Infrastructure: The foundation for Sustainable Economic Development
A case study of Rwanda

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Abstract
Infrastructure can broadly be defined as long-term physical assets that operate in markets with high barriers to entry and enable the provision of goods and services. The Economic infrastructure supports economic activity such as communication, transportation and distribution networks, financial institutions and markets and energy supply systems. The Social Infrastructure is a subset of the infrastructure sector and typically includes assets that accommodate social such as schools, hospitals, prisons and community housing.

United Nation, in 2000, has defined eight goals named Millennium Development Goals (MDGs) that can be considered as mirror for the Sustainable Economic Development of any country.

It is certain that infrastructure plays a role on the Economic Development of a country because Governments and Private Sector invest in infrastructure in order to develop the economy. The present research aims to analyze the real impact of infrastructure on the Sustainable Economic Development in order to conclude whether infrastructure is the foundation of Sustainable Economic Development on which can be built the superstructure of a society including culture, institutions, political power structures, roles, rituals, state and different economical activities.

The research found that infrastructure is the sure way of achieving MDGs. In fact, without strong infrastructure, MDGs as indicators of Sustainable Economic Development would be a dream and the Sustainable Economic Development never achieved.

Keywords: Economic Development, Infrastructure, Millennium Development Goals Sustainable Economic Development.

Introduction
Infrastructure can be assimilated as essentially public goods, providing in principle, non-exclusive goods accessible to all; Fixed investments, bulky and lump-sum with long (or no) payback periods; Having considerable variation in earning power capacity (e.g. telecommunications versus water); Output mostly paid for in local currency (less true for ports and airports); Until recently, the public sector playing a dominant role (finance, regulation); Sensitive to corruption and political shifts (UN, 2011).

Yoshino & Nakahigashi (2000) define infrastructure as the capital stock that provides public goods and services. It produces various effects, including those on production activities and quality of life for the households, which thus permeate the entire society.

The meaning of infrastructure has been shifting from one focusing on physical fixed assets such as roads, airports, sea ports, telecommunications systems, water distribution systems and sanitation (what might be called ‘public utilities’). It now often embodies notions of softer types of infrastructure such as information systems and knowledge bases (Button, 2002). In general, infrastructure can be categorized into ‘hard’ infrastructure and ‘soft’ infrastructure. The former refers to physical structures or facilities that support the society and economy, such as transport (ports, roads and railways); energy (electricity generation, electrical grids, gas and oil pipelines); telecommunications (telephone and internet); and, basic utilities (water supply, hospitals and health clinics, schools, irrigation).

The latter refers to non-tangibles supporting the development and operation of hard infrastructure, such as policy, regulatory, and institutional frameworks; governance mechanisms; systems and procedures; social networks; and transparency and accountability of financing and procurement systems (Bhattacharyay, 2009). Broadly defined, therefore, infrastructure refers to all basic inputs into and
requirements for the proper functioning of the economy. In spite of this, there are two generally accepted categories, namely, economic and social infrastructure.

Economic infrastructure is a part of an economy’s capital stock used to facilitate economic production, or serve as inputs to production (e.g. electricity, roads, and ports). This helps to produce items that are consumed by households (e.g. water, sanitation and electricity). Economic infrastructure can further be subdivided into three categories: utilities (power, piped gas, telecommunications, water and sanitation, sewerage and solid waste disposal), public works (roads and water catchments in dams, irrigation and drainage) and other transport sub-sectors (railways, waterways and seaports, airports and urban transport systems). Social infrastructure, on the other hand, encompasses services such as health, education and recreation.

At the United Nations (UN) Millennium Summit of September 2000, 189 nations adopted the ‘Millennium Declaration,’ out of which grew a set of eight Goals that can be assimilated as indicators of Sustainable Economic Development. Those goals are: Eradication of extreme poverty and hunger, Achievement of universal primary education, Promotion of gender equality and empower women, Reduction of child mortality, Improvement of maternal health, Combat against HIV/AIDS, malaria and other diseases, Ensuring environmental sustainability, and Development of a global partnership for development. The Millennium Development Goals (MDGs) commit the international community to an expanded vision of poverty reduction and pro-poor growth and vigorously place human development at the center of social and economic progress in all countries.

The present research aims to analyze whether infrastructure contributes to the achievement of those eight Millennium Development Goals.

1. Key infrastructures
Darling Downs (2013) lists common key infrastructures such as: Transport (including roads, rail, aviation and maritime), Energy, Telecommunications, Water & Sanitation and Dwelling or Housing. In general, physical infrastructure, infrastructure businesses, and infrastructure markets have at least some of the following characteristics (Beca & Covec, 2013):

- **Long asset lives**
  Infrastructure assets typically last for a long time, over 50 years in some cases.

- **Long payback periods**
  Related to long asset lives, for some infrastructure investments the ‘payback’ period may be relatively long, with the returns to the investment relatively low in initial years, compensated for by greater returns in later years. E.g. Investment in new technology depends on the rate at which consumers adopt the new technology, and adoption can take several years to gather momentum.

- **Relatively large capacity increments**
  For practical and cost efficiency reasons, infrastructure capacity is generally built or augmented in fixed increments, and the size of these increments may be substantial relative to the change in demand over the short term.

- **Economies of scale and scope**
  Economies of scale and scope mean that average costs reduce with activity, so increased activity in infrastructure sectors could be associated with a performance improvement.

- **Network structure**
  Economies of scale and scope partly reflect the network structure of many infrastructure sectors. Networks provide value by connecting things, and the efficient structure of these connections usually involves sharing infrastructure across users and services.
Infrastructure outputs are often inputs to other sectors
The output of infrastructure sectors is used as an input in production of other goods and services, or is used by consumers in combination with other products.

Externalities
The nature and scale of activities in infrastructure sectors means these often give rise to externalities, i.e. effects of the existence and usage of infrastructure on others aside from the users that the users don’t take into account.

Efficiency / equity trade-offs
Economic efficiency generally requires that infrastructure users face the marginal cost of their actions, including any externalities. For example, the efficient price of using a road should include the direct marginal costs in terms of additional road maintenance required, plus the marginal external congestion and environmental costs.

Demand volatility
The level of demand for the services provided by infrastructure often exhibits peaks and troughs driven by time of day, holidays, seasons, the weather, and so on. Capacity is generally built with peak demand in mind, but this means that costly excess capacity must be carried in off-peak times.

Demand for reliability
Users of infrastructure also generally demand reliability of the service.

Imperfect market provision
Markets and private businesses do not always do a good job of providing infrastructure and related services, for a variety of reasons: In some cases, such as local roads, it is technically difficult to charge a price for usage and restrict access only to those who pay; Even if usage can be charged for, this may not be the most efficient pricing mechanism; If private infrastructure provision is feasible, economies of scale and scope may mean that adequate competition is not workable.

Place matters
The demand for almost all infrastructure services is located at a specific place, and the infrastructure must physically exist at that place to serve the demand.

2. Infrastructure and Economic Development
The role of infrastructure on economic development has been well documented in the literature Fallon (2003) Tachiwou (2010) Calderón & Servén (2008); World Bank (1994); Calderon & Serven, 2004; Estache, 2006; Sahoo and Dash (2009). Infrastructure development, both economic and social, is one of the major determinants of economic growth, particularly in developing countries (Ali & Pernia (2004)).

Direct investment on infrastructure (i) creates production facilities and stimulates economic activities. (ii) Reduces transaction costs and trade costs improving competitiveness and (iii) Provides employment opportunities to the poor.

In contrast, lack of infrastructure creates bottlenecks for sustainable growth and poverty reduction (Sahoo, Dash & Nataraj, 2010).

Macroeconomic
A majority of this literature observes a positive long-run effect of infrastructure on output, productivity, or their growth rate. The researchers found also the effect of infrastructure on some combination of output, efficiency, productivity, private investment and employment. A strand of the literature has focused on the development impact of infrastructure in Africa. Estache, Speciale and Veredas (2006) present pooled OLS growth regressions based on an augmented Solow model, including a variety of infrastructure indicators. Their main conclusion is that roads, power and telecommunications infrastructure, with the exception of water and sanitation, contribute significantly to long-run growth in Africa. Other studies based on the same production function approach, such as those by Ayogu (1999), Boopen (2006) and Kamara (2006) make similar findings.

Microeconomic evidence
Infrastructure, no doubt, has major implications for a variety of development outcomes, both at the household level (health, education and social mobility), at the firm level (productivity, industrial development) and at the global level (climate change). In the micro-economic literature, considerable attention has been devoted to roads because of the perception that they will ineluctably lead to poverty reduction and income generation, especially in rural areas (Gibson & Rozelle (2003)). Fan, Nyange and Rao (2005) look at the impact of public investment and roads on household level income and poverty and find very positive effects.

3. Historical Evolution of Infrastructure in Rwanda
The National Institute of Statistics of Rwanda (NISR) (2012) describes the evolution of infrastructure in Rwanda

✔ Transportation
According to NISR (2012), the Government has increased investment in the transport infrastructure of Rwanda since the 1994 Genocide, with aid from the United States, European Union, Japan, and others. The transport system consists primarily of the road network, with paved roads between Kigali and most other major cities and towns in the country. Rwanda is linked by road to other countries in the East African Community, such as Uganda, Tanzania, Burundi and Kenya, as well as to the eastern Democratic Republic of Congo cities of Goma and Bukavu; the country's most important trade route is the road to the port of Mombasa via Kampala and Nairobi.

The country has an international airport at Kigali that serves one domestic and several international destinations. The country has no railways, although funding has been secured for a feasibility study into extending the Tanzanian Central Line into Rwanda. There is no public water transport between the port cities on Lake Kivu, although a limited private service exists and the government has initiated a program to encourage development of a full service. Rwanda plans to develop the inland water transport for the transportation of goods and passengers on the Kivu Lake. The waterway will connect the cities of Rubavu, Karongi and Rusizi with the construction of new terminals and equipment of new ships.

Concerning the Institutional transport organization in Rwanda, the parent Ministry responsible for transport is the Ministry of Infrastructure (MININFRA). The Ministry is responsible for overall transport policy and strategic planning, the creation of a transport enabling environment, and setting of transport rules, regulations and standards. Recently, Rwanda Transport Development Agency (RTDA) was established to assist the Ministry with the management and administration of the transport sector. The Rwanda Utilities Regulatory Agency (RURA) primarily ensures that utilities provide goods and services that meet the demand and needs of the users of such services. The Rwanda Civil Aviation Authority (RCAA) has been entrusted with the development, management and operation, and maintenance of all the services (except services handled in terms of a concession) associated with aviation. The institutional structure of the Strategy covers all modes of transport (namely: Roads, Road Transport, Inland Waterways, Rail and Aviation) and is divided into the following: Policy and Planning; Safety Regulation; Commercial Regulation; Infrastructure Provision; Infrastructure Funding; and Services (Republic of Rwanda, 2012).
Energy

According to NISR (2012), Rwanda's electricity supply was, until the early 2000s, generated almost entirely from hydroelectric sources; power stations on Lakes Burera and Ruhondo provided 90% of the country's electricity. The increased demand as the economy grew, precipitated a shortfall in 2004 and widespread load shedding. As an emergency measure, the government installed diesel generators north of Kigali; by 2006 these were providing 56% of the country's electricity, but were very costly. The government enacted a number of measures to alleviate this problem, including rehabilitating the Rugezi wetlands, which supply water to Burera and Ruhondo and investing in a scheme to extract methane gas from Lake Kivu, expected in its first phase to increase the country's power generation by 40%. Only 6% of the population had access to electricity in 2009.

Table 1: Hydroelectric Station

<table>
<thead>
<tr>
<th>Hydroelectric station</th>
<th>Capacity (MW)</th>
<th>Year completed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ntaruka</td>
<td>11.5 MW</td>
<td>1959</td>
</tr>
<tr>
<td>Mukugwa</td>
<td>12 MW</td>
<td>1982</td>
</tr>
<tr>
<td>Mukungwa II</td>
<td>2.5 MW</td>
<td>2010</td>
</tr>
<tr>
<td>Rukarara</td>
<td>9.5 MW</td>
<td>2010</td>
</tr>
<tr>
<td>Nyabarongo I</td>
<td>28 MW</td>
<td>2014</td>
</tr>
</tbody>
</table>

Table 2: Thermal

<table>
<thead>
<tr>
<th>Thermal power station</th>
<th>Fuel type</th>
<th>Capacity</th>
<th>Year completed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kivu Watt Power Station</td>
<td>Methane</td>
<td>25 MW</td>
<td>2015</td>
</tr>
</tbody>
</table>

Table 3: Solar

<table>
<thead>
<tr>
<th>Solar power station</th>
<th>Fuel type</th>
<th>Capacity</th>
<th>Year completed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ngoma Solar Power Station</td>
<td>Solar</td>
<td>2.4 MW</td>
<td>2011</td>
</tr>
<tr>
<td>Rwamagana Solar Power Station</td>
<td>Solar</td>
<td>8.5 MW</td>
<td>2015</td>
</tr>
</tbody>
</table>

Telecommunication Infrastructure

3.1 Telecommunication sector before 1994

Nsengiyumva A and Habumuremyi E. (2009) describe the historical development of telecommunication infrastructure in Rwanda as follow:

<table>
<thead>
<tr>
<th>Year</th>
<th>Telecommunication infrastructure installed</th>
</tr>
</thead>
<tbody>
<tr>
<td>1930</td>
<td>The telegraph is introduced in Rwanda. The first wireless telegraphy station (TSF) is established to link Kigali and Bujumbura.</td>
</tr>
<tr>
<td>1956-1962</td>
<td>Rwanda and Burundi set up their own provincial administration, and the first local telephone networks, served by small manual telephone exchanges, were established.</td>
</tr>
<tr>
<td>After 1962</td>
<td>The country’s telecommunications system operated within the Common Telecommunications Agency of Burundi and Rwanda (ATCBR). Telegraph, telephone and telex services opened between Kigali and Brussels in 1963. The same year saw the installation of an international telex network and a manual telephone switchboard center with 75 numbers in Kigali, and the country began serving its first manual table telex customers.</td>
</tr>
<tr>
<td>1979</td>
<td>The installation of an automated telex center and the inauguration of the Ecole Nationale Mixte des Postes et Telecommunications in Kigali took place.</td>
</tr>
<tr>
<td>1980</td>
<td>Fourteen linkages for a rural telecommunications network were established, and in November of the following year a high frequency connection between Kigali and Ruhengeri was replaced.</td>
</tr>
<tr>
<td>1982</td>
<td>The first Intelsat tests on the Nyanza- Kicukiro Terrestrial Station were performed.</td>
</tr>
<tr>
<td>1990-1993</td>
<td>Rwanda’s domestic telecommunications network consisted of twenty-six telegraph stations, twelve automated telephone switchboard centers, and the telex center at</td>
</tr>
</tbody>
</table>
Kigali for connections between Rwanda and the rest of the world via telex, telegraph and telephone.

In 1990, the Ministry of Planning adopted a systematic approach to IT development. These efforts resulted in the formulation of both a National IT Policy in 1992 and a Government Master Plan on Information Technology in 1993. In 1993 Rwandatel was funded. Because of the tragic events in 1994, the implementation of the above plan and policy was not possible until 1998.

The use of computers in the telecommunication sector was weak in Rwanda before 1994.

### Telecommunication sector after 1994

1995
- Rwandatel became SA when the Poste, Téléphone et Telecommunications (PTT) was separated into a post and telephone unit. One year later, the company already had 12,000 subscribers, and turnover of USD 6 million.
- Before the creation of Rwanda Utilities Regulatory Agency (RURA) 13 September 2001, the regulator, there was no effective regulation of the telecommunications sector in Rwanda.

From 1995
- By the time of privatization, 1996, Rwandatel was an underperforming fixed-line operator that failed to provide adequate access to telecommunications services, with a high level of demand amongst underserved parts of the country reflected in an unusually high level of mobile penetration – mostly provided by MTN Rwandacell, which was launched in 1998, and, until recently, continue to be of 3 mobile service providers in the country (MTN, TIGO and AirTel) (Nsengiyumva and Habumuremyi (2009)).

Current Situation
- Since 2000 Government has established institutions and mechanisms to create an enabling environment for ICT development. Rwanda strives to leverage ICTs in all sectors of the economy and is registering tremendous progress. In 2010, Rwanda was the top global reformer in the World Bank Doing Business report and second global reformer out of 183 countries in 2011. Rwanda is also the 9th easiest place to start a business in the world and the 6th most competitive economy in Sub-Saharan Africa according to the 2010 World Economic Forum global competitiveness report. This has largely been a result of several reforms including online business registration, aimed at making the business environment more conducive. In 2007, Rwanda took a key step toward its long-term goal when it became the 1st East African country and the 3rd in Africa to adopt the “One Laptop Per Child” program.
- Today, as ICT infrastructure and trends, Rwanda use Internet, Mobile Applications, Outsourcing, Information security, Cloud Computing, Green ICT AND Convergence (Government of Rwanda (2015)).

**Water and sanitation**

Table 4: Key dates in the reform of the sector in Rwanda (Unicef, 2015)

<table>
<thead>
<tr>
<th>Year</th>
<th>Event: Rural</th>
<th>Year</th>
<th>Event: Urban</th>
</tr>
</thead>
<tbody>
<tr>
<td>1964</td>
<td>Rural water supply delegated to an NGO for the whole country, under Government of Rwanda financing</td>
<td>1976</td>
<td>REGIDESO, created in 1939 and covering Rwanda and Burundi, is replaced by ELECTROGAZ, a national monopolistic public utility managing power and water in urban areas (Kigali city and 14 secondary towns by 2009)</td>
</tr>
<tr>
<td>1978</td>
<td>Participatory approach introduced by NGOs</td>
<td></td>
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</tr>
<tr>
<td>1992</td>
<td>First national policy on WSS</td>
<td></td>
<td></td>
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<tr>
<td>1994</td>
<td>Genocide, followed by humanitarian and emergency programs up to 1999</td>
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<td></td>
</tr>
<tr>
<td>Year</td>
<td>Event</td>
<td></td>
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<tr>
<td>------</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>1997</td>
<td>Update of national water policy (demand responsiveness, community management through Regies Associatives)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2001</td>
<td>RURA (multisectoral regulatory agency) created</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2006</td>
<td>Decentralization process enters second phase, with central staff reduced by factor of five</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2007</td>
<td>National Strategy on Sanitation and Promotion of Hygiene</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2008</td>
<td>Management of environment, water resources, and water supply services separated between three ministries Law passed for the use, conservation, protection, and management of water resources Environmental Health Policy (MINISANTE, the ministry of health) Government of Rwanda participates in AfricaSan II and signs the eThekwini Declaration</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2009</td>
<td>SWAp MoU signed National WSS Policy fourth revision (decentralization, PPP, and sanitation)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2009</td>
<td>Rwanda Water and Sanitation Corporation (RWASCO) launched</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2010</td>
<td>Establishment of EWSA (Energy, Water and Sanitation Authority) to absorb RECO (energy) and RWSACO (water and sewerage)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2014</td>
<td>EWSA is spited into two Companies: WASAC (Water and Sanitation Corporation) and EUCL (Energy Utility Corporation Limited)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Dwelling**

According to NISR (2012) the past three population and housing censuses conducted in Rwanda in 1978, 1991 and 2002 have thrown some light into the changing characteristics of dwellings in the country. In 1978, a very big proportion of houses in Rwanda (62.4%) were covered by straw. However, in 1991 and 2002, this rate significantly dropped to 23% and 12% respectively. The upcoming General Population and household Census in August 2012 will show if Rwandans really said “bye bye” to “Nyakatsi”, that is if the grass-thatched houses were eradicated in the country. Censuses have shown that iron sheets and tiles are increasingly making the roofs of houses in Rwanda. In 1978, around 19% of houses were covered by iron sheets while 18% of houses were covered by tiles. In 1992, almost half of all dwellings in Rwanda were covered by iron sheets (42%) and 34% by tiles. This trend was confirmed in 2002, with 44% of houses covered by iron sheets and 40% by tiles. The changing trends in roofing types have been accompanied by similar trends in the material used for walls and floors of houses in Rwanda. In the past, the overwhelming majority of floors in Rwandan houses were made of dirt. For instance, 88% and 85.9% of houses’ floors were made of dirt in 1991 and 2002 respectively. The proportion cement floored houses increased from 9.5% to 12.3% between 1991 and 2002.

Data also show that there has been significant improvement in the type of materials for building walls in Rwanda. Until early eighties, Rwandans mainly used wood, dirt mixed with straw or pebbles adobe to construct their houses’ walls. Indeed, 89.9% houses’ walls were made in wood and dirt in 1978. This proportion declined to 67.9% and 60.1% in 1991 respectively 2002. Adobe bricks have gained in
importance as construction material for walls in Rwanda. In 2002, 34.5% of houses in Rwanda were made with adobe bricks against 22.4% in 1991 and only 5.0% in 1978. To a lesser extent, cement blocks and burnt bricks have been increasingly used in construction of walls, but they are still used almost exclusively in urban centers and made up to a mere 2.4% of Rwanda houses’ walls in 2002. The upcoming Population and Housing Census will provide updates to the physical characteristics of dwellings in Rwanda.

4. Infrastructure: The Foundation of Sustainable Economic Development

✓ Infrastructure and Millennium Development Goals

In order to conclude whether Infrastructure affects Sustainable Economic Development, in this section, the research is going to compare each component of infrastructure to all eight goals of MDGs (Willoughby, 2004).

Table 5: Transport (Local and International)

<table>
<thead>
<tr>
<th>Transport</th>
<th>Goal 1: Eradicate extreme poverty and hunger</th>
<th>Goal 2: Achieve universal primary education</th>
<th>Goal 3: Promote gender equality and empower women</th>
<th>Goal 4: Reduce child mortality</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transport allows income generation by different ways: Exchange of goods and services. Farmers sell their products and get income. People move to work in towns and get income.</td>
<td>Transport allows establishment of schools in rural area accessible by the roads. Teachers and students are facilitated to go to schools.</td>
<td>Transport empowers women doing their businesses: They do commercial activities. Also transport encourages girls going to school and get knowledge.</td>
<td>Child mortality is caused by difficulties to access hospitals and other health services. Local transport facilitates access to health services and hospitals.</td>
<td></td>
</tr>
<tr>
<td>Goal 5: Improve maternal health</td>
<td>Goal 6: Combat HIV/AIDS, malaria and other diseases</td>
<td>Goal 7: Ensure environmental sustainability</td>
<td>Goal 8: Develop a global partnership for development</td>
<td></td>
</tr>
<tr>
<td>Transport allows access to health care services and to facilities such water, pharmacies, markets where can be found all input necessary for maintaining the human health.</td>
<td>Transport allows easy communication between people and health service providers (such as health advisers) in case of a campaign. Also transport allows easy access to health services</td>
<td>Engineers need moving to the field using transport ways. Also, for getting input for protecting environment, people need transport ways. Greening area needs transportation of materials and workers.</td>
<td>Transport ways connect people locally and internationally. This is done via roads, rails, maritime or air transportation.</td>
<td></td>
</tr>
</tbody>
</table>

Note: What is said to the local transport can be expended to the international transport. In fact, what is done locally using local ways of transportation is also done internationally using international ways of transportation such as air transport, maritime and rails.
Table 6: Energy

<table>
<thead>
<tr>
<th>Energy</th>
<th>Goal 1: Eradicate extreme poverty and hunger</th>
<th>Goal 2: Achieve universal primary education</th>
<th>Goal 3: Promote gender equality and empower women</th>
<th>Goal 4: Reduce child mortality</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy is essential in Economic Development of rural and urban area. Energy allows technical activities generating income. It allows working 24h/24h. It urbanizes the rural area.</td>
<td>With energy, students revise lessons at home. Also, energy allows modern technics of education such as research on internet, PowerPoint projection.</td>
<td>Energy encourage girls go to schools. Energy modernizes schools and makes them affordable and interesting and parents do not hesitate to send their kids to study.</td>
<td>By energy effect, Water and food consumed are safe from bad conservation at home. Energy also allow conservation of drugs at the hospitals and allow cleaning of materials used for maintaining health.</td>
<td></td>
</tr>
</tbody>
</table>

Goal 5: Improve maternal health

Goal 6: Combat HIV/AIDS, malaria and other diseases

Goal 7: Ensure environmental sustainability

Goal 8: Develop a global partnership for development

Electricity improves medical services (hours, equipment, refrigeration). Materials used for maintaining maternal health needs electricity. Also, giving birth without electricity at night is high risky.

In area without energy, specialists cannot live. Energy also allows the maintenance of equipment and allows the use of modern technical equipment to combat diseases such as video conversation, research.

Fuel- wood need is enemy of environment. Energy gives a better solution.

Partnership involves communication. In today’s modern world, communication is essentially via ICT. And ICT necessarily works with energy.

Table 7: Telecommunications

<table>
<thead>
<tr>
<th>Telecoms</th>
<th>Goal 1: Eradicate extreme poverty and hunger</th>
<th>Goal 2: Achieve universal primary education</th>
<th>Goal 3: Promote gender equality and empower women</th>
<th>Goal 4: Reduce child mortality</th>
</tr>
</thead>
<tbody>
<tr>
<td>ICT plays important role in poverty reduction. ICT accelerate Businesses such in urban or rural area.</td>
<td>ICT facilitate research and make a class more interesting because of the use of ICT technologies in education.</td>
<td>Girls are motivated to attend school because animated by ICT equipment and technologies.</td>
<td>ICT work together with modern diagnostic technics. It allows easy communication between sick person and doctor. It facilitates transportation of the sick to the hospital.</td>
<td></td>
</tr>
</tbody>
</table>
Goal 5: Improve maternal health
ICT enable arrangements for emergency treatments. ICT allows quick access to the hospital and maintains communication between concerned people.

ICT makes efficient referrals to higher medical institutions. ICT equipment also contributes in campaign against those diseases.

ICT allows keeping and retrieving services of importance for environmental protection. ICT allows research improving the current situation of environment protection.

Partnership and communication makes a unity. ICT equipment allows local and international continue communication and promote businesses.

Table 8: Water

<table>
<thead>
<tr>
<th>Water</th>
<th>Goal 1: Eradicate extreme poverty and hunger</th>
<th>Goal 2: Achieve universal primary education</th>
<th>Goal 3: Promote gender equality and empower women</th>
<th>Goal 4: Reduce child mortality</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Convenient, good water can substantially reduce morbidity and mortality, time spent fetching water, and enterprise interruptions, and improve nutrition, with significant effects on poor people’s productivity.</td>
<td>Cleaned water reduces sickness due to bad water and increases school attendance. Having water at home reduces delay students pass fetching water.</td>
<td>Traditionally, girls and women fetch water and boys do other activities. Home water supply liberates girls to go to school and reduce sickness due to fetching water early in order to be not late.</td>
<td>Some cases of child mortality are due to women who go fetching water passing through inconvenient ways. Some fall down, others carry heavy water materials. Home water is the solution to this situation.</td>
</tr>
<tr>
<td>Goal 5: Improve maternal health</td>
<td>Goal 6: Combat HIV/AIDS, malaria and other diseases</td>
<td>Goal 7: Ensure environmental sustainability</td>
<td>Goal 8: Develop a global partnership for development</td>
<td>Partnerships go together with good health and good health cannot be without clean water. Water is essential in life.</td>
</tr>
<tr>
<td>Maternal health needs good and frequent water.</td>
<td>Some diseases are due to lack of clean water. Clean water is important for disease treatment, and for formula milk (HIV mothers).</td>
<td>It is difficult to maintain garden, greening area, without being equipped with water. In different situation, water allows to maintain environment.</td>
<td>Partnerships and communication makes a unity. ICT equipment allows local and international continue communication and promote businesses.</td>
<td></td>
</tr>
</tbody>
</table>
### Table 9: Sanitation

<table>
<thead>
<tr>
<th>Sanitation</th>
<th>Goal 1: Eradicate extreme poverty and hunger</th>
<th>Goal 2: Achieve universal primary education</th>
<th>Goal 3: Promote gender equality and empower women</th>
<th>Goal 4: Reduce child mortality</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adequate sanitation reduces illness and expenditure on medical treatment.</td>
<td>Good sanitation attracts qualified teachers and motivates students.</td>
<td>Good school sanitation and water facilities increase girls’ attendance</td>
<td>Improved sanitation decreases child mortality &amp; improves nutrition</td>
<td></td>
</tr>
<tr>
<td>Goal 5: Improve maternal health</td>
<td>Goal 6: Combat HIV/AIDS, malaria and other diseases</td>
<td>Goal 7: Ensure environmental sustainability</td>
<td>Goal 8: Develop a global partnership for development</td>
<td></td>
</tr>
</tbody>
</table>

| Improved sanitation reduces maternal illness and improves maternal health. | Improved sanitation reduces malaria mosquito breeding and combat different diseases. | Improved sanitation combats environment degradation. | Least developed countries entertain partnership with More Developed Countries for improving Sanitation techniques and equipment. |

### Table 10: Dwelling/ Housing

<table>
<thead>
<tr>
<th>Dwelling</th>
<th>Goal 1: Eradicate extreme poverty and hunger</th>
<th>Goal 2: Achieve universal primary education</th>
<th>Goal 3: Promote gender equality and empower women</th>
<th>Goal 4: Reduce child mortality</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eradicating the traditional houses covered by straw motivate to work hard. and people gain income and fight poverty.</td>
<td>Good dwelling allows comfortable courses revision at home.</td>
<td>With good equipment at home, girls are encouraged to study.</td>
<td>Modern housing contributes to the good health especially for children than traditional ones.</td>
<td></td>
</tr>
<tr>
<td>Goal 5: Improve maternal health</td>
<td>Goal 6: Combat HIV/AIDS, malaria &amp; other diseases</td>
<td>Goal 7: Ensure environmental sustainability</td>
<td>Goal 8: Develop a global partnership for development</td>
<td></td>
</tr>
</tbody>
</table>

| Modern dwelling once equipped appropriately contribute to maternal health. | Traditional dwelling was easy to give access to malaria and diseases comparing to modern ones. | Modern dwelling uses bricks and save the environment. Those bricks also are prepared modernly in order to save environment. | Partnership is reciprocal. You can’t entertain a partnership when you are fear of having guests because of lacking equipment. |

### Findings
With UN (2011), the present research found various channels through which infrastructure contribute to sustainable growth by: (i) Reducing transaction costs and facilitating trade flows within and across borders. (ii) Enabling economic actors – individuals, firms, governments – to respond to new types of
demand in different places. (iii) Lowering the costs of inputs for entrepreneurs, or making existing businesses more profitable. (iv) Creating employment, including in public works (both as social protection and as a counter cyclical policy in times of recession). (v) Enhancing human capital, for example by improving access to schools and health centers; and (vi) Improving environmental conditions, which link to improved livelihoods, better health and reduced vulnerability of the poor.

**Energy**

The wide-ranging role of energy in economic development and poverty alleviation is widely acknowledged. Expanded provision and use of energy services is strongly associated with economic development. This makes energy also central to reducing poverty and hunger, increasing literacy and education and reducing infant and maternal mortality. Note that energy is produced by different ways: Biomass, Hydropower, Geothermal, Solar Energy, Wind Energy, Liquid Biofuels, Natural Gas, Clean Coal Power Generation.

**Transport**

Effective mobility and timely access to goods and services require well-developed, safe, secure and affordable transport network and services: Roads, Railways, Maritime transport and Airports.

**Information and Communications Technology**

Information and Communication Technologies (ICT) plays a major role in national development. Within a short time, ICT has become one of the major building blocks of a modern society through Telephones, Internet and Bandwidth.

**Water and Sanitation**

Water and sanitation are essential for achieving sustainable development, poverty reduction and the MDGs. They contribute to poverty alleviation both directly and indirectly – through improved sanitation services, water supply, affordable food and enhanced resilience of poor communities faced with disease, climate shocks and environmental degradation. Access to water and sanitation is a necessary precursor to other forms of development. Without easy access to these facilities, time spent on water collection, household income spent on medical treatment and water purchase, all contribute to keeping people in the poverty trap.

**Conclusion**

Infrastructure in Rwanda, as in Africa or worldwide in general, is very central to the various efforts to support growth, reduce poverty and improve the overall quality of life of citizens. There will be no growth and no significant poverty alleviation in Africa without a major improvement in the level and state of its infrastructure supporting the widely held consensus that the MDGs will not be achieved without at least a seven percent annual growth rate for the region, and that this target will not be achieved without a significant increase in infrastructure investment. The strongest impact comes from telecommunications, followed by roads and electricity.

**Recommendations**

For Government

Expand infrastructure in rural area

New investments should aim to focus on infrastructure

Private Sector

Private investment is likely to remain an important component of infrastructure development. Private participation in infrastructure is not only about financing, it is also more importantly about capacity building, transferring better technologies, innovations and removing capacity constraints to implementation.

For Citizens

Maintain infrastructure in place.
References


