Effects of Basic Infrastructure in Planned Settlements on Community Livelihood in Rwanda. The case of Bugesera District.

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ABSTRACT

This research is about the effects of Basic Infrastructure in Planned settlements on Community Livelihood in Rwanda; The case of Bugesera Distict.

The Descriptive design was applied to describe independents and dependents variables; to analyze quantitative data descriptive statistical methods were adopted and a survey interviews methodology was used as a study strategy that allowed generalization of the results from the sample size that represent the entire population. The research was conducted in Rwanda, Bugesera District June 2023-December 2023.

The stratified sampling used and 381 households from planned Settlements was our sample size whereby 184 was from Kanzenze Cell while 197 was from Nyamata Town Cell. The calculated households was based on 5th Population and housing census Rwanda 2022.

The findings identified, mainly the existing basic infrastructure for drinking water connectivity 96%, electricity 99%, earth roads 95%, High Schools 87%, Health centers 53%, Nursery schools 90% and Police stations 54%. More than 90% recommend providing basic infrastructure such as water, electricity, road networks and 72% wastes water ways during spatial planning. The remaining basic infrastructure such as schools, health centers and security institutions among others recommend being provided during physical plan implementation. However, there is a gap in the provision of basic wastes water collection facilities which is 0%, cooking gas 0%and University0%. 73% have access to advisory health services only while 62% have full access to all health services. 36% dispose wastewater in the open space while 63% dispose in the septic soak pits,10% reuse it for watering garden. Health services contribute to the income generation at 98%, completed road 82%, Schools 81%, clean water 68% and electricity 65%. Findings highlight the increase in basic infrastructure facilities, has a potential to increase the level of community livelihood. Indeed, the p value of this study was not significant p=0.121, the reason why the null hypothesis was therefore accepted.

Findings pointed out, all basic infrastructure including wastes water management systems that should be provided a space during spatial planning, others in the physical plan implementation. Furthermore, researchers should focus on designing all required basic infrastructures in planned settlements of the study area as well in all other planned settlements in Rwanda and focus on emphasis of the decentralized sewerage system facilities to receive wastewaters from the community which can be reused for conservation and environmental protection.

Keywords: Basic Infrastructure, Community, Facilities, Livelihood, Planned Settlements

I. INTRODUCTION

The population of a country and its geographical distribution affects the surrounding environment state from the speed of development and household formation, accessing basic infrastructure and services, employment opportunities and wealth of ecosystem services (REMA, 2009). Expending the urban markets is a foundation factor of increasing the rural incomes as well as sustaining the increasing urban high productivity. Despite these movements, rural urban links are affected by inadequate transportation facilities between products and markets, unreliable and costly sources of electricity and clean water access, and limited provision of the information communication Technology. Poor management of the responsible Institutions aggravate these constraints due to the big inconsistency in living

standards among sub regions and nations whether urban and rural areas, encourage migration toward urban settlements. Therefore, all this result in a high agglomeration of people in large cities, urban sprawl and slum housing, which are the three main features of Africa's urbanization (ADB, 2013). Lack of access to essential products, services and facilities is a barrier socio-economic and human growth. Combined with and absence of physical infrastructure, these communities often face major crisis of securing livelihood opportunities. To achieve the sustainable Development Goals and their main goal of leaving no one behind, it is crucial to overcome these obstacles. Community infrastructure referred to small-scale infrastructure in and around local community areas that are not maintained properly by the government or sectorial agencies. Farm to market and other access roads, footbridges, water supply facilities, irrigation canals and drainage systems, and communal facilities are some examples of such community infrastructure (ILO, 2010). Rwanda striving to become a middle income nation (MIC) status by 2035 and high-income country by 2050 (WB, 2021b). Rwanda has demonstrated a distinct commitment to protecting the environment in addition to focusing on economic growth through poverty reduction plan, 2013-2018, vision 2020, the commitment of the sustainable development Goals of the United Nations of 2015, the National Strategy for transformation one for 2017-2024 as well as Vision2050. Based on 2050 Vision of Rwanda, the catalyst in the future development include the agglomeration, integration, innovation, and competition (REMA, 2021). Bugesera district is a district that is at the border of City of Kigali whereby a lot of people from Kigali are migrating and make a new urban area. Due to those migration movements, Bugesera District undertook its step to planned settlements accordingly for avoiding the urban sprawl issues that currently observed in some parts of Kigali and other urban areas, generating a lot of slums or informal settlements difficult for basic infrastructure systems to install. To meet the requirement of sustainable growth, Bugesera District need to ensure availability of basic infrastructure required to accommodate the migration movement from both rural areas and the City of Kigali. The basic infrastructure includes but not limited to; energy, sanitation and communication structures that contribute to social-economic and environmental protection. This research is in the domain of infrastructure planning by ensuring community well being in a protected environment and promotion of the green economy for sustainable development. The scope of the secondary data covered the information collected from December 2010 to December 2022. It was focused on assessing the effects of basic infrastructure in planned settlements on community livelihood in Rwanda, case study of Bugesera District to find out possible recommendations, to be advised to policy makers and local Government including Bugesera District which can support the sustainable planning for achieving Rwanda vision 2035 as well as 2050 for sustainable development.

II. METHODOLOGY
2.1. DESCRIPTION OF THE STUDY AREA.
The study research was conducted in Bugesera District located in the South Eastern plains of Rwanda notably in the south west of the Eastern Province. By using strategic sampling the study research on two sectors; Ntarama Sector and Nyamata Sector of the District which have already Planned settlements whereby Kanzenze Cell of Ntarama and Nyamata Cell of Nyamata Sector were selected. It borders Republic of Burundi (Kirundo Province) in the south, Ngoma district in the East, Kigali City and Rwamagana district in the North. The District is sandwiched between Rivers Nyabarongo and Akanyaru which converge at the southern part to form Akagera River.
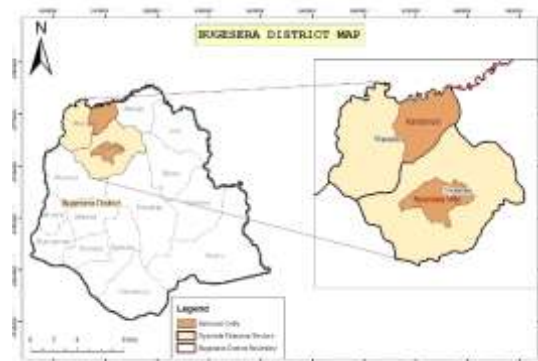

Figure1: **The study area**

Bugesera is one of seven Districts of the Eastern Province in Rwanda. It covers a total surface area of 1337 Km². The district is composed of 15 Sectors (Gashora , Juru, Kamabuye, Ntarama, Mareba, Mayange, Musenyi, Mwogo, Ngeruka, Nyamata, Nyarugenge, Rilima, Ruhuha, Rweru and Shyara), 72 Cells and 581 Villages.
2.2. STUDY DESIGN
This study adopted descriptive design to assess the effects of basic infrastructure in planned settlements on community livelihood in Bugesera District. This described independent and dependent variables. To analyze quantitative data by using

descriptive statistical methods, a survey interviews methodology was used as the study strategy whereby it allowed the generalization of results from a sample size that represented the entire population.

2.3. SAMPLE SIZE AND SOURCE OF DATA

381 heads of households have been calculated from two sectors to be interviewed respectively 197 in Nyamata town cell and 184 in Kanzenze cell as stratified sampling results. The primary that were used includes the respondents such as interviews, field observation and from self administered questionnaires while the secondary data include published reports, textbooks, journals, articles, internet and Government Publications.

2.4. DATA COLLECTION AND ANALYSIS

Qualitative data collection method used whereby a pre-test of the questionnaire was carried out before conducting the actual survey to test its validity and suitability for the research study. The questionnaire was drafted in Google forms to be available to the interviewer mobile phone; the researcher and other personnel with degree holder carry out interviews. The questions answers were collected and submitted to the researcher email for analysis.

The questionnaire was designed in a way that, it will respond all research objectives in respective order while Arc map GIS and remote sensing software was used to localize the study area by using the recent data collected by the Ministry of Environment and the Ministry of Infrastructure with collaborating institutions including ESRI –Rwanda.

Data were coded and recorded into SPSS (version 20) software for data analysis. The analysis highlight the existing basic infrastructure in planned settlements and the level of community livelihood in Bugesera District.

III. RESULTS AND DISCUSSION
3.1.BASIC INFRASTRUCTURE IN PLANNED SETTLEMENTS OF BUGESERA DISTRICT

This part of the results discussion, the research findings contains the data analysis of the first specific objective of assessing the existing basic infrastructure in planned settlements in Bugesera District, water supply, walking distance for collecting drinking water, type of health center, schools, roads, communication facilities and other ideas from the respondents.

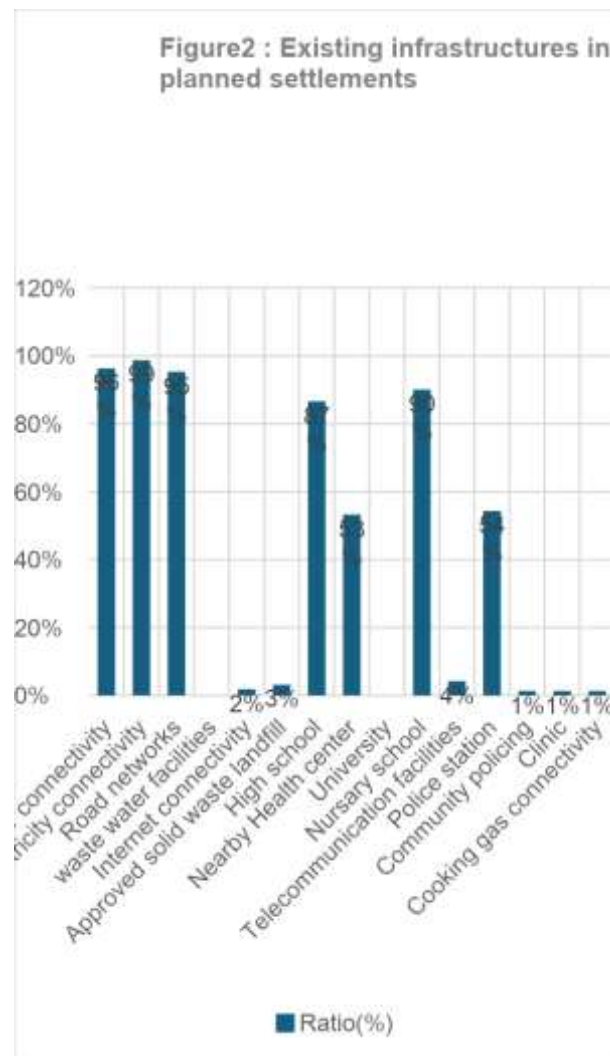### 3.2.EXISTING BASIC INFRASTRUCTURE IN PLANNED SETTLEMENTS

The impacts that the community might be facing are related to health and sanitation issues from the polluted air, pollution to the downstream surface water loss of income due to going finding the university studies far away or not attending university. Missing some important information for development due to poor telecommunication services and destruction of the natural biodiversity due to cutting of trees for firewood. All this affect community itself as well as the environment they live in called planned settlements.

Figure2 : Existing infrastructures in planned settlements
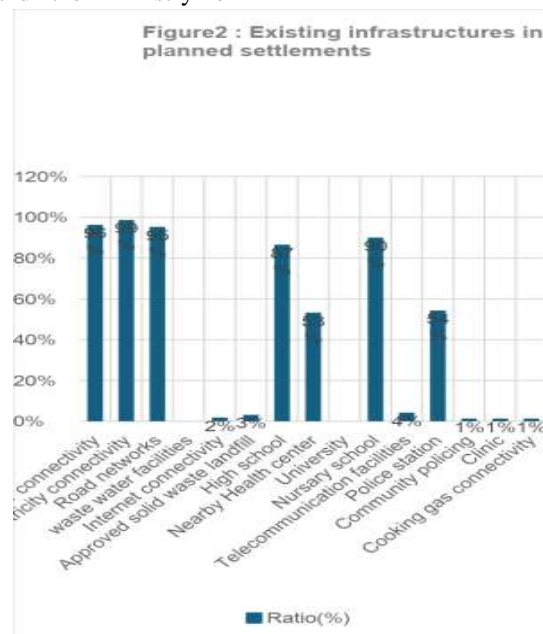
3.3. BEST PERIOD FOR BASIC INFRASTRUCTURE INSTALLATION IN MODERN SETTLEMENTS

In average 80.6% of the respondents confirmed that basic infrastructure to be considered during spatial planning implementation including Electricity connections, drinking water, wastes waterways, road networks, internet, and cooking gas. However, this is not the case; the practice is that; the basic infrastructures installed after physical planning implementation and affect local community in a way that they compensate for installing the basic infrastructure. Social -economic impact is observed when demolishing the existing buildings, compensation requirements displacing and resettle the affected local community.

Figure2 : Existing infrastructures in planned settlements

3.4. EXPECTED LIVELIHOOD IN PLANNED SETTLEMENTS

The basic infrastructure pointed out in the study research in the area. However, the existing basic infrastructure identified the gap in the provision of waterways systems whereby there is no such basic infrastructure, road networks are not asphalt and without drainage systems for storm water, cooking gas infrastructure is not available and not connected to the community homes. Meaning that the majority of the study area, for cooking the local they use mostly firewood, and charcoal which aggravate the degradation of forests and impact the biodiversity conservation. This also will impact the existing biodiversity in the area that will be cleaned and increase the climate change impacts.

Figure 23: Expected livelihood services in the planned settlements
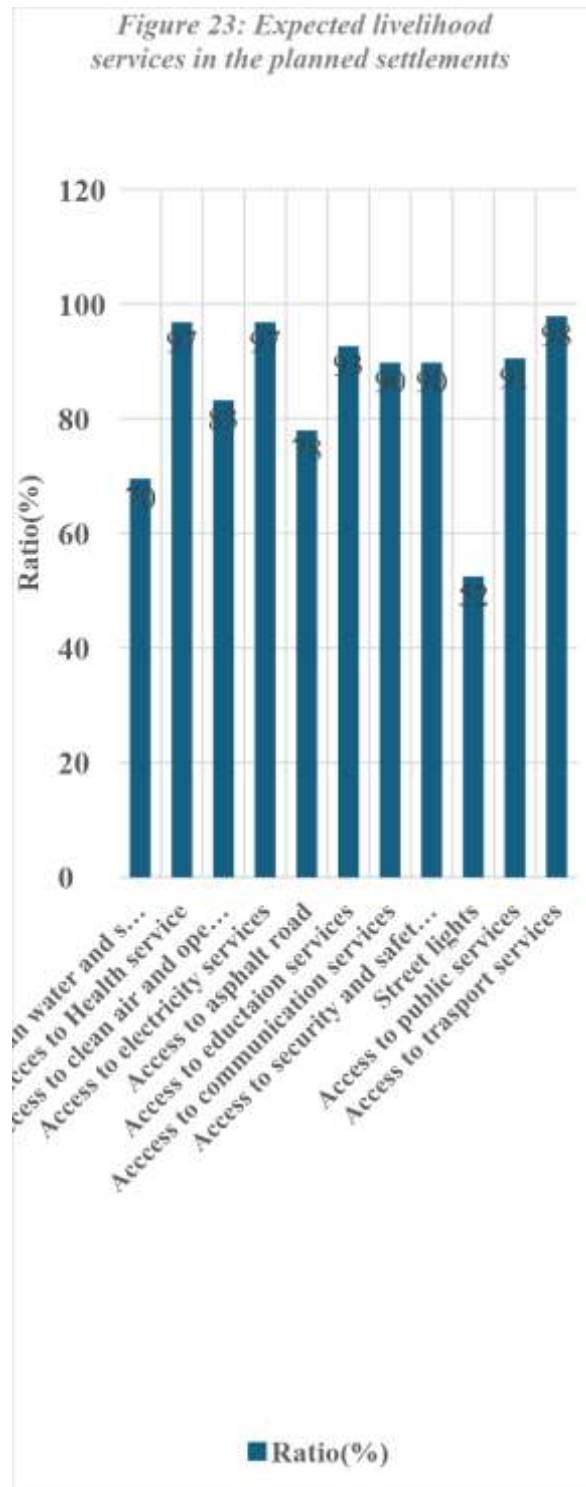
3.5. RELATIONSHIP BETWEEN EXISTING BASIC INFRASTRUCTURE AND COMMUNITY LIVELIHOOD

By analyzing the existing basic infrastructure recorded data and the expected community livelihood in the planned settlements, the paired sample statistics and the paired sample tests have been used to analyses the situation of the study area as demonstrated here below:

Table2: Paired sample statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Ratio(%) of existing basic infrastructures	61.00	8	40.610	14.358
	Ratio(%) of expected level community livelihoods	87.75	8	9.996	3.534

N stands for the sample size of the existing basic infrastructure of the community livelihoods while Std. stands for the standard eg: Std. Deviation, Std. Error Mean (Standard deviation, standard error of the mean). This is a normal distribution since the sample size is not large enough and less than 30(N=8) The analyzed results indicate that above average of the community in the study area expect high living standards in planned settlements depending on basic infrastructure availability due to the recorded low standard deviation of expected community livelihood which is 9.996 indicating the recorded results are not far from the mean compared to existing basic infrastructure whereby Std deviation is 40.610. The difference of the mean of both existing basic infrastructure and the level of community livelihood in planned settlement which is 26.75 indicates the gap in the provision of basic infrastructures in planned settlements which require the planners and the policy makers to revise the

implementation of the basic infrastructure in planned settlements.

Paired sample test
t stands for t test, df stands for degree of freedom, sig: significance
The Analysis of paired sample test of the existing basic infrastructure in the study area and the community livelihood expected in planned settlements, the findings identify that P value greater than 0.05 as it is found equal to 0.121, significance level of the two tailed tests, as the p value =0.121 (0.121>0.05).

Therefore, H0 is accepted. The findings of this study area shows that there is a positive relationship between the existing basic infrastructure and the community livelihood. This means that the improvement in basic infrastructures has the potential to raising the community livelihood of the residence leading to the sustainable development.

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	Ratio(%) of basic infrastructures - Ratio(%) of expected livelihoods	-26.750	42.844	15.148	62.569	9.069	1.766	7	.121

IV. COMPARISON OF THE RESEARCH FINDINGS WITH OTHER STUDIES

How much does the physical infrastructure contribute to economic growth?
The study has been conducted by: Govinda et al, 2021. This is a policy research working paper 9888 Published by World Bank; December, 2021. As research methodology , the study evaluated the contributions to economic growth of three main categories of basic

infrastructure; transport, electricity and telecommunications infrastructure using data from 87 countries over 1992-2017.Compared with existing studies the study uses more recent data that includes new types of infrastructure such as mobile phones and provide separate estimates for developing and developed countries. The pooled mean group estimator, which tests for the weak exogeneity of infrastructure variables, has been employed. Key findings is that an increase in infrastructure particularly electricity generation

capacity and telecommunications has significant positive effects in more recent years(1992-2017) than in earlier (1970-1991) and the effects of basic infrastructure are higher in developing economies than in industrialized economies. The key finding on the study is that an increase in infrastructure, especially electricity generation capacity and telecommunications, has significant effects on gross domestic product. The research mainly, is highlighting only effects of three basic infrastructure on global scale which contribute to economic growth including transport electricity and telecommunications it is not finding out the effects of other basic infrastructure that has effects on community livelihood in developing countries, these basic infrastructure such as health facilities, wastes waterways systems, schools facilities, and their corresponding services to the community livelihood.

Lack of basic infrastructure the impact on economic development.

According to Gaal and Afrah (2017), for the study conducted in Benadir region and Hir-Shabelle, Somalia. A survey research method was adopted to examine the impacts of lack of basic infrastructure on economic development. The data were collected through questionnaires filled by respondents equally. The results of the questionnaire were analyzed by using SPSS version 16.0. The result findings identified that lack of basic infrastructure brings poor standards of living and increase poverty. This research has not discussed the level of existing basic infrastructure and the level of community livelihood from the study area to advise the policy makers and or government to what they can start the planning and project the future economic development based on findings of the existing basic infrastructure on community livelihood.

Effects of city of Kigali expansion on the livelihood of the surrounding communities.

A study conducted by Gakuba (2020) in Rwamagana District, Rwanda. The purposive sampling technique was used and 70 respondents from four sectors of Rwamagana which are adjacent to City of Kigali. The sample includes 50 people representing the local residents affected by the movement, 16 who went to live there migrating from other places and four executive secretaries of sectors who were taken as key informants. The study also used quantitative approaches. The quantitative approach used the questionnaire to collect the information from the respondents and

qualitative one used semi-structured interviews guide to collect information from key informants. Data collection instruments were also administered to pilot group of people to ensure reliability. Collected data were arranged, analyzed using SPSS and tables to summarize findings. The research study find that the City of Kigali is undergoing a high and quick growth which expand it towards its surrounding rural areas; positive effects include improvement of some basic infrastructures like roads, schools and Health centers. Local residents by getting the money from selling their land to migrants improve their standards of living. Negative effects include the increase of the price of housing, decrease of the land for agriculture, conflicts among families after selling their land. Overcrowding of some infrastructure like schools and roads and people in poor quality of houses and other shelter-less after selling the land and misuse the income. This study has looked the effects of migration on informal settlements and the impacts it can cause on the existing local residents. The study did not highlighted the effects of the basic infrastructure in the planned settlements on community livelihood of the study areas, from migration impacts to ensure sustainable development. The study has not also highlighted the level of existing basic infrastructure and the level of community livelihood as baseline information to advise the Government and policy makers for improving the future endeavors of planned settlements particularly on community livelihood.

Morphological study of planned human settlement affected by service trade activities.

R Aditantri et al, 2019, have conducted the research study. The study has been conducted in Tanjung Duren Selatan; West Jakarta. The study used the qualitative method with mapping and parameter assessment based on aspects in Human settlement morphology. The findings identify that the trade and service sector in Tanjung Duren Selatan give the impact for housing morphology such as increasing the land use for housing solid formation dominate more than the formation of empty spaces, morphological formation of figures on ground linkage and places that increase the impacts. The study has looked only for the trade service activities negative impacts only, it has not discussed on the impact of trade service activities on community livelihood in the study location.

The impacts of infrastructure on rural communities.

The study was conducted by Manggat et al, 2018. It was conducted in Sintok, Malaysia. The methodology used is the survey to view the link between social health and availability of well finished basic infrastructure facilities. Findings identify that failure to incorporate changes specifically basic infrastructure development into communities is believed to affect the community's state of wellbeing. This research has not highlighted and detail typical basic infrastructure services that can leverage the community standards of living and highlight the status of the existing basic infrastructure as well as the status of their services in the study location.

Physical demarcation of infrastructures and making detailed physical plan of Kabeza site.

The study was conducted in Kabeza site, Kabeza Village, Kanzenze Cell and Ntarama Sector in Bugesera District. Researchers suggest that the waste disposal area be located at least 6km from residential area or be located at 5km form area of Kabeza site. This will be facilitated by the use of daily transport of the waste to the dump area (Habiyaremye, 2020).

In addition to this research concentrating on physical plan, re-plotting of the concerned village produced total parcels of 1309. These new plots represent residences where 908 plots are for single family residential and 188Plots are for single family residential with one store while other 2013 plots remain as they are currently on the site. Other area of the site is designed for roads with 24km of the length of 12 and 9m of width, Commercial (Small market and off-core commercial area) with 1.24ha, education and research with 1.13ha, green space of 0,97ha, health post with 0,5ha, recreational area with 1.51ha and five (5) existing houses are affected by the planned road (Habiyaremye, 2020). This research findings is not highlighting the management of wastes water for the environmental protection and pollution control of the downstream surface and underground water.

4.1. GAP ANALYSIS AND RESULTS FINDINGS

The study under discussion assessed the effects of basic infrastructure in planned settlements on community livelihood in Rwanda, case study of Bugesera District. Its specific objectives is to assess the existing basic infrastructures in Bugesera District, to assess the level of community livelihood in Bugesera district and to analyse the relationship of the basic infrastructure and the community livelihood in Bugesera District. Reference on other cited above researches whereby the gap has been identified for each research findings, this research covered all basic infrastructure that exist in the study area with their status and the level of community livelihood compared to the existing basic infrastructure. The research also highlighted the findings of expected basic infrastructure that can level the concerned households livelihood for sustainable development which both maintaining social economic development and environmental protection. The first objectives was to assess the existing basic infrastructure in the study area in whereby 99% are connected to electricity,96% connected to drinking water, 95% to road networks (earth roads), 87% to High Schools, 90% Nursary Schools , 53% Health centers and 54%Police station. However, there is no wastes water ways systems available for pollution controls as well as cooking gas infrastructure to reduce the use of firewood. The expectations from the household heads identified the need of all cited basic infrastructure to be provided spaces or ways before the community installation, in the spatial planning(above 90% for water ,electricity and roads networks) and others during physical planning implementation(above 60%) to avoid the socio-economic destruction of the economic infrastructure.

The second objective was to analyze the level of community livelihood whereby the findings 99% of the household heads interviewed access to electricity services, 91% have access to safe drinking water, 62% access to full health services while others access advisory services, malaria and diarrhea treatment provided by community health workers.9% don't have access to safe drinking water, they use water from spring or wells. The livelihood that contribute to the income generation includes Health centers at 98%, Completed roads 82%, Schools 81%, clean safe drinking water 68% and electricity at 65%.

The resident don't have access to wastes water disposal facilities. It was found that 10% use wastes water for watering gardens, 36% dispose the wastes water to the open space while 63% dispose the collected wastes water in the septic soak pits, as a result of underground water pollution and the surrounding environmental air pollution.77% use their cell phones with internet, 26% use mobile phones without internet, 19% use computer with internet. For security services 48% access community policing services and 42% access police

station services while 10% of respondent responded to do not have security services.

The third objective was to in analyze the relationship between existing basic infrastructure and community livelihood whereby the research findings from statistical analyses identified the relationship between the two variables as the H0 hypothesis concluded depending on the P value obtained as 0.121 which is greater than 0.05 as a meaning of improving basic infrastructure raise community livelihood.

V. CONCLUSION &LESSON LEARNED

The effects of basic infrastructure in planned settlements on community livelihood, research has proved that the improved basic infrastructure improve the community livelihood and the increased basic infrastructure increase community livelihood as well the standards of living which is the core goal for generation to generation for sustainable development including social-economic and environmental measures of development.

Infrastructure sector in Rwanda should consider the research findings in the areas of wastes water management to protect natural resources such as water, air and the community as a whole and infrastructure that help the residents in planned settlements to access energy required for cooking as a measure to reduce the forests degradation for cooking.

It is also noted that all basic infrastructure in the research findings should be provided a space during spatial planning, others in the physical plan implementation to avoid the destruction of the socio-economic structures that supports community to survive.

This can be implemented through the infrastructure policy, planning, implementation and funding to ensure the expected development in planned settlements. As highlighted in this research the Government can take lead of the requirements to provide required basic infrastructure in planned settlements to enhance sustainable development.

5.1. RECOMMENDATIONS

The recommendations of the research study discussed; reference on the study findings from existing basic infrastructure in planned settlements and the level of community livelihood findings from the study area.

The recommendation can help the policy, planning and implementation levels of the development in the country for achieving sustainable development goals as the current global development measure to ensure increased community wellbeing, based on provision of the improved basic infrastructure in planned settlements which raise the community livelihood as identified by this research findings.

The findings on the existing basic infrastructure in the study area identified a big gap in the provision of the waste water basic infrastructure facilities, university, internet connectivity, cooking gas facilities, health centers, and security facilities. All above mentioned items unavailability in the community affect social economic and environmental interdependence and reduce the standards of living and affect negatively the sustainable development expected in planned settlements.

The following recommendations are proposed to different levels of the Government at the policy, planning and implementation to stick the expected development in planned settlements in the study area as well as in the entire country Rwanda. Ministry in charge, District and future researchers can implement the following measures to ensure the research findings are implemented to solve the identified gaps:

• Awareness and the best practice to reuse water should be included in local community program implementation in planned settlements, this can be developed by the Government, non-governmental organizations, Privet sector and community organizations with the support of the local government to reduce air and soil pollution by ensuring water conservation.

• Looking on the characteristics of the road networks, 98% are earth roads .Improve the existing road networks status in the planned settlements which are characterized by roads without storm water drainage systems .To facilitate the transport services which is not functional in the community due to inaccessible place the responsible planners and implementers should include the completed road networks in planned settlements to attract transport investors which may come to invest in transport

• Planned settlements should have wastes water disposal facilities (wastes water channels) which has a reuse system facility (wastes water treatment facility). The facilities should be protected in a way that, air and natural water pollution is avoided and water is reused for other purposed such as watering the dry grounds, mopping houses, etc. The action will increase water conservation, protect open space, raise social economic income, prevent

related diseases from the wastes water as well as prevent climate change.

• Provision of the Higher learning education institution in planned settlements will improve the standards of living of the future generation by equipping the youth on the required current global development with the advanced technologies without walking a long distance to look for university studies. Yes the online system reduced this. However, the internet connection is also another barrier. The reason why to provide a higher education infrastructure in the planned settlements is a major key for sustainable development.

• Provision of the internet connectivity in the planned settlements will increase the communication, research, innovation as the community will find easy to find skills from all over the world to be applied in their daily life for social economic development.

• Provide drinking water kiosks as basic infrastructure for the community (poor) who are not able to afford connecting drinking water inside their home compounds this will prevent the community who use untreated water from the wells for drinking.

• .Basic infrastructure ways/systems should be captured during the spatial planning and implemented during physical planning implementation to prevent the conflicts and the destruction of the permitted housing infrastructures which is conducted in case the implementation of the basic infrastructures is conducted after physical planning implementation.

• Street lights have been pointed out by the respondents to be included in the provision of basic infrastructure to improve security and safe environment in the night hours, this will be agent of transformation from working few hours to work many hours which will increase production and income generation.

• To design a typical planned settlements which cater required basic infrastructure possible ways in the spatial planning and highlights space of the basic infrastructure that can be installed during physical planning implementation by the Government.

• Propose a decentralized wastes water collection and treatment facility location that can help residents of the study area to connect their wastes water in that facility and reuse that water for other purposes or leave the facility once treated to join other water bodies.

COMPETING INTERESTS
Authors have declared that there is no competing interests.

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