternoon**	**Evening**
Domestic chores						
Fetching water						
Cooking						
Cleaning the house						
Laundry						
Taking care of children						
Income generation						

Employed/wage work						
Business activities						

38. Any other comments?

……
……
……
……
……

Thank you so much for your time

Annex 3: Interview Guide

BASIC INFRASTRUCTURE IMPROVEMENT AND LIVELIHOOD STRATEGIES OF FEMALE-HEADED HOUSEHOLDS OF SWAHILI INFORMAL SETTLEMENT, MACHAKOS, KENYA

Interview guide for the treatment group

This interview guide is part of an academic study conducted by Caroline Nduta, pursing a Master Degree in Urban Management and Development at IHS, Erasmus University. The goal of the study is to gain more insight on the influence of improvement to basic infrastructure on the livelihoods of female-headed households. The information you provide will be treated anonymously and the results will be used solely for the academic study. I take this opportunity to thank you in advance for your cooperation.

KENYA INFORMAL SETTLEMENT IMPROVEMENT PROJECT (KISIP)

1. What is the role of KISIP?
2. Which infrastructure categories fall under the responsibilities of KISIP?
3. What situation did you find in Swahili Informal Settlement with regard to the following basic infrastructure
    - ✓ Access to potable water – what were the sources of water in this area?
    - ✓ Sanitation (type of toilet facilities, adequacy of sanitation services)
    - ✓ Solid waste management
    - ✓ Security lighting (high mast flood lighting)
    - ✓ Access roads (condition of the roads)
    - ✓ Drainage (availability and condition of the storm water drains)
4. What were the main challenges faced by residents and especially women as a result of lack of access to basic infrastructure services in Swahili?
5. How does KISIP engage the community in the improvement process? Are women also engaged?
6. How was the Settlement Executive Committee (SEC) formed? What are the responsibilities of the SEC?
7. Are there women representatives in the SEC? What are their roles?
8. Which basic infrastructure components were improved? Were there gender sensitive basic infrastructure components? If yes, which ones?
9. How did you choose which basic infrastructure components to give priority for improvement to?
10. Did women participate in the selection of the basic infrastructure services to be improved? How were female-headed households incorporated?
11. What in your opinion has been the impact of improvement in access to;
    - ✓ Potable water
    - ✓ Sanitation (Connection to sewer and provision of ablution blocks)
    - ✓ Solid waste management facilities
    - ✓ Security lighting (high mast flood lighting)
    - ✓ Access roads
    - ✓ Drainage (storm water drains)

    to the livelihood activities of women and especially female-headed households?
12. What are the challenges you encountered in the implementation of this project?
13. You are free to make any other comments.

SETTLEMENT EXECUTIVE COMMITTEE (SEC)

1. What are the roles and responsibilities of the SEC?
2. What were the condition of the following basic infrastructure before 2011?
    - ✓ Access to potable water – what were the sources of water for this area?
    - ✓ Sanitation (type of toilet facilities and connection to main sewer)
    - ✓ Solid waste management
    - ✓ Security lighting (high mast flood lighting)
    - ✓ Access roads
    - ✓ Drainage (storm water drains)
3. What were the main challenges faced by residents and especially women, as a result of lack of access to basic infrastructure services in Swahili?
4. Were you involved in the prioritization of the basic infrastructure to be improved? How?
5. Are you aware of the existence of female-headed households?
6. What in your opinion are the main challenges/ problems faced by female-headed households with regards to access to basic infrastructure?
7. In your opinion, how has improvement to the following basic infrastructure influenced the lives of women and especially female-headed households?
    - ✓ Potable water
    - ✓ Sanitation (Connection to sewer and provision of ablution blocks)
    - ✓ Solid waste management facilities
    - ✓ Security lighting (high mast flood lighting)
    - ✓ Access roads
    - ✓ Drainage (storm water drains)
8. What other benefits have been derived from the improvement to basic infrastructure by female-headed households?
9. Who manages the communal infrastructure services for example the ablution blocks, community cooker?
10. How are conflicts in use of the communal facilities dealt with?
11. You are free to make any other comments.

Annex 4: Tables – Data analysis

Table 1: General Characteristics

Indicator	**Experiment group**		**Control group**	
Age (Mean)	49 Years		56 Years	
	Frequency (N)	**Percentage**	**Frequency (N)**	**Percentage**
Age profile of respondents				
37 Yrs and below	9	21.4	17	29.3
38 - 55 Yrs	18	42.9	9	15.5
56 - 66 Yrs	10	23.8	12	20.7
67 Yrs and above	5	11.9	20	34.5
Total	42	100	58	100
Period lived in the settlement				
0-5 Year	2	4.8	1	1.7
6-10 Years			4	6.9
11-15 Years	4	9.5	2	3.4
More than 16 Years	36	85.7	51	87.9
Total	42	100	58	100.0
Level of education				
No formal education	6	14.3	14	24.1
Primary school	22	52.4	29	50.0
Secondary school	12	28.6	13	22.4
Vocational training	-	-	-	-
University/ College	2	4.8	2	3.4
Total	42	100	58	100

Table 2: Independent t-test: Comparison between the experiment and control group

Group Statistics

	Name of the settlement	N	Mean	Std. Deviation	Std. Error Mean
How long have you lived in the settlement	Experiment group	42	3.76	.692	.107
	Control group	58	3.78	.650	.085
Highest education level	Experiment group	42	2.29	.891	.138
	Control group	58	2.09	.884	.116
Age of respondent	Experiment group	42	48.79	15.740	2.429
	Control group	58	56.07	20.901	2.745

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
How long have you lived in the settlement	Equal variances assumed	.017	.897	-.103	98	.918	-.014	.135	-.282	.255
	Equal variances not assumed			-.102	85.155	.919	-.014	.137	-.286	.258
Highest education level	Equal variances assumed	.204	.653	1.110	98	.270	.200	.180	-.157	.556

	Equal variances not assumed			1.108	88.086	.271	.200	.180	-.158	.557
Age of respondent	Equal variances assumed	4.757	.032	-1.901	98	.060	-7.283	3.832	-14.888	.322
	Equal variances not assumed			-1.987	97.826	.050	-7.283	3.665	-14.556	-.010

Table 3: Independent t-test: Main source of water

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Main source of water before 2011	Equal variances assumed	2.945	.089	-4.144	96	.000	-1.510	.364	-2.234	-.787
	Equal variances not assumed			-4.296	94.831	.000	-1.510	.352	-2.208	-.812
Main source of water in 2017	Equal variances assumed	.000	.986	1.202	98	.232	.378	.315	-.246	1.003
	Equal variances not assumed			1.202	88.522	.233	.378	.315	-.247	1.004

Table 4: Cronbach's alpha – Improved access to water

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.748	.770	7

Table 5: Independent t-test: Type of toilet facility used in 2011

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Type of toilet facility used before 2011	Equal variances assumed	10.122	.002	-.527	96	.600	-.096	.182	-.457	.265
	Equal variances not assumed			-.482	57.378	.632	-.096	.199	-.494	.302
Type of toilet facility used in 2017	Equal variances assumed	27.815	.000	.440	98	.661	.085	.192	-.297	.466
	Equal variances not assumed			.391	50.823	.697	.085	.216	-.349	.519

Table 6: Cronbach's alpha for opinion on access to sanitation facilities

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.676	.739	7

Table 7: Frequency table for improved access to sanitation

Access_Sanitation

Name of the settlement			Frequency	Percent	Valid Percent	Cumulative Percent
Experiment group	Valid	Strongly agree	5	11.9	11.9	11.9
		Agree	32	76.2	76.2	88.1
		Neutral	2	4.8	4.8	92.9
		Disagree	3	7.1	7.1	100.0
		Total	42	100.0	100.0	
Control group	Valid	Strongly agree	11	19.0	19.0	19.0
		Agree	33	56.9	56.9	75.9
		Neutral	13	22.4	22.4	98.3
		Disagree	1	1.7	1.7	100.0
		Total	58	100.0	100.0	

Table 8: Independent t-test: Method of garbage disposal

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Method of waste disposal before 2011	Equal variances assumed	.478	.491	-9.964	97	.000	-1.407	.141	-1.687	-1.127
	Equal variances not assumed			-10.144	91.343	.000	-1.407	.139	-1.683	-1.132
Method of waste disposal in 2017	Equal variances assumed	.019	.890	-8.512	98	.000	-1.326	.156	-1.635	-1.017
	Equal variances not assumed			-8.529	89.096	.000	-1.326	.155	-1.635	-1.017

Table 9: Frequency table for improved garbage disposal method

Access_Garbage

Name of the settlement			Frequency	Percent	Valid Percent	Cumulative Percent
Experiment group	Valid	Strongly agree	1	2.4	2.4	2.4
		Agree	1	2.4	2.4	4.8
		Neutral	4	9.5	9.5	14.3
		Disagree	10	23.8	23.8	38.1
		Strongly disagree	12	28.6	28.6	66.7
		Not Applicable	14	33.3	33.3	100.0
		Total	42	100.0	100.0	
Control group	Valid	Neutral	2	3.4	3.4	3.4
		Disagree	4	6.9	6.9	10.3
		Strongly disagree	2	3.4	3.4	13.8
		Not Applicable	50	86.2	86.2	100.0
		Total	58	100.0	100.0	

Table 10: Independent t-test: Availability of security lighting

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Availability of high mast flood lights in 2011	Equal variances assumed	26.783	.000	2.259	97	.026	.158	.070	.019	.297
	Equal variances not assumed			2.488	91.111	.015	.158	.064	.032	.284
Availability of high mast flood lights in 2017	Equal variances assumed	182.663	.000	-4.180	98	.000	-.321	.077	-.473	-.169
	Equal variances not assumed			-4.769	72.412	.000	-.321	.067	-.455	-.187

Table 11: Frequency table for how often security lights work

How often did the high mast flood lights work in 2011

Name of the settlement			Frequency	Percent	Valid Percent	Cumulative Percent
Experiment group	Valid	Almost Always	1	2.4	50.0	50.0
		Sometimes	1	2.4	50.0	100.0
		Total	2	4.8	100.0	
	Missing	999	40	95.2		
	Total		42	100.0		
Control group	Valid	Almost Always	2	3.4	16.7	16.7
		Often	1	1.7	8.3	25.0
		Sometimes	4	6.9	33.3	58.3
		Seldom	1	1.7	8.3	66.7
		Never	4	6.9	33.3	100.0
		Total	12	20.7	100.0	
	Missing	999	46	79.3		
	Total		58	100.0		

How often do the high mast flood light work in 2017

Name of the settlement			Frequency	Percent	Valid Percent	Cumulative Percent
Experiment group	Valid	Almost Always	22	52.4	52.4	52.4
		Often	10	23.8	23.8	76.2
		Sometimes	3	7.1	7.1	83.3
		Seldom	5	11.9	11.9	95.2
		Never	2	4.8	4.8	100.0
		Total	42	100.0	100.0	
Control group	Valid	Almost Always	21	36.2	55.3	55.3
		Often	4	6.9	10.5	65.8
		Sometimes	3	5.2	7.9	73.7
		Seldom	4	6.9	10.5	84.2
		Never	6	10.3	15.8	100.0
		Total	38	65.5	100.0	
	Missing	999	20	34.5		
	Total		58	100.0		

Table 12: Independent t-test: Condition of roads

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Condition of roads before 2011	Equal variances assumed	15.563	.000	-1.910	97	.059	-.126	.066	-.257	.005
	Equal variances not assumed			-1.775	62.628	.081	-.126	.071	-.268	.016
Condition of roads in 2017	Equal variances assumed	19.412	.000	-14.597	98	.000	-.838	.057	-.952	-.724
	Equal variances not assumed			-16.275	83.605	.000	-.838	.052	-.941	-.736

LIVELIHOOD STRATEGIES

Table 13: Frequency – formal and informal employment

What type of employment

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Formal	4	4.0	33.3	33.3
	Informal	8	8.0	66.7	100.0
	Total	12	12.0	100.0	
Missing	System	88	88.0		
Total		100	100.0		

Table 14: Independent t-test: Source of income

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Source of income before 2011	Equal variances assumed	.000	.987	-2.211	96	.029	-1.852	.838	-3.514	-.189
	Equal variances not assumed			-2.211	86.333	.030	-1.852	.838	-3.517	-.187
Source of income in 2017	Equal variances assumed	.164	.686	-3.119	98	.002	-2.463	.790	-4.030	-.896
	Equal variances not assumed			-3.106	87.215	.003	-2.463	.793	-4.039	-.887

Table 15: Opinion on the influence of the improvement project on economic activities

Statement	Strongly agree	Agree	Neutral	Disagree	Strongly disagree	Don't know	Not applicable
I have access to more employment opportunities		42.9	9.5	19	2.4	2.4	23.8

from the improvement project							
I got more customers for my business	7.1	35.7	19	9.5			28.6
I saw an opportunity to start my business after the improvement project		33.3	2.4	16.7	23.8		23.8

Table 16: Independent t-test for disease incidences in 2011

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Have you or your household members suffered from Malaria before 2011	Equal variances assumed	1.729	.192	1.137	97	.259	.116	.102	-.086	.318
	Equal variances not assumed			1.132	84.919	.261	.116	.102	-.088	.319
Have you or your household members suffered from diarrhoea before 2011	Equal variances assumed	.082	.776	.142	97	.887	.012	.083	-.152	.176
	Equal variances not assumed			.143	87.246	.887	.012	.082	-.152	.176
Have you or your household members suffered from tuberculosis before 2011	Equal variances assumed	13.883	.000	1.725	97	.088	.069	.040	-.010	.148
	Equal variances not assumed			2.055	57.000	.044	.069	.034	.002	.136
Have you or your household members suffered from typhoid before 2011	Equal variances assumed	.243	.623	-.247	97	.806	-.007	.029	-.065	.050
	Equal variances not assumed			-.239	76.550	.811	-.007	.030	-.067	.052
Have you or your household members suffered from respiratory problems before 2011	Equal variances assumed	36.569	.000	-3.254	97	.002	-.277	.085	-.445	-.108
	Equal variances not assumed			-3.064	66.699	.003	-.277	.090	-.457	-.096
Have you or your household members suffered from other ailments before 2011	Equal variances assumed	11.367	.001	1.579	97	.118	.140	.088	-.036	.315
	Equal variances not assumed			1.635	94.920	.105	.140	.085	-.030	.309

Table 17: Independent t-test for disease incidences in 2017

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Have you or your household members suffered from malaria in 2017	Equal variances assumed	.356	.552	3.122	98	.002	.305	.098	.111	.498
	Equal variances not assumed			3.130	89.314	.002	.305	.097	.111	.498
Have you or your household member suffered from diarrhoea in 2017	Equal variances assumed	6.913	.010	1.258	98	.212	.073	.058	-.042	.188
	Equal variances not assumed			1.341	97.167	.183	.073	.054	-.035	.181
Have you or your household members suffered from tuberculosis in 2017	Equal variances assumed	6.324	.014	1.212	98	.228	.034	.028	-.022	.091
	Equal variances not assumed			1.427	57.000	.159	.034	.024	-.014	.083
Have you or your household members suffered from typhoid in 2017	Equal variances assumed	.377	.541	.306	98	.760	.011	.035	-.059	.080
	Equal variances not assumed			.315	95.834	.754	.011	.034	-.057	.078
Have you or your household members suffered from respiratory problems in 2017	Equal variances assumed	16.125	.000	-2.155	98	.034	-.191	.089	-.367	-.015
	Equal variances not assumed			-2.081	76.376	.041	-.191	.092	-.374	-.008
Have you or your household members suffered from other ailments in 2017	Equal variances assumed	11.921	.001	1.670	98	.098	.158	.095	-.030	.347
	Equal variances not assumed			1.706	94.513	.091	.158	.093	-.026	.343

Table 18: Opinion on the influence of infrastructure improvement on the general health of respondents

Statement	Strongly agree	Agree	Neutral	Disagree	Strongly disagree	Don't know	Not applicable
My family and I are healthier now as compared to before project commencement	16.7	69	9.5	4.8			
My family and I spend less now on healthcare compared to before project commencement	14.3	64.3	14.3	4.8		2.4	
My household members visit the doctor less often now as	4.8	73.8	14.3	2.4	2.4	2.4	

compared to before project commencement							
I do not miss work now due to illness compared to before the project commencement	16.7	50	7.1	2.4	4.8	4.8	14.3

Table 19: Reliability test and frequencies for opinion on improved health status

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.765	.770	3

Improve_Health

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly agree	4	9.5	9.5	9.5
	Agree	30	71.4	71.4	81.0
	Neutral	5	11.9	11.9	92.9
	Disagree	2	4.8	4.8	97.6
	Don't know	1	2.4	2.4	100.0
	Total	42	100.0	100.0	

Table 20: Type of business in the house

Type of business	Frequency	Percent
General retail shop	1	7.1
Groceries shop	1	7.1
Hairdressing/ Barber shop	2	14.3
Food shop	7	50.0
Tailoring business	1	7.1
Other	2	14.3
Total	14	100

Table 21: Independent t-test: Home based enterprises and subletting of rooms

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Use of the house as a business premise before 2011	Equal variances assumed	50.337	.000	-3.167	97	.002	-.217	.068	-.352	-.081
	Equal variances not assumed			-2.851	54.090	.006	-.217	.076	-.369	-.064
Had you sublet rooms in the house in 2011	Equal variances assumed	123.755	.000	-3.998	97	.000	-.220	.055	-.328	-.111
	Equal variances not assumed			-3.354	40.000	.002	-.220	.065	-.352	-.087

Table 22: Independent t –test: Household expenditure

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Monthly expenditure on rent before 2011	Equal variances assumed	10.942	.002	-2.387	31	.023	-843.452	353.417	-1564.250	-122.655
	Equal variances not assumed			-2.077	15.427	.055	-843.452	406.022	-1706.785	19.880
Monthly expenditre on water before 2011	Equal variances assumed	.414	.522	1.922	80	.058	518.466	269.809	-18.470	1055.403
	Equal variances not assumed			1.928	76.206	.058	518.466	268.948	-17.166	1054.099
Monthly expenditre on electricity before 2011	Equal variances assumed	20.359	.000	-2.076	26	.048	-1205.615	580.766	-2399.397	-11.833
	Equal variances not assumed			-1.701	10.848	.117	-1205.615	708.892	-2768.546	357.316
Monthly expenditure on medical services before 2011	Equal variances assumed	2.644	.112	.764	40	.449	364.471	476.888	-599.357	1328.298
	Equal variances not assumed			.708	25.402	.486	364.471	515.060	-695.464	1424.405
Monthly expenditure on rent in 2017	Equal variances assumed	3.523	.070	-4.204	32	.000	-1734.848	412.673	-2575.437	-894.260
	Equal variances not assumed			-3.512	14.230	.003	-1734.848	493.970	-2792.703	-676.994
Monthly expenditure on water in 2017	Equal variances assumed	9.946	.002	2.660	92	.009	510.738	192.015	129.379	892.096
	Equal variances not assumed			2.403	52.570	.020	510.738	212.577	84.280	937.195
Monthly expenditure on electricity in 2017	Equal variances assumed	1.635	.206	.622	56	.537	555.394	893.434	-1234.370	2345.158
	Equal variances not assumed			.551	26.801	.586	555.394	1008.598	-1514.795	2625.583
Monthly expenditure on medical services in 2017	Equal variances assumed	.326	.571	-1.224	54	.226	-621.222	507.588	-1638.875	396.431
	Equal variances not assumed			-1.255	32.389	.218	-621.222	495.030	-1629.089	386.646

Table 23: Independent t-test: Perception of personal safety

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
I feel safe to walk alone outside my house at night now compared to 2011	Equal variances assumed	23.974	.000	-4.065	98	.000	-.920	.226	-1.370	-.471
	Equal variances not assumed			-4.390	94.949	.000	-.920	.210	-1.337	-.504
I feel safe to walk in my	Equal variances assumed	.082	.775	-1.591	98	.115	-.242	.152	-.544	.060

neighbourhood during the day now compared to 2011	Equal variances not assumed			-1.617	93.216	.109	-.242	.150	-.540	.055

Table 24: Independent t-test: Time in productive and reproductive activities

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Time of day spent fetching water before 2011	Equal variances assumed	.065	.800	-.117	95	.907	-.010	.082	-.172	.152
	Equal variances not assumed			-.119	90.619	.905	-.010	.080	-.169	.150
Time of day spent cooking before 2011	Equal variances assumed	25.605	.000	-3.093	95	.003	-.400	.129	-.657	-.143
	Equal variances not assumed			-2.897	63.410	.005	-.400	.138	-.676	-.124
Time of day spent cleaning the house before 2011	Equal variances assumed	.863	.355	.436	94	.664	.043	.100	-.154	.241
	Equal variances not assumed			.422	74.443	.674	.043	.103	-.162	.249
Time of day spent doing laundry before 2011	Equal variances assumed	.260	.611	-.283	94	.778	-.024	.083	-.188	.141
	Equal variances not assumed			-.284	86.883	.777	-.024	.083	-.188	.141
Time of day spent taking care of children before 2011	Equal variances assumed	1.158	.288	-1.452	46	.153	-.397	.273	-.946	.153
	Equal variances not assumed			-1.448	45.016	.155	-.397	.274	-.948	.155
Time of day spent undertaking employed/wage work before 2011	Equal variances assumed	6.298	.031	1.226	10	.248	.457	.373	-.374	1.288
	Equal variances not assumed			1.076	5.031	.331	.457	.425	-.633	1.547
Time of day spent undertaking business activities before 2011	Equal variances assumed	6.576	.013	1.998	56	.051	.358	.179	-.001	.717
	Equal variances not assumed			2.089	53.192	.041	.358	.171	.014	.702
Time of day spent fetching water in 2017	Equal variances assumed	.349	.556	-.294	94	.769	-.011	.036	-.083	.062
	Equal variances not assumed			-.303	91.305	.763	-.011	.035	-.081	.060
Time of day spent cooking before in 2017	Equal variances assumed	21.183	.000	-2.664	96	.009	-.345	.130	-.602	-.088
	Equal variances not assumed			-2.516	66.704	.014	-.345	.137	-.619	-.071
Time of day spent cleaning the house in 2017	Equal variances assumed	3.029	.085	.835	96	.406	.071	.086	-.098	.241
	Equal variances not assumed			.783	63.961	.437	.071	.091	-.111	.254
Time of day spent doing laundry in 2017	Equal variances assumed	1.398	.240	-.628	95	.531	-.050	.080	-.209	.108
	Equal variances not assumed			-.636	91.865	.526	-.050	.079	-.207	.107

Time of day spent taking care of children in 2017	Equal variances assumed	.893	.349	.068	48	.946	.022	.332	-.645	.690
	Equal variances not assumed			.069	43.651	.946	.022	.327	-.636	.681
Time of day spent undertaking employed/wage work in 2017	Equal variances assumed	2.327	.171	.695	7	.510	.350	.504	-.842	1.542
	Equal variances not assumed			.742	6.428	.484	.350	.472	-.786	1.486
Time of day spent undertaking business activities in 2017	Equal variances assumed	5.386	.024	2.101	53	.040	.390	.186	.018	.762
	Equal variances not assumed			2.220	51.267	.031	.390	.176	.037	.742

Table 25: Independent t-test: Mode of transportation

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Mode of transport to place of work in 2011	Equal variances assumed	2.020	.161	.653	52	.517	.092	.141	-.192	.376
	Equal variances not assumed			.689	38.764	.495	.092	.134	-.179	.364
Mode of transport for children to school in 2011	Equal variances assumed	9.545	.003	1.381	51	.173	.350	.253	-.159	.859
	Equal variances not assumed			1.340	36.720	.188	.350	.261	-.179	.879
Mode of transport to health facility in 2011	Equal variances assumed	1.495	.224	-.669	96	.505	-.100	.150	-.397	.197
	Equal variances not assumed			-.684	92.424	.496	-.100	.146	-.391	.191
Mode of transport to the market in 2011	Equal variances assumed	45.076	.000	-2.855	96	.005	-.404	.141	-.684	-.123
	Equal variances not assumed			-3.372	56.000	.001	-.404	.120	-.643	-.164
Mode of transport to place of work in 2017	Equal variances assumed	.015	.903	.063	53	.950	.013	.211	-.409	.436
	Equal variances not assumed			.064	52.292	.949	.013	.209	-.407	.434
Mode of transport for children to school in 2017	Equal variances assumed	7.218	.010	1.213	49	.231	.334	.275	-.219	.887
	Equal variances not assumed			1.223	42.858	.228	.334	.273	-.217	.884
Mode of transport to health facility in 2017	Equal variances assumed	1.499	.224	-1.290	98	.200	-.272	.211	-.690	.146
	Equal variances not assumed			-1.308	92.652	.194	-.272	.208	-.684	.141
Mode of transport to the market in 2017	Equal variances assumed	22.845	.000	-2.419	98	.017	-.541	.224	-.985	-.097
	Equal variances not assumed			-2.546	98.000	.012	-.541	.213	-.963	-.119

Table 26: Linear Regression – Paving of roads and income generation

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.056[a]	.003	-.022	3.996

a. Predictors: (Constant), Extent to which paving of roads has influenced household activities
b. Dependent Variable: Source of income in 2017

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	2.005	1	2.005	.126	.725[b]
	Residual	638.781	40	15.970		
	Total	640.786	41			

a. Dependent Variable: Source of income in 2017
b. Predictors: (Constant), Extent to which paving of roads has influenced household activities

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	6.623	1.674		3.957	.000
	Extent to which paving of roads has influenced household activities	-.351	.990	-.056	-.354	.725

a. Dependent Variable: Source of income in 2017

Table 27: Linear Regression – Security lighting and time in business activities in the evening

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.166[a]	.028	.003	2.468

a. Predictors: (Constant), Extent to which installation of high mast flood lighting has influenced household activities
b. Dependent Variable: Security lighting has increased the number of hours i can carry out my business in the evening now compared to 2011

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	6.889	1	6.889	1.131	.294[b]
	Residual	243.587	40	6.090		
	Total	250.476	41			

a. Dependent Variable: Security lighting has increased the number of hours i can carry out my business in the evening now compared to 2011
b. Predictors: (Constant), Extent to which installation of high mast flood lighting has influenced household activities

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	3.196	.691		4.625	.000
	Extent to which installation of high mast flood lighting has influenced household activities	.330	.311	.166	1.064	.294

a. Dependent Variable: Security lighting has increased the number of hours i can carry out my business in the evening now compared to 2011

Table 28: Linear Regression – Paving of roads and improved health status

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.127[a]	.016	-.008	.87422

a. Predictors: (Constant), Extent to which paving of roads has influenced household activities
b. Dependent Variable: Improve_Health

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	.501	1	.501	.656	.423[b]
	Residual	30.570	40	.764		
	Total	31.071	41			

a. Dependent Variable: Improve_Health
b. Predictors: (Constant), Extent to which paving of roads has influenced household activities

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	1.939	.366		5.294	.000
	Extent to which paving of roads has influenced household activities	.175	.217	.127	.810	.423

a. Dependent Variable: Improve_Health

Table 29: Linear Regression – Water connections and household expenditure

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.038[a]	.001	-.028	1157.298

a. Predictors: (Constant), Extent to which water connection has influenced household activities
b. Dependent Variable: Monthly expenditure on water in 2017

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	64423.529	1	64423.529	.048	.828[b]
	Residual	45537540.359	34	1339339.422		
	Total	45601963.889	35			

a. Dependent Variable: Monthly expenditure on water in 2017
b. Predictors: (Constant), Extent to which water connection has influenced household activities

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	1181.650	354.735		3.331	.002
	Extent to which water connection has influenced household activities	21.765	99.238	.038	.219	.828

a. Dependent Variable: Monthly expenditure on water in 2017

Table 30: Linear Regression – Perception of personal safety and availability of security lighting

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.777[a]	.604	.594	.497

a. Predictors: (Constant), Extent to which installation of high mast flood lighting has influenced household activities
b. Dependent Variable: I feel safe to walk alone outside my house at night now compared to 2011

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	15.080	1	15.080	60.948	.000[b]
	Residual	9.897	40	.247		
	Total	24.976	41			

a. Dependent Variable: I feel safe to walk alone outside my house at night now compared to 2011
b. Predictors: (Constant), Extent to which installation of high mast flood lighting has influenced household activities

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	1.069	.139		7.671	.000
	Extent to which installation of high mast flood lighting has influenced household activities	.489	.063	.777	7.807	.000

a. Dependent Variable: I feel safe to walk alone outside my house at night now compared to 2011

Table 31: Linear Regression – Time in business activities and availability of water

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.115[a]	.013	-.011	2.009

a. Predictors: (Constant), Extent to which water connection has influenced household activities
b. Dependent Variable: I have more time to carry out my business activities

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	2.170	1	2.170	.538	.468[b]
	Residual	161.449	40	4.036		
	Total	163.619	41			

a. Dependent Variable: I have more time to carry out my business activities
b. Predictors: (Constant), Extent to which water connection has influenced household activities

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	2.890	.567		5.098	.000
	Extent to which water connection has influenced household activities	.123	.168	.115	.733	.468

a. Dependent Variable: I have more time to carry out my business activities

Annex 5: Thesis time schedule

Date	Activity
13th March	Submission of background and problem statement
14th – 29th March	Develop research questions
29th March	Colloquium 1 – research questions
28th -31st March	Review chapter one with comments from colloquium 1
31st March	Submission of first draft chapter 1
1st – 20th April	Literature review
7th April	Review chapter 1 comments with supervisor
18th April	Submission of conceptual framework for comments
19th April	Colloquium 2 – literature review/conceptual framework
20th – 21st April	Review chapter 1 and 2 with comments from supervisor and colloquium 2
21st April	Submission of 2nd draft research chapter 1 and draft chapter 2
2nd May	Submit to supervisor reviewed chapter 1 and 2
3rd – 18th May	Operationalization
18th May	Submit to supervisor draft chapter 3 for review
29th May	Submit to supervisor draft thesis proposal
2nd June	Colloquium 3 – choice of research strategy
3rd – 11th June	Incorporate comments from supervisor and colloquium Work on draft data collection instruments
12th June	Submit thesis proposal Chapter 1, 2 and 3 and draft data collection instruments)
22nd – 27th June	Review thesis proposal and data collection instruments
19th – 27th June	Prepare for field work
28th June	Break for field work
29th – 12th July	Data collection
5th – 28th July	Sorting questionnaires collected, Data entry
31st July – 7 September	Initial data analysis
31st July – 4th August	Colloquium 4 –research findings
4th -18th August	Analysis and conclusion
21st August	Submission of first draft of the thesis
7th September	Final submission
11th – 15th Sept.	Thesis defense

Annex 6: Field work time schedule

Activity	Month																										
	Jun-17													Jul-17													
	Week 1						Week 2							Week 3							Week 4						
Date	19	20	21	22	23	24	25	26	27	28	29	30	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Contact KISIP officials																											
Book appointment for interview with KISIP officials																											
Get contacts for SEC representative from KISIP officials																											
Work with a colleague to assist recruit research assistants																											
Application for research permit																											
Book appointments with SEC																											
Semi-structured interview with KISIP Coordinator																											
Train research assistants																											
Test questionnaire																											
Edit questionnaire and interview guide																											
Print Questionnaires																											
Female-headed households survey																											
Semi-structured interview with Machakos KISIP project manager																											
Interview with SEC representatives																											
Key in data collected																											
Request project documents from KISIP																											
Review project documents																											

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