Republic of Rwanda

National Land Use & Development Master Plan

NLUDMP 2020–2050

Ensuring tomorrow's sustainability today!

Integrative Plan

July 2020

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List of Acronyms

AfCFTA: African Continent Free Trade Area

APH: Apartments Per Hectare

BAU: Business As Usual

BIA: Bugesera International Airport

CHW: Community Health Workers

COMESA: Common Market of Eastern and Southern Africa

CPA: Complementary Package of Activities

DMA: Destination Management Area

DOT: Directly Observed Therapy

DRC: Democratic Republic of Congo

EAC: East African Community

ECD: Early Childhood Development

EDPRS: Economic Development and Poverty Reduction Strategy

EICV4: Integrated Household Living Conditions Survey

ENR: Environment and Natural Resources

FAO: Food Agriculture Organisation

GDP: Growth Domestic Product

GEP: Growth Elasticity of Poverty

GER: Gross Enrolment Ration

GOR: Government of Rwanda

HC: Health Center

HH: House Hold

HIC: High Income Country

HIV: Human Immunedeficiency Virus

HPs: Health Posts

HRYR: Aviation Code for Kigali International Airport

IATA: International Air Transport Association

ICAO: International Civil Aviation Organization

ICT: Information and Communications Technology

ICTR: International Criminal Tribunal for Rwanda

ITS: Intelligent Transport Systems

KIA: Kigali International Airport

Kwh: Kilowatt

LUCA: Land Use Category

MICE: Meetings, Incentives, Conferences and Exhibitions

MINAGRI: Ministry of Agriculture and Animal Resources

MINALOC: Ministry of Local Government

MINECOFIN: Ministry of Finance and Economic Planning

MININFRA: Ministry of Infrastructure

MOE: Ministry of Environment

MoU: Memorandum of Understanding

MPA: Minimum Package of Activities

MW: Megawatt

NGP: National Growth Product

NLUDMP: National Land Use and Development Master Plan

NST: National Strategy for Transformation

PSG: Paris Saint Germain

PUSH: Population, Urbanization, Settlement and Housing

R&D: Research and Development Expenditure

RDB: Rwanda Development Board

RHA: Rwanda Housing Authority

RTDA: Rwanda Transport Development Agency

RWF: Rwandan Franc

SAATM: Single Africa Air Transport Market

SADC: South African Development Community

SDGs: Sustainable Development Goals

SME: Small and Medium Enterprises

TB: Tuberculosis

UMIC: Upper Middle-Income Country

US: United States

USD: United States Dollar

USDA: United States Department of Agriculture

WTTC: World Travel and Tourism Council

Executive Summary

The National Land Use and Development Master Plan (NLUDMP) is one of the most prioritized plans stemming from Vision 2050. It is a national spatial plan (location/space-based) that is structured around the following thematic areas:

- Population, Urbanization, Settlements, and Housing (PUSH).
- Spatial Economy (Employment, manufacturing, industry, mining).
- Agriculture.
- Environment and Natural Resources (land, forestry, water resource, mining resource, climate change, environment).
- Tourism and Conservation.
- Transportation.
- Infrastructure - Public Utilities (Water, Energy, ICT)
- Public Services (Health, Education, Public Administration, Religious, Recreational facilities, etc).
- GIS database and National Basemap.
- Legal Analysis Report
- Implementation, Compliance, and Monitoring Strategy.

The Cabinet adopted the first version of the NLUDMP in January of 2011 to determine the actual land use and prepare for the efficient use of resources and facilitate development in the country from 2011 to 2020. The Ministry of Environment, through Rwanda Land Management and Use Authority, jointly with key stakeholders, conducted an assessment and evaluation of the NLUDMP implementation of different land-use plans at the District level. They found that the NLUDMP is not in harmony with the Vision 2050, NST1, the new Land Law, the Secondary City Approach, Green Growth Policies, and sector databases provided by national authority custodians. The outcome of this assessment suggested a need for revision of the plan. Elaboration of NLUDMP 2020-2050 started in December 2018 and completed in June 2020. All sectors, which are land users, have been analyzed in parallel, feeding, and influencing each other, to produce for each of them land consumption demands for 2050. But in a densely populated country where land is in shortage, land users are in permanent competition and conflict. Therefore, a determined solution for the allocation of land, in the long run, can be achieved through economic and spatial considerations. Hence, the main target of NLUDMP is to find the best land-use balance sheet based on spatial and economic analysis.

With a current annual growth rate of 2.4%, the population in Rwanda may reach 25.8 Million in 2050, with gross density approaching 1000p/sq.km, the highest in Africa. Future family planning resulting in a growth rate of not more than 2.0% can lead to a smaller population of 22.1 Million, which better fits the impending shortage of land in Rwanda. The size of the average household will decrease from 5 to 4, bringing the number of households to 5,525,000.

The land area of Rwanda, including water bodies, is 26,338 km². Current agricultural land is the primary component with almost 12,000 km², only 8400 km² are currently very suitable for agriculture.

The second broad current land cover category is two groups of forests: Natural forests – 1,389 km², Plantations- 3,873 km², and other savannah and shrubland woods – 1,980 km². Together, they cover 30.4% of the country's dryland surface by December 2019. All built-up areas, including roads, are 2,888 km² or 11% of the country surface, 1,500 km² of which are rural settlements. Two-thirds of the

rural settlements are small disjointed parcels of poorly used agricultural lands. These lands may potentially be added to the stock of consolidated agricultural lands, once the rural system is transformed. 2068 km² are wetlands, including buffer zones, and 1637 km² of water bodies, also with buffer zones close to the list.

The National Land Use and Development Master Plan for the period 2020-2050 will include 13 prime land consumers: Prime Agriculture Lands, Secondary Agriculture Lands, Conditional Agriculture in wetlands, Grassland for livestock, Natural Forests and Forest Plantations, Wooded savannah and Shrublands, Urban settlements, Rurban Settlements, Rural Settlements, Industry, Roads, and Airfields.

The category of settlements contains secondary land users: Housing, Commerce & Trade, Public Services, Financial & Business Services, Open spaces, Parks & Sports, Tourism, urban farming, urban forest, industrial parks, Infrastructure Utilities, streets, etc. and other urban environmental constraints.

This report analyses for each land-use the current cover, the long-term needs, and calculates how much area the plan should allocate towards 2035 and 2050. NLUDMP suggests preserving entirely 1,389 km² of natural forests and all existing 3,873 km² of forest plantations. 1,554 km² of bare high slopes will be planted too. In parallel, the plan will preserve 497 km² of Wooded savannah and 7km² of shrublands. 1476 km² of the last two kinds of wood will be allocated for Agriculture. All the water bodies and their buffer zones and the protected wetlands and their buffer zones will be fully protected. Unprotected wetlands will be conditionally open for agriculture, which may add 1,100 km² to the agricultural stock.

The proposed balance sheet achieves zero balance and reasonable equilibrium between - Natural resources, Arable lands, Built-up areas & Roads.

Agricultural land in Rwanda plays a dual role in creating income and foreign currency through the export of agricultural products (mainly coffee and tea) and in producing food for the local population. Given the size of the country, a central question to be asked is whether it is possible to feed the people (today in 2019 and 30 years from now), given the limited arable land. It is the central question that this report addresses.

An affirmative answer is dependent on the following conditions:

- The existing agricultural land would be protected against scattered housing and degradation due to soil erosion and improper management along the period of 2020-2050.
- All means will be taken to improve agricultural productivity and crops' yields: farmland consolidation, irrigation projects, drainage projects, construction of terraces on hills' slopes; instruction for farmers; agricultural education, research, and development at the regional level. Most of all, climate-resilient options should be implemented, such as improved bench terraces, agroforestry, improved seeds, drainage, irrigation on the hillside, and marshlands.
- The efforts for agricultural development should concentrate on the best suitable land for agriculture. Therefore, all 8,414 km² of very suitable lands would be preserved entirely for consolidated commercial agriculture. 1,092 km² of "not suitable lands" will be used instead of agriculture, for built-up areas in urban and rural settlements and roads and railways.
- Altogether there will be no less than 12,433 km² of agricultural land in Rwanda in 2050. It means that the country could be food secured if yields are improved 15 times more than the existing 2019 return.

- NLUDMP recommends developing a local industry for livestock feeds.
- Land/worker ration should be around 1.5 hectares per worker.
- NLUDMP's recommendation is to protect available agriculture lands with relevant laws and catered for in other local master plans.
- Scattered homestead to be eliminated gradually through- consolidate/agglomerate in few settlement sites to decongest agriculture zones.

Agriculture should account for less than 10% of GDP in 2050. It does not mean that agriculture's land and value should decrease; on the contrary, it should dramatically increase. However, the economic value of industry and services should increase in more significant rates than agricultural GDP, so that its relative share will be lower.

In the Eastern, Northern, and Southern districts – agriculture should be developed further so that cultivated land grows in size, and yields improve dramatically. However, in the Western region, where landslides prevail, Cash crops like tea, pyrethrum, and coffee plantations, as well as other economic sectors, should be emphasized.

In 2050, about 8.4% of the employment will work in consolidated commercial agriculture, either in farming estates, big communal farms, or medium-size private farms. 8.9% of jobs will still be engaged in subsistence agriculture.

The plan guides the future urbanization by the following principles:

The superiority of Kigali will be limited to 3.8M to support decentralization. Migration to Kigali will be restrained by creating outlets towards cities in the country periphery and Kigali's Satellites. Movement from Kigali to areas in the outskirts of Kigali that creates suburbanization must stop.

Three cities (Rwamagana, Muhanga, and Nyamata/Bugesera) play the role of Satellite cities of 800k - 1 M people because they are the potential to grow faster than secondary towns. Thus they need special attention in terms of building quality cities and better livelihoods. When combined with Kigali City, they become a "golden triangle," agglomerating 6.4M people. This quantity is much healthier than the current centralization that reaches 90% dominance. Rwamagana as an agricultural hub, Muhanga, as a trade and mining processing hub and Bugesera as a logistics and airport city. Fighting urban sprawl by agglomeration and consolidation of settlements will be a very crucial task going forward .

Eight Secondary or Peripheral Cities are Nyagatare, Musanze, Rubavu, Rusizi, Huye, Karongi, Kirehe, and Kayonza. They are serving the peripheries of the country and playing the role of cross-border opportunities and trade. The peripheral border cities are essential. They are located on an external belt near the borders, grow fast as outer growth poles of 300,000-650,000 people. They are expected to make use of their location as international border towns and to optimize commerce beyond their specific advantages and specialization. A belt of arterial roads will connect the peripheral/secondary cities. The development of secondary cities will be in two phases according to available capacities– five (Musanze, Rubavu, Rusizi, Nyagatare and Huye) in the first and three (Karongi, Kayonza and Kirehe) in the second phase.

The primary source of population growth of secondary/peripheral cities should be the surrounding villages. It is in situ urbanization that controls migration, specifically to Kigali.

The internal movement of farmers towards the eastern province to join sophisticated agriculture is very positive. However, it should only be well oriented and organized in proposed cities and rural settlement nodes.

73 Rurban settlements are proposed as linking nodes of rural and urban areas, as small emerging trade centers. Rurban Population in small and emerging weak towns will be minimized, directing in situ urbanization towards big cities with several hundred thousand inhabitants. As the Rurban Phenomenon cannot be eliminated immediately, the plan suggests a maximum of 1.8M for this segment and a freeze policy at 73 nodes. Other hundreds of existing trade centers (rurban) could be among 3000 rural settlements sites for the rural setting.

Quick Transportation is a prerequisite for a country with high-income status. Economic interaction between distant poles will be realized through a network of expressways. Currently, there is not a single expressway in the country. Cargo from the nearest international ports will be developed with railways.

The distribution of the population is based on the recommended urbanization hierarchy and specific constraints and potentials of each city. The land needs for cities, based on desired gross densities and local constraints, are 897 km² by 2035 and 1447 km² by 2050.

The NLUDMP proposes that given the future population trends and high housing needs that require a big housing stock and space, it is highly recommended to develop in vertical housing infrastructure in urban and rural settlement areas in form of multi-family apartments, socio-economic infrastructures (commercial, Industries, schools, health facilities, public administration, Religious buildings, etc.). The mixed-use and incremental development of buildings are encouraged. At every phase of the construction, the building should be strictly seen as a finished product.

Rural settlements are currently the negative power against the improvement of GDP. Two major steps must be taken: Eliminating the scattered homesteads gradually, decreasing the number of current Imidugudu sites, and decreasing the size of rural residential lots.

Arable and other lands, on which about 14,000 Imidugudu are currently scattered, cover 1500 sq.km. The rural Population is 10,621,000M and 2,360,000 HH or 81.6% by 2019. The average size of an Umudugudu in Rwanda is, therefore, 80.5 Ha, containing 777 people on average, which is about 172 households. The gross land size per household is, therefore, 0.46 Ha, including the house and farm. This land distribution among farmers is going to change in 2050. A significant change is also required in the size and spatial arrangements of the residency component of rural settlements.

The size target of new residence lots should be 300m² per household in 4x1 and 8x1 style and other high density models.

The accumulated net residential areas in the new compact Imidugudu system will be 49,500 Ha, 495 sq.km. The gross area will be 495 sq.km x ~2.5 = 1241 km², including roads, open space, agricultural processing facilities, and public services. Hence, the average size for one Umudugudu would be 0.414 km².

An assessment of the current and future Housing stock was conducted: The country has today in 2019 about 2.8M housing units and needs 5.5M (150,000 dwelling units to be constructed annually) to cater

for 22.1M by 2050. Start by replacing and upgrading existing informal settlements and densifying existing cities and centers before using the new land.

The National Land Use and Development Master Plan proposes five categories of housing to be considered by local-level planning to achieve the desired consolidation and agglomeration.

Future Transportation will provide the following components:

1. **Railways** with a total length of about 505km (Western Line 125km, Eastern Line 300km, Upper Central Line 80 km).
2. **Expressways** are totaling about 730 km, (Western 335 km, Eastern 208km, Central 187km.
3. **Arterial Roads** length will be about 805 km.
4. **District feeding roads** length will be about 13,650 km, based on the current district roads, plus complete pavements by modern standards.
5. Local Feeders will accumulate to about 22,000 km.

The total length of roads will be 37,185 km. And the land needed for all roads and railways is 821 sq.km.

The NLUDMP also takes into account the efficient and optimal use of land by encouraging the exploitation of the underground infrastructure development including but not limited to transport facilities, industries, parking space, business development infrastructure and archives, etc.

The industrial sector in Rwanda is still small but quite competitive and currently occupies about 10 Km2. The industry is primarily engaged in the production and processing of wood, tobacco, cement, textiles, agricultural products, small scale beverages, soap, furniture, shoes, plastic goods, tea, and coffee. Others include chemicals, construction, printing, paper, engineering, and methane gas. Thus, the economy is heavily dependent on the primary sector, with industry strongly tied to the processing of primary products. The manufacturing industry in Rwanda has undergone significant changes in the past ten years, owing to increased industrialization and government involvement in manufacturing industries.

The 2050 employment targets, based on vision 2050, are for 13M employees, in which the main change is the growth in competitiveness of the industry, which would be ten times bigger by 2050, from half a million in 2018 to 5.4M employees in 2050. The forecast of the demand for industrial parklands is based on the employment targets of manufacturing and districts competence. The spatial distribution criteria of industrial parks have also been considered for selection.

Out of **13M persons in the labor force**, around **11.7M** will be formally employed, and **1.3M** will be engaged with informal employment, especially in subsistence agriculture. 2.4M will work in manufacturing and high-tech. 560,000 workers will find room in industrial parks. The consumption of land of those developing parks is 88 km², more than seven times from the current land allocation in the existing parks. Only 13 districts including the City of Kigali would have industrial parks. Other districts would only plan for light industries, agro-processing mills and handicraft factories (Agakiriro) according to their potential.

Mining is one of the critical drivers of economic development. It will continue to grow due to the growing world demand for minerals and metals, which is assumed to double. As a result, the Government of Rwanda established a mining board to re-design the mineral sector to deliver higher-

level results. The Rwanda Mines, Petroleum, and Gas Board (RMB) has a responsibility to re-design the industry to transform mining resources into crucial drivers of Rwanda's growth. Mining has hence been integrated as a critical driver for Rwanda's national economy in the government's seven-year program. As Mining is being conducted in other land use areas, a cost-benefit analysis should be done before developing mining activity for sustainability purposes.

In planning the future of tourism, some assumptions have been made of what is the best competitive products and services that will underpin the industry. Total Tourism direct and indirect contribution to GDP will be 20% based on the overall country's GDP of 274,472 Billion US Dollars. The immediate assistance will be 10% accounting for 27,447 Billion US Dollars. It is projected that to achieve this target; tourism will grow at around a 4% rate per annum from the current 1.2% growth rate per annum. Tourist parcels outside national parks allocated for tourism development will sum up to 12 km², which are part of secondary land uses, and therefore are included either in settlements areas or conservation and forest areas.

In brief, the NLUDMP motto is "*Ensuring tomorrow's sustainability today!*", and its ideals are encapsulated in the word "**COOPERATE**" as follows:

(1) **C**onsolidated development,

(2) **O**rderly planning,

(3) **O**penness for innovation,

(4) **P**reservation of nature,

(5) **E**conomic yields,

(6) **R**ational urbanization,

(7) **A**mbient services, education and healthcare,

(8) **T**ransportation for all,

(9) **E**mployment all over.

1. Introduction

Central to the achievement of Rwanda's ambitions to transform into a prosperous, food secure, knowledge-based economy, is the optimal use of land. Rwanda's land size is just 26,338 km², including water areas. The population is about 12.5 million by 2019, increasing at nearly 2.4 percent per annum. Urbanization is growing at 4.4 percent, and agricultural production contributes more than 36.7 percent of export earnings.

For the past decade, the need for land has become more pressing, given its small size, hilly topography, and rapid population growth. Rwanda experienced rapid urbanization, which is correlated with economic growth. The Government of Rwanda through Vision 2050 has an ambitious objective of accelerating urbanization and increasing the average annual growth of the gross domestic product, and the annual GDP per capita. By achieving this vision, Rwandan citizens will enjoy a better livelihood with adequate social protection, improved health, disaster risk reduction, and food security. Appropriate urban infrastructure development will be combined with biodiversity conservation, thus reducing citizen's vulnerability to the impacts of climate change.

The Cabinet adopted the first version of the NLUDMP in January of 2011 to determine the actual land use and prepare for the efficient use of resources and facilitate development in the country. The NLUDMP is one of the most prioritized programs and underlined factorial policies in the land and agricultural domain. The national document, National Strategy for Transformation (NST1), is another similarly important policy tool stemming from the Vision 2020 for the Country.

In 2016 and 2017, the Ministry of Environment, through Rwanda Land Management and Use Authority (RLMUA), jointly with key stakeholders, conducted an assessment and evaluation of the NLUDMP implementation of different land-use plans at the district and national levels. Moreover, the current physical situation is problematic due to poor land use management and planning, high competition over land by sectors, settlement sprawl, loss of agriculture and strategic lands for investment, vague long run Infrastructure planning, and management challenges, and issues related to rainwater management.

The outcome of this assessment suggested a need for revision of the NLUDMP. The Ministry of Environment through Rwanda Land Management and Use Authority has started the revision of the plan from December 2018 to June 2020.

The overall objective of the new NLUDMP 2020-2050 is to find solutions for those issues and generate specific guidelines for implementation and primarily to design a new and updated spatial structure for the nation. All settlements, urban, rural, big or small, are part of the national spatial puzzle, including Kigali and the secondary cities.

NLUDMP Planning Approach is a Normative one, based on global experience and quality values, striving for a desired future, as expressed in V2050. This approach is opposed to the methodology, which believes in the projection of trends, perpetuating "Business as Usual (BAU)" and ending up with "MORE OF THE SAME." The approach guarantees novel solutions and higher achievements of goals.

Land users are in permanent competition and conflict. Therefore, a determined solution for the allocating of land, in the long run, is needed. The main target of NLUDMP is to assess the current land users 'status and issues and find the best solutions as well as showcasing at the same time

orientations and measures for implementing the Vision 2050 goals. The NLUDMP strives to produce the best land-use balance sheet for the country and to give the GOR the data, argumentation, and recommendations of preferred land allocations, coordinated by the national land balance sheet.

An intensive consultation process took place along the planning process and included the following involvements:

- Cabinet adopted the NLUDMP 2020-2050 on 29th July 2020
- Inter-Ministerial Coordination Committee (IMCC) meeting approved it on 28th July 2020
- Inter-Ministerial taskforce established by IMCC took place in May 2020
- Economic Cluster Meeting took place in April 2020
- Technical Advisory Group meetings (MINECOFIN-chair, MININFRA-Cochair, RLMUA- secr, OTP, Office of PM, MoE, MINAGRI, MINALOC, MINICOM, RDB, RHA, RTDA, REMA, RODA, CoK, RFA, RAB, NISR). Four TAG meetings with a 4 days' workshop have been conducted for quality assurance.
- Workshops conducted in 27 Districts and Kigali City as well as field visits
- Focused group discussions with sectors
- ENR sector Thematic Working Group
- High-level meetings – Ministerial-level meetings
- Civil Society organizations and PanAfrican Movement meeting
- Consultation with citizens through media (TV, Radio, Twitter among others)

2.   Economic and Social Vision

Rwanda aspires to provide economic prosperity, creating wealth for all Rwandans. It requires high and sustained economic growth over the long term. Rwanda's aspirations are translated as becoming an upper-middle-income country (UMIC) by 2035, and a high-income country (HIC) by 2050. Quantitatively, this means: by 2035: GDP per capita of over USD 4,036; and by 2050: GDP per capita of over USD 12,476. Rwanda projects the population to increase by more than 50% to 17.6 million by 2035 and to double to about 22.1 million people by 2050. During this period, the share of the working-age population is expected to grow from around 56.3% of the people today to 65.7% in 2050.   Fertility is declining backed up by investments in human capital.

Reforms are planned so that the country will become healthier, well educated, and highly skilled. Investment in human capital is the soil from which all aspects of human habitat grow and flourish, including the economy. Therefore, education becomes the dominant pillar of development. Science, Technology, Engineering, and Mathematics across all levels of education must be strengthened to position Rwanda among the leading African countries in technology and innovation. Vision 2050 requires that Gross Domestic Expenditure on Research and Development will be one of the main tools to achieve this target, namely that the percentage of R&D in GDP will increase from 0.4% in 2016 to 1.2% by 2035 and 2.0% by 2050, respectively. The transition of the employment from surplus labor in agriculture to services and industry will happen in parallel, and jobs will need to be created in high value-added products. This evolutional principle is transformed into targets for each wealth-creating sector: agriculture, manufacturing, high-tech, trade and commerce, tourism, societal transformation, and poverty reduction.

The NLUDMP motto is "*Ensuring tomorrow's sustainability today!*", and its ideals are encapsulated in the word "**COOPERATE**" as follows:

(1) **C**onsolidated development, (2) **O**rderly planning, (3) **O**penness for innovation, (4) **P**reservation of nature, (5) **E**conomic yields, (6) **R**ational urbanization, (7) **A**mbient services, education and healthcare, (8) **T**ransportation for all, (9) **E**mployment all over.

The agricultural sector will have a high focus on productivity, climate resilience and standards, commercial agro-processing, and agri-businesses. The advanced food industry will be developed in the country basing on strong linkages between commercial farmers and industries. The agricultural sector will be market-driven, linked to urbanization and trade. In 2050 agriculture in Rwanda will be market-led and high-tech, driven by a few professional farmers with large farms on irrigable lands. Farms will be mechanized and use high-tech inputs in higher volumes. Yields will improve to the optimal international return.

Special Economic Zones are developing fast: In Kigali, Bugesera, Huye, Musanze, Rwamagana, Muhanga, Nyagatare, Rubavu, and Rusizi Districts. Linkages between production and processing will be focused on ensuring that domestic supply chains are efficient. Light manufacturing will include organic fertilizers and aquaculture textile, apparel and leather, International textiles, and garments firms. Construction and construction materials industries will continue to be one of the significant parts of the Rwandan industrial sector

Accelerating high-value, niche emerging sectors, such as nanotechnology, biotechnology, blockchain technology, or artificial intelligence, is essential for the future economy. Special Investment in Export-oriented knowledge services based on the high-value technology will be made.   Clusters of knowledge services such as Fin-tech, Edu-tech, Energy-tech, Agri-tech, big-data management, Pharmaceutical, Biotech, Cyber-tech will fill the economic landscape in 2050.

Rwanda will become a Sub Regional trading hub of logistic services and an aviation hub as well, serving as the gateway to East and Central Africa. Heavy investments in regional infrastructure will develop modern cargo and handling facilities, facilitation of trade and integration into the EAC, as well as to the entire continent. Bugesera Airport will serve as the primary hub for producers to access West Africa, Europe, Asia, and the United States and integrate into global value chains.

Knowledge-based services will head the pyramid of services in high-value niche services such as software lifecycle management, legal, and business consultancy services for emerging digital economies like life science. Services will also play a key role in facilitating production and exports throughout the value chain, mainly in the back office and production stages. Rwanda will establish and position herself as an international financial service center through the continuous development of the business ecosystem.

High-end sustainable tourism will be emphasized, especially the branch of Meetings, Incentives, Conferences, and Events (MICE). Rwanda will attract investors to diversify high-end tourism offerings by developing wellness facilities. A particular focus here will be the continued development of the Kivu belt.

Rwanda, in 2050, will be built upon the social cohesion and mutual trust of today. Social cohesion and mutual trust are appreciated today at 94.55%. Citizens identify themselves as Rwandans first and not in ethnic identity at 95.3%. These achievements gradually matured by the **"triple choice": staying together, being accountable, and thinking big.** Staying together is a precondition to building a country without discrimination and fear. Being accountable constitutes a core value of taking responsibility for one destiny. Thinking big is helping the country to build the future. The societal climate that values openness to new ideas, accountability, and community participation in spearheading local innovations. Post-genocide Rwanda addressed some specific mechanisms:

Umushyikirano council, where all categories of citizens participate in the discussion of national issues and priorities. **Itorero**, the school of civic education, helps Rwandans to regain their values and maintain a self-reliant culture. **Imihigo** serves as a tool for self-evaluation by all sectors and all Districts. They help to measure performance at the same time, identify the areas in need of attention for the next fiscal year. It is now becoming a culture in every institution, be they public, private, or civil society. **Imihigo** has also been decentralized at the household level. **Umuganda** contributes to supporting the national budget. The value of Umuganda in terms of money is 19 billion Rwandan francs in 2016. Umuganda also has other benefits, such as the promotion of social cohesion through community meetings held after Umuganda activities.

Vision 2050 will be driven by continued transformational leadership, which has enabled Rwanda to become the right place of doing business and to become more competitive globally. Another area that characterizes Rwanda's governance is participation and inclusiveness, in particular, gender parity in leadership. Gender parity in leadership is becoming a reality in Rwanda, where the country is one of the best-performing countries in this area. Rwanda is ranked 4th/144 (Global Gender Gap Report, 2017), and the country is globally leading in the percentage of women in parliament with 64%. Rwanda's justice sector also made significant reforms to ensure justice to all – to be further strengthened over the course of this Vision. **Gacaca courts** succeeded in bringing justice to the Rwanda post-genocide, where the International Criminal Tribunal for Rwanda (ICTR) was unable to handle all planned cases. Gacaca also contributed to social cohesion and unity and reconciliation among Rwandans.

Poverty is the biggest threat to the future of Rwanda. In vision 2050 the word poverty appeared only seven times. However, one of the declarations was: "Rwanda will build on the strong progress made in reducing poverty over the last two decades, from 78% after 1994 to 38% in 2017. The aim is to eliminate poverty by 2030." The average rate of the annual reduction of poverty in that period was 3.2%. To reduce it from 38% to zero in ten years means a yearly decrease in 7% over the next ten years, which is double the annual reduction of the last 25 years.

The purpose of this section is to find out if the vision of reducing poverty to zero in 10 years is applicable. The principal indicator of welfare used here is Annual Consumption per adult equivalent ("real consumption"). Real consumption in 2017 for the country as a whole was in 2017 **RWF 279,000.** The **Poverty Line** is set at **RWF 159,375** (or 564 American Dollars PPP) per adult per year, 57% of the annual consumption. The cost of providing 2,500 Kcals per adult equivalent per year would be RWF 105,064, which is 66% of their income spent on food. The most straightforward measure of poverty is the HEADCOUNT POVERTY RATE, which is the percentage of people living in households whose consumption per adult equivalent is below the poverty line. The proportion of people who were poor in 2016/17 was 38.2%, compared to 39.1% in 2013/14. The reduction in the poverty between these two time periods was not statistically significant. The reduction of Poverty over a more extended period, from 2010-2017, was 17.1%. The distribution of poverty within the country shows that rural poverty is three times higher than the urban, and the provinces are three times poorer than Kigali (Tab. 2-1).

	Total Poverty (%)	Extreme Poverty (%)
	2017	2017
Rwanda	38.2	16
Urban	15.8	5.9
Rural	43.1	18.1
Kigali City	13.9	4.2
Southern	41.4	16.9
Western	47.1	21.6
Northern	42.3	17.4
Eastern	37.4	15.3

Table 2-1 distribution of poverty in 2017

The two maps below show the distribution of poverty: Fig. 2-1 shows the Poverty rates and Fig. 2-2 shows the Extreme poverty rates.
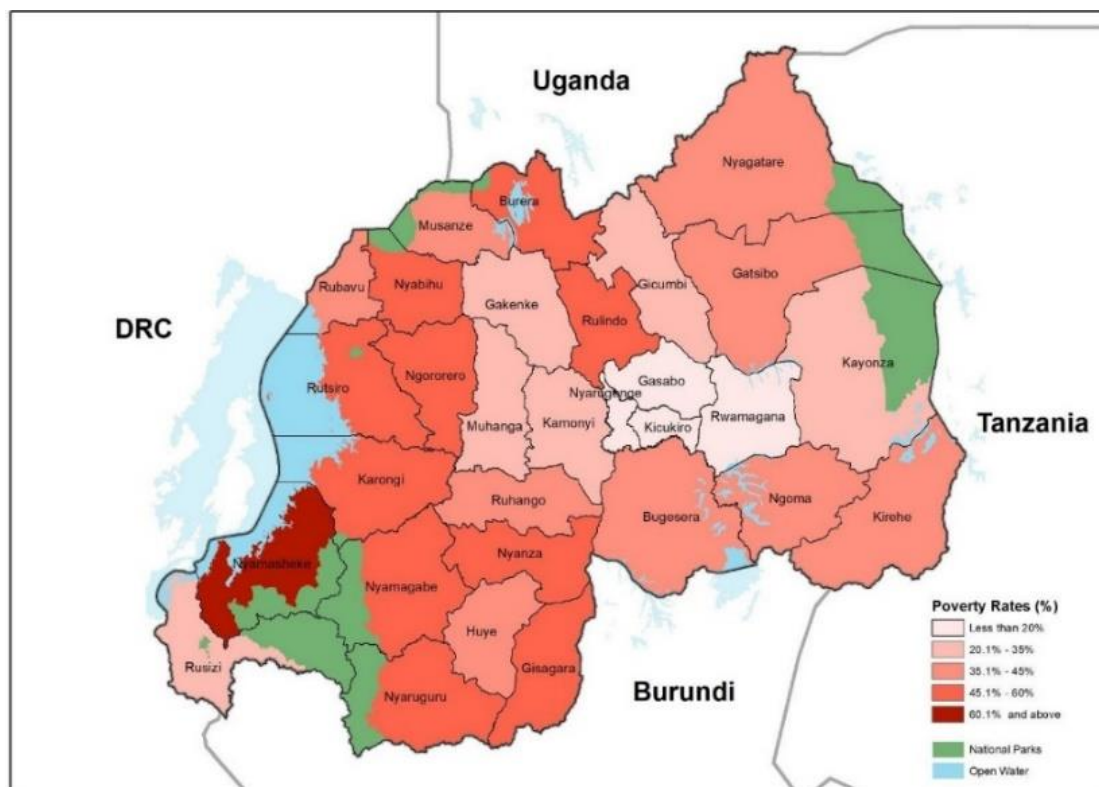
Figure 2-1 Poverty rates
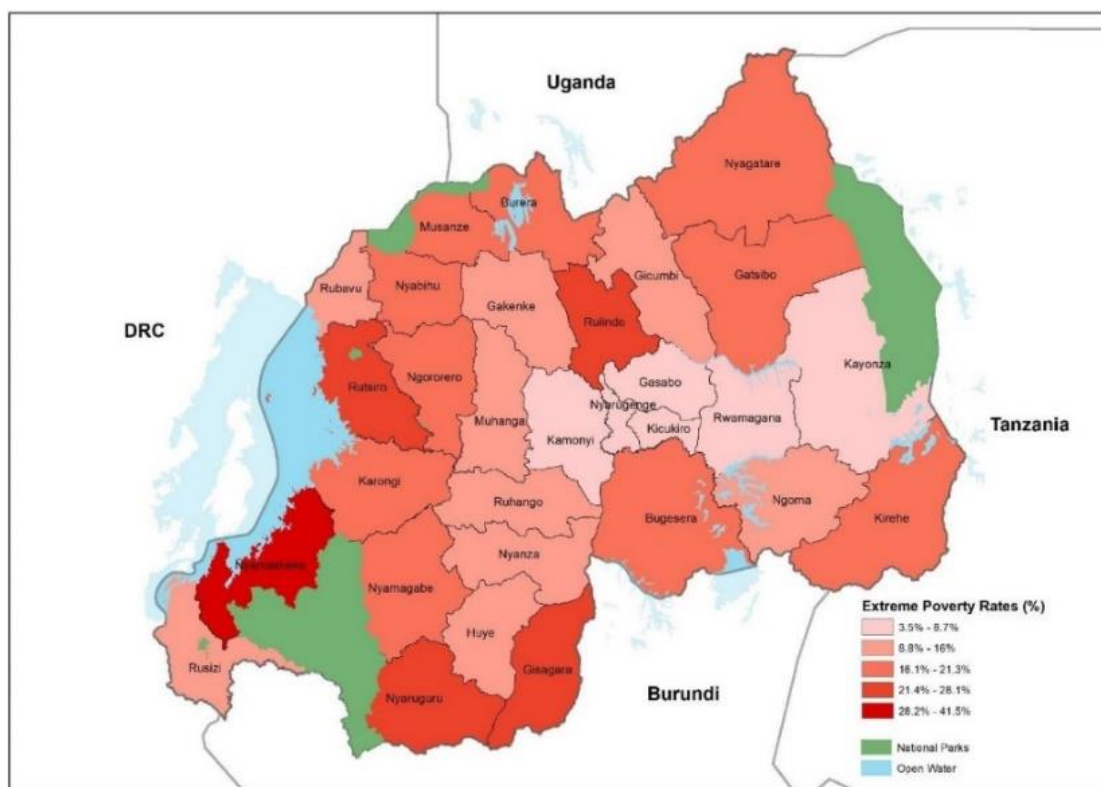
Figure 2-2 Extreme Poverty Rates

Vision 2050 aims to reduce the poverty rate from 38% to zero in ten years, a yearly decrease in 7% over the next ten years.   The only way to achieve this target is to increase GDP and distribute it with preference to the poor. From 2011 to 2017, poverty reduction was -0.85 or 15%. In the same period, GDP per capita increase was + 1.857 or 85.7%. The ratio between these values is named "Growth Elasticity of Poverty (GEP)."   When GEP values -1, that means equality between poverty reduction and GDP growth. All numbers below -1 show that GDP grows quicker than the decrease in poverty. The data for the last ten-year show that Growth Elasticity of Poverty was -0.45, signifying that the reduction in poverty was half the increase in GDP. The social indication is an unequal distribution of wealth in the country. Eliminating poverty can only be achieved if the distribution of wealth will immediately change course, and investments in poverty reduction by the government will triple.

Drivers of Growth and Competitiveness

Summary

The World Bank Group and GoR are suggesting 6 Reforms & Priorities identified as future drivers of growth in Rwanda. Each reform can be capitalized by the letter E, which together form a **Hexagon of Growth Drivers**. These six growth drivers match very well with the internationally **Competitiveness Pillars**, determining the level of a country's productivity, which improves living standards and long-term economic growth.

Raising productivity is a necessary pre-condition towards more significant human development. The **GCI (Global Competitiveness Index**) annual report for 2018 ranks Rwanda in the 108 positions out of 140 countries, with a score of 51 out of 100. Within the south Sahara African countries, Rwanda is ranked in 5th position, which is very rewarding. Still, the cons are market size, skills, innovation, and ICT. The pros are institutions, macroeconomy, labor market, business dynamism.

The physical habitat and infrastructure get the same score of the overall. Looking forward, Rwanda is targeting to belong to the top ten countries in doing business in 2035 and maintain the position. Also, to rank among the top 20 economies in competitiveness by 2035 and the top 10 in 2050.

Vision 2050 is built upon six pillars which are believed to generate growth:

- Human Capital and Innovation
- Trade, Exports, and Regional Integration,
- Urbanization through more significant Agglomeration,
- Competitiveness, and Enterprises,
- Agriculture and Food,
- State Institutions to become Capable and Accountable.

The following section will present how vision 2050 growth pillars are elaborated in the **Hexagon of Growth Drivers** (Fig. 3-1), **when each driver starts with a capital E.**
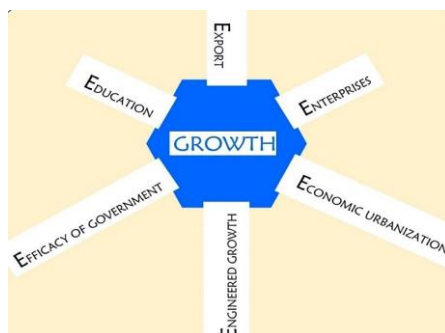
Figure 2-3 Hexagon of Growth Drivers

Education & Training

While the concept of educational quality is continually evolving, important quality factors today include: developing digital literacy, interpersonal skills, and the ability to think critically and creatively. Education embeds skills and competencies in the labor force. Highly educated populations possess a more exceptional collective ability to perform tasks and transfer knowledge quickly and create a more versatile and dynamic workforce,

Making the human capital a pivotal aspect in the planning process. A reformed education sector will lay the foundation for Rwanda to join the most advanced economies in 2050 with a market-driven education system. Access to quality primary education will be open to all classes and reach middle-income standards for a pupil- classroom and pupil-teacher ratios. Science, Technology, Engineering, and Mathematics across all levels of Education will be strengthened to position Rwanda among the leading African countries in technology and innovation by 2035.

Rwanda will ensure digital literacy for all by 2035, going forward to ensure inclusive participation in a knowledge society and attain new levels of productivity for the labor force. Tertiary education will be core to building a more robust and competent Rwandan society. The structural transition of the workforce from surplus labor in agriculture to other economic sectors of service and industry will happen gradually. Training will need to anticipate where and when new jobs are necessary, such as light manufacturing, tourism, and services. Developing these sectors requires building the right skills base starting now to become competitive in the 2020s and to reap the benefits between 2025 and 2035. Rwanda's education system will be market-driven and competence-based, matching Rwandans to the innovative jobs created in tourism, engineering, computer programming, and venture capital. Diffusion of specific information and communication technologies (ICTs) reduce transaction costs and speed up information and idea exchange, improving efficiency and sparking innovation. As ICTs are general-purpose technologies increasingly embedded in the structure of the economy, they are becoming as necessary as power and transport infrastructure for all marketplaces.

Export & Trade

Export growth will happen through cross-border and intra-Africa trade, spur investment in infrastructure, agriculture, and energy, and strengthening the region and continent by harmonizing policies and practices. Regional integration will provide a stable environment for Rwandan citizens to channel their energies and resources into development and entrepreneurial initiatives. Rwanda needs to team up with other countries as a way of addressing challenges inherent to the country's geography and move from a landlocked to a land-linked country. Rwanda may engage more effectively with the EAC, SADC, and the Common Market for Eastern and Southern Africa (COMESA) and bilaterally with the Democratic Republic of Congo on a regional division of labor. It must become a regional trading hub (logistic services, aviation hub, and innovation hub) and the gateway to East and Central Africa. Bugesera International Airport will serve as the primary hub for producers to access Africa, Europe, Asia, and the United States with daily flights and will become a major cargo hub. Innovations will drive down the cost of trading, currently 20-30% of the total cost of production in Rwanda. Lowering the cost of trade will occur through massive investments in regional infrastructure, concerted efforts to facilitate trade and integration into the EAC as well as the full continent. Moderate and predictable inflation and sustainable public budgets reduce uncertainties, set returns expectations for investments, and increase business confidence-boosting productivity. The competition supports productivity gains by incentivizing companies to innovate and update their products. The labor market encompasses the extent to which human resources reorganize ("flexibility") and the area to which human resources are leveraged ("talent management"). Well-functioning labor markets foster productivity by matching workers with the most suitable jobs for their skillset and developing talent to reach their full potential.

The size of the domestic and foreign markets to which a country's firms have access is proxied by the sum of the value of consumption, investment, and exports. Broader markets lift productivity through economies of scale: the unit cost of production tends to decrease with the amount of output produced. Large markets also incentivize innovation. As ideas are non-rival, more potential users mean higher potential returns on a new idea. Moreover, large markets create positive externalities as the accumulation of human capital, and transmission of knowledge increases the profits to scale embedded in the creation of technology.

Economy based Urbanization

Agglomeration will be an essential factor in driving growth of urban areas in Rwanda, rapidly evolving with increasing numbers of towns and cities emerging. Urbanization presents many opportunities for increased access to markets, skills, employment, among others. Rwanda has pro-actively embarked on a path to promote urbanization. The new focus will be on identifying and creating agglomerations of socio-economic benefits. Urbanization will continue to rapidly change with **new growth poles** planned to emerge besides the already planned six secondary cities and Kigali city due to significant investments being undertaken, for example, in Bugesera.

Urbanization will mostly have to take place in existing settlements to overcome urban sprawl and will be upgraded to high-density settlements. The economy is the foundation of Urbanization. Since 2009, the Rwandan industrial sector has grown together with urbanization at an average of 9.4% per annum. Within manufacturing, there have been some stand-out performers, most notably metal products,

machinery & equipment, and furniture. Construction has consistently been the most substantial part of the Rwandan industrial sector, now contributing 6.9% in 2017 GDP – higher than the entire manufacturing sector's contribution to GDP. Rwanda will strive to continue developing agro-processing, manufacturing, construction industries, inorganic and organic fertilizers, and aquaculture, knowledge-based industries. High-value sectors will take the lead. labor-intensive industries like textile, apparel, and leather sectors are of strategic importance to Rwanda, given the significant potential these sectors hold in terms of employment and value addition. By 2050, "Made in Rwanda" will be a recognized brand locally and internationally. Rwanda's industrial parks will operate at full capacity and feature state-of-the-art infrastructure, dedicated power lines, and high-speed internet connectivity. The advanced food industry will be developed in the country basing on strong linkages between commercial farmers and industries.

Construction is already a significant contributor to Rwanda's GDP. It will further increase its economic role through industrial park infrastructure, modern housing needs, local materials development, and expansion of transportation.

Allocation of enough land in optimal locations and related infrastructure for economic activities is the foundation of all pillars. Better-connected geographic areas have generally been more prosperous. Well-developed infrastructure lowers transportation and transaction costs and facilitates the movement of goods and people and the transfer of information within a country and across borders. It also ensures access to power and water—both necessary conditions for economic activity.

Enterprise

Rwanda will encourage the private sector's capacity to generate and adopt new technologies and new ways to organize work. The future business culture will embrace change, risk, new business models, and administrative rules that allow firms to enter and exit the market quickly. An agile and dynamic private sector increases productivity by taking business risks, testing new ideas, and creating innovative products and services. In an environment characterized by frequent disruption and redefinition of businesses and sectors, successful economic systems are resilient to technological shocks and can continually re-invent themselves. The availability of credit, equity, debt, insurance, and other financial products, and the mitigation of excessive risk-taking and opportunistic behavior of the financial system foster productivity in three ways: pooling savings into productive investments; improving the allocation of capital to the most promising ventures through monitoring borrowers, reducing information asymmetries; and providing an efficient payment system. At the same time, appropriate regulation of financial institutions is necessary to avoid financial crises that may cause long-lasting adverse effects on investments and productivity. The GOR will address cross-cutting constraints, and the first imperative is to provide affordable access to finance. probably best achieved through regional (rather than national) banking institutions. More activities include Improvement of targeting and monitoring of industrial incentives. Promoting creativity and innovation culture, especially among youth, and supporting talented youth to realize their potentials will encourage the creation of future jobs. An innovative and technological culture and mindset will be upheld and promoted Strategic countrywide partnerships with private sector companies.

The GOR will support the quantity and quality of formal research and encourage collaboration, connectivity, creativity, diversity, and confrontation. It will increase the capacity to turn ideas into new

goods and services, generating more significant knowledge accumulation and offer better collaborative or interdisciplinary opportunities. The result will be more capacity to create innovative ideas and new business models, which are widely considered the engines of economic growth.

Engineered Growth

Growth does not happen wildly and randomly. Growth should be engineered, especially by strengthening vertical coordination and regulations. Engineered Growth includes public investment in infrastructure and high-level human capital formation policy. Developing an efficient services sector makes not only direct contributions to a country's GDP and export capabilities, but also high-value-added segments of value chains such as nanotechnology, biotechnology, blockchain technology, or artificial intelligence. Services will also play a key role in facilitating production and exports throughout the value chain, mainly in the back office and production stages, e.g., Inventory Management, Distribution and Supply Management, R&D, Design, Marketing, Engineering, Accounting, and Legal support.

Energy will continue to be a requirement for household and commercial purposes in the future. Evidence shows a strong correlation between the increase in energy consumption and a rise in income levels. Per capita consumption of energy will increase from 1,026 Kwh in 3035 to 3,080 Kwh in 2050. It is anticipated that there could be a need for about 3,788 MW and 13,981 MW of energy capacity in 2035 and 2050, respectively. There will be a high emphasis on an adequate and stable supply of electricity for household and commercial purposes.

Ease and speed of movement between places, the median time is taken to commute to work, and the use of public transportation. Rwanda will develop a modern and efficient transport system where the median time taken to commute to work is 45 minutes by 2035 and 25 minutes by 2050. The percentage of the population using public transportation will be at 90%, or more and convenient public transport will be accessible at least within a 500m radius or less. Rwanda will develop railway lines, maritime transport on Lake Kivu and River Akagera, air transport, and expressway networks. Housing is the main product for more than 70% of Rwandans projected to be living in urban areas. The target is a steady annual increase of housing units constructed and housing mortgages accessed resulting from the public, private partnership schemes. Research into new local construction materials and housing typologies for affordable decent will be essential.

Efficacy of Institutions and Governance

Institutions are responsible for security, property rights, social capital, checks and balances, transparency and ethics, and corporate governance. Institutions impact productivity, mainly through providing incentives and reducing uncertainties. For Vision 2050 to be successful, a set of Governance prerequisites are needed: **consistency in prioritization, Increasing the role of the private sector,** deepening regional integration, adopting an unconventional approach. "Business-as-usual" is not sufficient to reach the objectives of Vision 2050. With an average GDP growth rate of around 7%, Rwanda would become a high-income country only by 2075. The most significant gains have to be made in the next seven years to lay a strong foundation for reaping the rewards in the decades to come. As a result, the Government must build the state's core capabilities based on capacity, meritocracy,

coordination, and rule-based authority. Strengthen market economy foundations, accountability of the country, and ensure that policies and programs are aligned with the needs of citizens. Efficacy of Institutions and Governance also cares for public health, public amenities, housing, energy, and transport. Health-adjusted life expectancy is the average number of years a newborn can expect to live in good health. Healthier individuals have more physical and mental capabilities, are more productive and creative, and tend to invest more in education as life expectancy increases. Healthy children develop into adults with more potent cognitive abilities. Maternal, neonatal, infant and under-5 mortality rates will reduce significantly to high-income country standards (70-90% reduction). Universal Uptake to family planning will be delivered toward reducing the Fertility rate from 4.2 (2014) to high-income countries' standards of 2.3 births per woman in 2050. Expanding upon the Community based Health Insurance Scheme, the focus will be on improving the quality of services offered. Health service delivery systems will further be devolved down to community levels. Rwanda will also position itself as a center for medical tourism, biomedical research, and pharmaceutical industries. World-class health facilities will be developed, offering specialized health care with quality services that are competitive on the continent.

Access to **water** will be scaled up from 87% (Estimate 2017) to 100% by 2024. Household connections within premises will be increased from the current 9% (Estimate 2017) to 95 by 2035 and 100% by 2050. Access to **sanitation** will be scaled up to all from 86% (Est. 2016) to 100% and waste management systems. Efforts shall be directed towards increasing household onsite access to sanitation services from 2% to 80% by 2035 and 100 by 2050. Modern sanitation sewer and management services in urban areas to handle solid and liquid waste shall be established. All households in urban areas will be connected to sewer networks. In rural areas, all families will have access to standardized on-site improved sanitary systems that respect the level of sanitation organization chains.

3.   Population and Employment

Summary of Principles and actions:

With a current annual growth rate of 2.4% (between 300 -400k new annual population), the population in Rwanda may reach 25.8 Million in 2050, with gross density approaching 1000p/sq.km, the highest in Africa. Future family planning resulting in a growth rate of 2.0% can lead to a smaller population of 22.1 Million, which better fits the impending shortage of land in Rwanda.

The employment profile in 2050, as shown in Table 4-1 and specified by 12 attributes:

1. The manufacturing sector will gain priority.
2. Specialization of industrial parks according to district/regional competence should be considered.
3. The total number of formal employees in "manufacturing districts" is 43.2% = 5,520,074.
4. The percentage of employment in manufacturing is 26.5% in average = 1,462,997.
5. 40% of manufacturing employment will be in Industry Parks = 585,199
6. The growth rate of industrial parks will be an average of 7% annually, reaching 88 km² in 2050. But the pace will be smaller in the first 15 years, only 6% and will increase to about 8% between 2035 and 2050.
7. A strong Coordination in industrial land allocation has to be well enforced.
8. The allocation result will be 29 km² in 2035 and 88 km² in 2050. Industrial parks will be developed in 13 districts and the City of Kigali. Other districts would be allowed only for agro-processing plants and handicraft factories.
9. A strong Coordination in industrial land allocation has to be well enforced.
10. The vertical construction of industrial buildings is highly encouraged.
11. Mining will Move from small-scale mining exploitation to a regional mineral processing hub. Adding value to minerals within Rwanda is preferable before exporting them.
12. Agriculture land will have to be protected, economically consolidated and agri-business highly developed.

Total employment		13,067,730
Subsistence foodstuff producers (Informal)		1,306,773
Formal Employment 2050	100.00%	11,760,957
1. Agriculture, forestry and fishing	8.40%	987,920
2. Mining and quarrying	6.00%	705,657
3. Manufacturing + high-tech	20.60%	2,422,757
5. Construction	15.00%	1,764,143
6. Services	50.00%	5,880,478

Table 3-1 Employment profile 2050

3.1   Current Demographic Profile

By mid-2017, Rwanda had a population of 11.8 million, with an annual growth rate of 2.4% from the corresponding previous year of 2016. Between 1980 and 2015, there has been a remarkable decline in the Total Fertility Rate, or the average number of children per woman throughout her lifetime, from 8.4 children per woman in 1980 to 4.2 children per woman in 2015.

The use of modern contraceptive methods increased from 10% in 2005 to 45% in 2010 and then rose slightly to 48% in 2015. In recent years, the country has invested in family planning and behavior change and provided training on long-acting and permanent contraceptive methods. As a result, fertility has declined. An opportunity for economic growth has been indicated, if combined with the promotion of equitable and good quality education, right investments in health, job creation, and good governance.
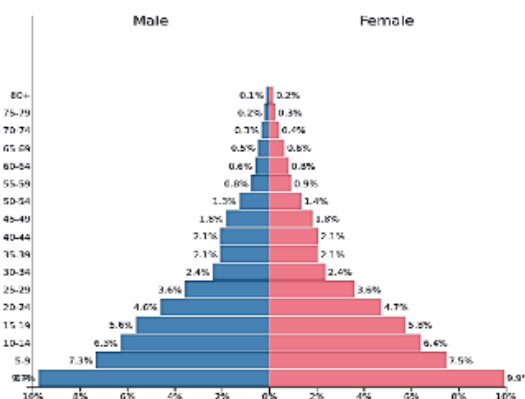
Figure 3-1 Distribution of Population by age and gender - 1975
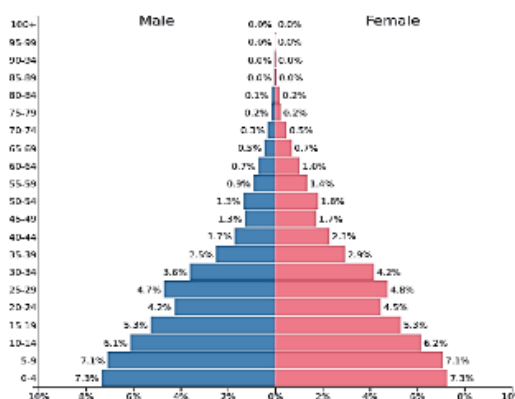
Figure 3-1 Distribution of Population by age and gender- 2015

Rwanda's population pyramids (Fig. 4-1 and Fig. 4-2) from 1970 to 2015 reveals a remarkable narrowing at the base of the Pyramid. The shape of "Rwanda 2015" has a noteworthy reduction in age groups 15-19, 20-24, and 25-29, which was due to the 1994 Genocide against the Tutsi and not just low fertility. Nevertheless, though Rwanda's population age structure has changed remarkably in the last five decades, total fertility rates remain high. The Total Wanted Fertility Rate is lower than the Total Fertility Rate. It has narrowed marginally between 2010 and 2015, from 1.5 children in the 2010 Rwanda Demographic and Health Survey (DHS) to 1.1 children in 2014-15. United Nations projections assume a decline in total fertility to 2.98 children per woman over her lifespan. The vision 2050 shows a further narrowing of the base of the population pyramid, based on the assumption that fertility will decline further to 2.21 children per woman. The result will be an increased working-age, well-educated population, leading to significant economic growth, hence achieving the demographic dividend.

Rwanda has made substantial investments in reproductive health, family planning, and maternal and child health programs. These efforts and initiatives have led to the reduction of the fertility rate. If existing interventions are strengthened, and new innovative strategies are established, fertility can be further reduced to achieve the national total fertility rate goal. Nonetheless, would the current progress continue, Rwanda has the excellent potential of harvesting the fruits of the demographic dividend by the year 2030. For this to happen, substantial investments are needed to educate the growing youth

population, to provide for the health needs of the Rwandan people, and to stimulate job creation further.

The Government of Rwanda has made family planning a key component of its development agenda, as documented in its Economic Development and Poverty Reduction Strategy (EDPRS 2013-2018). It aims to sustain family planning achievements and increase family planning availability and uptake.

Table 4-2 describes the **2012 population distribution** by districts and the dichotomy in distribution between urban and rural.

Population by district

District	2012 Pop.	Urban 2012	Rural 2012	% Urban 2012	% Rural 2012
Rwanda	10,515,973	1,737,684	8,778,289	16.50	83.50
Kigali City	1,132,686	859,332	273,354	75.90	24.10
Muhanga	319,141	50,608	268,533	15.90	84.10
Rwamanga	313,461	26,959	286,502	8.60	91.40
Bugasera	361,914	28,786	333,128	8.00	92.00
Nyagatare	465,855	47,480	418,375	10.20	89.80
Kirehe/Rusumu	340,368	10,083	330,285	3.00	97.00
Huye	328,398	52,768	275,630	16.10	83.90
Musanze	368,267	102,082	266,185	27.70	72.30
Rubavu	403,662	149,209	254,453	37.00	63.00
Rusizi	400,858	63,258	337,600	15.80	84.20
Gatsibo	433,020	23,914	409,106	5.50	94.50
Kayonza	344,157	34,008	310,149	9.90	90.10
Ngoma	336,928	15,236	321,692	4.50	95.50
Karongi	331,808	22,756	309,052	6.90	93.10
Nyanza	323,719	25,417	298,302	7.90	92.10
Gisagara	322,506	5,011	317,495	1.60	98.40
Nyaruguru	294,334	5,922	288,412	2.00	98.00
Nyamagabe	341,491	24,946	316,545	7.30	92.70
Ruhango	319,885	26,059	293,826	8.10	91.90
Kamonyi	340,501	39,035	301,466	11.50	88.50
Rulindo	287,681	8,630	279,051	3.00	97.00
Gakenke	338,234	9,347	328,887	2.80	97.20
Burera	336,582	6,205	330,377	1.80	98.20
Gicumbi	395,606	34,544	361,062	8.70	91.30
Rutsiro	324,654	7,034	317,620	2.20	97.80
Nyabihu	294,740	40,673	254,067	13.80	86.20
Ngororero	333,713	12,245	321,468	3.70	96.30
Nyamasheke	381,804	6,137	375,667	1.60	98.40

Table 3-2 Population Distribution by districts (NISR rphc4-population)

3.2   Population Projections and Target

Before setting population targets for Rwanda 2050, it is essential to have the base of the projection done by professional statistics institutions. Two sources are excellent and reliable: The National Institute of Statistics of Rwanda and the United Nations Department of Economic and Social Affairs. The projections done by NISR are only up to 2032. They show total population and density as in Figure 4-3:

- •   High scenario   - 16,875,142,
- •   Medium scenario   - 16,332,184,
- •   Low scenario   - 15,402,934.

Rural Population in 2032 is projected to be 70%, between 10,782,054 and 11,812,599. Urban Population in 2032 is projected to be 30%, between 4,620,880 and 5,062,543. Working-age will be 60.2% between 9,272,566 and 10,158,835.

The population increase will undoubtedly affect the land use as the population density will increase from 518 population per sq.km to 887.2 population per sq.km in 2050. The increasing population density will put under pressure the land use, which requires proper reflection and strategic adjustments of the settlement structure.

Population trend in thousands

	2019	2030	2050
Medium Scenario	12,794	16,024	21,886
High Scenario	12,883	16,645	24,292
Low Scenario	12,711	15,403	19,580
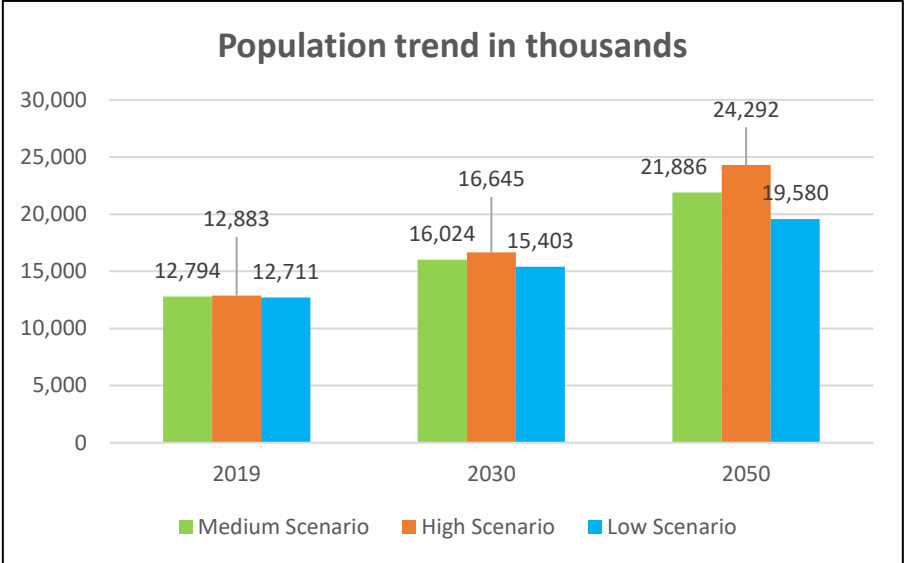
Figure 3-2 UN DESA Rwanda Population projection and trends

With a current annual growth rate of 2.4%, the population in Rwanda may reach 25.8 Million in 2050, with gross density approaching 1000p/sq.km, the highest in Africa. Future family planning resulting in a growth rate of 2.0% can lead to a smaller population of 22.1 Million, which better fits the impending shortage of land in Rwanda.

In summary:

1. The quantitative programs in all sectors will be based on this projection of 22.1 Million, which fortunately is also the target of vision 2050.
2. Twenty-two million people will be allocated among all types of settlements and distributed in all districts by their carrying capacity and the desired role and competitiveness in the national fabric.

3.3   Labor Force and Employment

Rwanda conducted its first national labor force survey (LFS) in 2016. According to the new international standards, employment includes only persons working for pay or profit, excluding persons engaged wholly or mostly in subsistence foodstuff production. According to the survey results, among the 6,573,000 persons 16 years old and over, about 3,329,000 persons representing 51 percent were in the labor force, either employed (2,703,000) or unemployed (626,000). The remainder 3,244,000 persons were outside the labor force, including some 1,665,000 persons engaged wholly or mostly in subsistence foodstuff production.

Under the new international standards, agriculture employment includes only those who produce agriculture goods intended mainly for sale. Agriculture employment was still predominant even under the new international standard, with a proportion of 37.3%. The branch of economic activity with the next highest number of employed persons was in trade (14.7 percent) followed by construction

(11.2 percent) and activities of households as employers of domestic personnel (6.8 percent). The share of the industry was 19% and 43.7% in services. About 2,060,100 were employed in the informal sector. The number of persons of working age who were outside the labor force was approximately 3,243,900, the majority of them being subsistence foodstuff producers, 1,665,000 (51 %). The total employment in agriculture, formal and informal, is, therefore, 2,673,293, 56% of the total employment (4,763,300).

The 2016 employment picture is summarized in Table 4-3.

Population 2016= 11,670,000 Working age population >16 years old = 6,573,200 (56.3)				
Informal Labor force 3,243,900 (49.4%)	Formal Labor force = 3,329,300 (50.6%)			
Informal Employed 2,060,100 (63%)	Employed (All who worked for pay or profit) 2,703,200 (81%)			Unemployed (All not employed but seeking for pay or profit) 626,100 (19%)
Total Employment = 4,763,300				
Subsistence foodstuff producers 2,026,000 (estimated)	Agriculture excluding subsistence foodstuff production 1,008,293 37.3%	Industry 523,608 19%	Services 1,181,298 43.7%	
Engaged in Agriculture: **3,034,293** (63.7% of total employment)				

Table 3-3 Employment distribution by economy branches 2016

The 2016 benchmark must change dramatically to reach the goals of vision 2050. The main influential goal is the very high 65.7% rate of the working-age population.

Six more essential and challenging measures have been taken, causing significant changes in the following parameters:

- The informal labor force will decrease to 20% instead of 49.4%.
- Out of the 11.6M persons in the formal labor force, 90% will be employed, compared to 81% in 2016, reaching an employment rate of 90% or 9,547,200 persons.
- This employment will be differently distributed among the economy branches: Agriculture (excluding subsistence foodstuff production) – 8.4%, Industry 26.5%, Construction 15%, Services 50%.
- Subsistence foodstuff producers will be 50% of the informal employment – 1.3M farmers, including women.
- The total employment in agriculture, formal and informal, will be 2,184,924, 16.7% of the total employment (13,067,730).

In countries that have an income of about 12,000 $ per capita as expected in Rwanda in 2050, agriculture usually accounts for 5% to 32% of the workforce (see table 4-4, based on the data of the World Bank). Hence, the goal of having about 17 % of employment in agriculture in 2050 seems reasonable. South Africa is a good example.

Country	GDP $ per capita 2018	% of agriculture in GDP	% of agriculture in the workforce
Mexico	18,149	3%	13.4%
Botswana	17,354	2%	26.4%
China	16,807	8%	31.4%
Brazil	15,484	5%	14.5%
Colombia	14,552	6%	16.9%
South Africa	13,498	2%	5%

Table 3-4 GDP and the workforce of Agriculture

The 2050 employment system is summarized in Table 4-5.

Population 2050= 22,100,000 Working age population >16 years old = 14,519,700 (65.7%)				
Formal Labor force = 13,067,730 (90%)				**Informal labor force (IFLF) 1,451,970 (10%)**
Unemployed (All not employed but seeking for pay or profit) **1,306,773 (10%)**	**Employed** (All who worked for pay or profit) **11,760,957 (90%) 53.2% of Population**			**Informal Employment 1,306,773 (90% of IFLF)**
	Total Employment = 13,067,730			
	Services 5,880,478 (50.0%)	**Manufact & High-tech 2,422,757 (20.6%)** ⎯ **Mining 705,657 (6%)** ⎯⎯ Construct. **1,764,143 (15.0%)**	**Agriculture** excluding subsistence foodstuff production **987,920 (8.4%)**	**Subsistence** foodstuff producers 1,306,773
				Engaged in Agriculture: **2,229,693 (17.5% of total employment)**

Table 3-5 2050 Employment system

The employment structure in Rwanda is very far from the high-income countries, as shown in table 4-6. The well-known target formula in high-income countries of "75% - 2% - 23%" for employment distribution among economy branches (respectively: services, agriculture, industry) is unreachable in Rwanda, even in 2050. This target will remain relevant for the next decades of after 2050.

Employment in **services** (% of total employment)				
Country Name	**2016**	**2017**	**2018**	**2019**
Belgium	77.5	78.1	78.2	78.4
Brazil	68.9	70	70.2	70.3
Canada	78.4	79	79	79.1
European Union	71.7	71.7	72	72.2
High income countries	74.1	74.3	74.5	74.7
North America	78.7	78.8	79.1	79.4
Singapore	82.7	82.8	82.9	83
Rwanda	24.2	24.4	24.6	24.8

Employment in **agriculture** (% of total employment)				
Country Name	**2016**	**2017**	**2018**	**2019**
Belgium	1.3	1.2	1.2	1.1
Brazil	10.2	9.5	9.4	9.3
Canada	1.9	1.5	1.5	1.5
European Union	4.3	4.2	4.2	4.1
High income countries	3.1	3	3	2.9
North America	1.5	1.4	1.4	1.4
Singapore	0.5	0.5	0.5	0.5
Rwanda	67.5	67.1	66.6	66.1

Employment in **industry** (% of total employment)				
Country Name	**2016**	**2017**	**2018**	**2019**
Belgium	21.3	20.8	20.6	20.5
Brazil	20.9	20.5	20.4	20.4
Canada	19.6	19.5	19.5	19.4
European Union	24	24.1	23.9	23.7
High income countries	22.8	22.7	22.5	22.3
North America	19.8	19.7	19.4	19.2
Singapore	16.8	16.7	16.6	16.5
Rwanda	8.3	8.6	8.8	9.1

Table 3-6 Employment distribution by economy branches in high-income countries

4. Space for Growth: Current Land Cover and Uses

Summary

The net size of Rwanda land, excluding 3300 km² of rivers, lakes, and wetlands, but including buffer zones, is 23,038 km². Rwanda's dry land, excluding only lakes and rivers, is 24,801 km².

The country has been divided into three land-use categories (LUCA's): A, B, C. The full potential of agricultural lands is 12,433 km², 63% in category A, 24% in Category B, and 13% in category C.

This potential distribution of Agricultural lands will be the most potent pool factor in the future delivery of Imidugudu in the country.

The 2019 distribution of land cover is specified in Table 5-1 and in the map in Fig. 5-1:

Current Situation 2019		
Land cover	Km²	%
Agriculture	10,949	41.6%
1.Agriculture (Very Suitable)	8,414	
2.Agriculture (Not Suitable)	1,438	
3.Grass Land (Livestock)	1,097	
Forests	7,242	27.5%
1.Natural Forest	1,389	
2.Forest Plantation	3,873	
3.Wooded savannah	1,537	
4.Shrubland + Bamboo	443	
Bare high Slopes	1,554	5.9%
Bare high Slopes of abover 55%	1,554	
Built up areas & Infrastructure	2,888	11.0%
1.Cities	1,025	
2.Rurban Settlements	38	
3.Rural Settlements (Gross)	1,500	
4.Industry	12	
5.Roads, railways & Airfields	313	
Water Bodies	1,637	6.2%
1.Lakes & Rivers	1,537	
2.Buffer zones (50m)	100	
Wetlands	2,068	7.8%
1.Wetlands (protected)	480	
2.Wetlands (Conditioned Agri.)	1,283	
3.Buffer zones (20m)	305	
Balance	26,338	100.0%

Table 4-1 Land Cover 2019

Hillside agricultural lands are the primary component with 10,949 km² or 41.6%. This category includes 8,414 km² of very suitable areas for Agriculture, 1,438 km² of land, which is used for agriculture but regarded as not ideal for commercial production. In this category, 1097 km² of grassland are also included. An optional addition to this category is 1,283 km² which may come from unprotected wetlands but under certain environmental conditions.

The second broad land cover category is two groups of **forests**: Natural forestry: 1,396 km², Plantations: 3,873, and Wooded Savannah, Shrubland, and Bamboo: 1,978 km². Together, they cover 27.5% of the country. All **built-up areas,** including roads, include 2,888 km² of land, 1,500 km² of which are rural settlements. Two-thirds of the rural settlements (1,000 km²) are small disjointed parcels of poorly used agricultural lands. These lands may potentially be added to the stock of commercial agricultural lands, once the rural system is transformed. 482 km² are protected wetlands, and 1510 km² of water bodies close the list. The column on the right side of the table shows how much land in each land cover category is currently designated as protected. 1,554 km² of the total 2,419 km² are included in National parks.
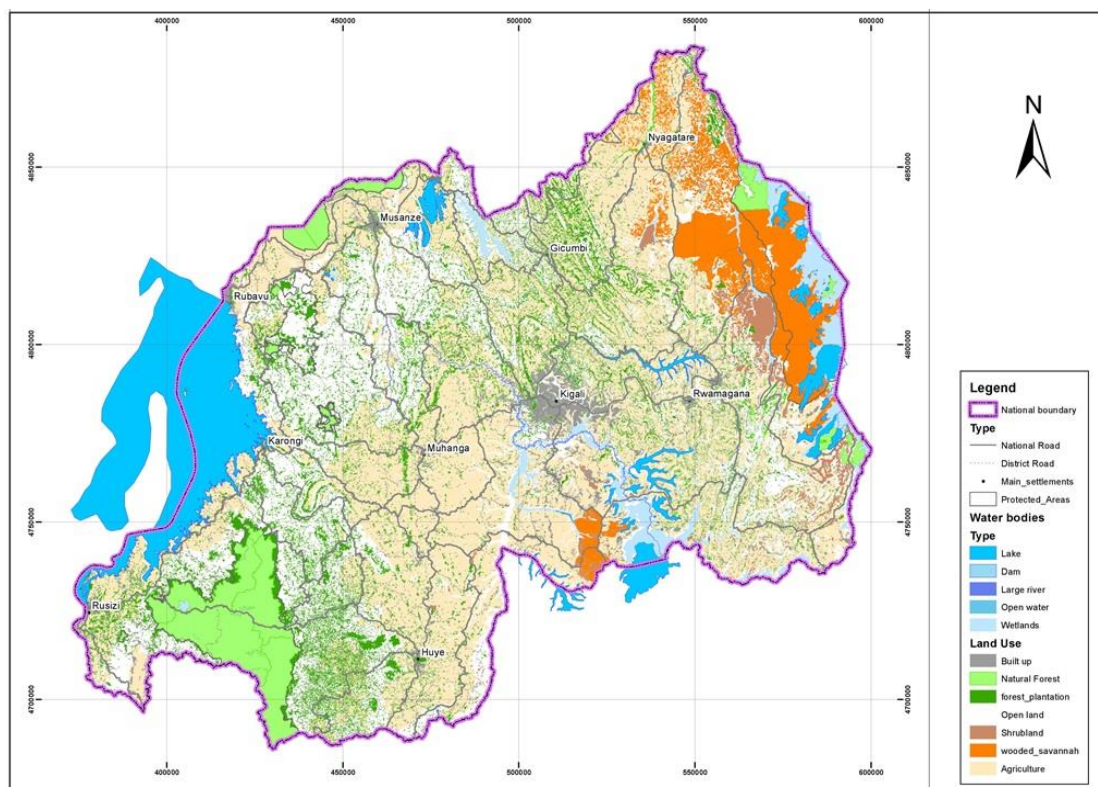
Figure 4-1 Land Cover 2019

In table 5-2 and Fig 5-2, three more columns (A, B, C) of Land use categories (LUCA) have been added. These categories divide the country into polygons, containing a blend of Land uses, out of which one is dominant:

LUCA A (8,227 km²) is dominated by **Prime Agricultural lands,** the most suitable lands as defined by the Ministry of Agriculture. Other areas in this blend include small amounts of Natural Forests, 844 km² of the Forest Plantations, scattered within the agricultural lands with no harm to their consolidation and continuity. The reason is that Forest plantations in blend A are only 16% of the farming areas. The

majority of Wooded savannah (656 km²) and Shrublands + Bamboo (443 km²) are also included because of their potential to become prime agricultural lands.

Land cover	LUCA A	LUCA B	LUCA C	Total Km²
	Prime Agri	Secondary	Open Land	
Agriculture 10,949 41.6%				
1.Agriculture (Very Suitable)	5,047	3,062	305	8,414
2.Agriculture (Not Suitable)	255	209	974	1,438
3.Grass Land (Livestock)			1,097	1,097
Forests 7,242 27.5%				
1.Natural Forest	19		1,370	1,389
2.Forest Plantation	844	725	2,304	3,873
3.Wooded savannah	656	15	866	1,537
4.Shrubland + Bamboo	443			443
High Slopes 1,554 5.9%				
High Slopes (>55%)			1,554	1,554
Built-up, Infrastructure 2,888 11%				
1.Cities		0	1,025	1,025
2.Rurban Settlements	38			38
3.Rural Settlements (Gross)	372	270	858	1,500
4.Industry	4	4	4	12
5.Roads, railways & Airfields	116	72	125	313
Water Bodies 1,637 6.2%				
1.Lakes & Rivers			1537	1,537
2.Buffer zones (50m)			100	100
Wetlands 2,068 7.8%				
1.Wetlands (protected)	21	36	423	480
2.Wetlands (Conditioned Agri.)	428	**428**	**427**	1,283
3.Buffer zones (20m)	105	**100**	**100**	305
4.Buffer zones (20m)	**305**			

Table 4-2 Land Cover divided by LUCA's A, B, C.

LUCA B (4,940 km²), also includes **Prime Agricultural** lands but half the size and much more scattered. This blend has a negligible amount of natural forests. Still, it contains 725 km² of the forest plantations, mixed with agriculture lands at a rate of 1:4. This rate explains why Agri lands are less consolidated and more scuttered, a factor which decreases suitability for commercial crops.
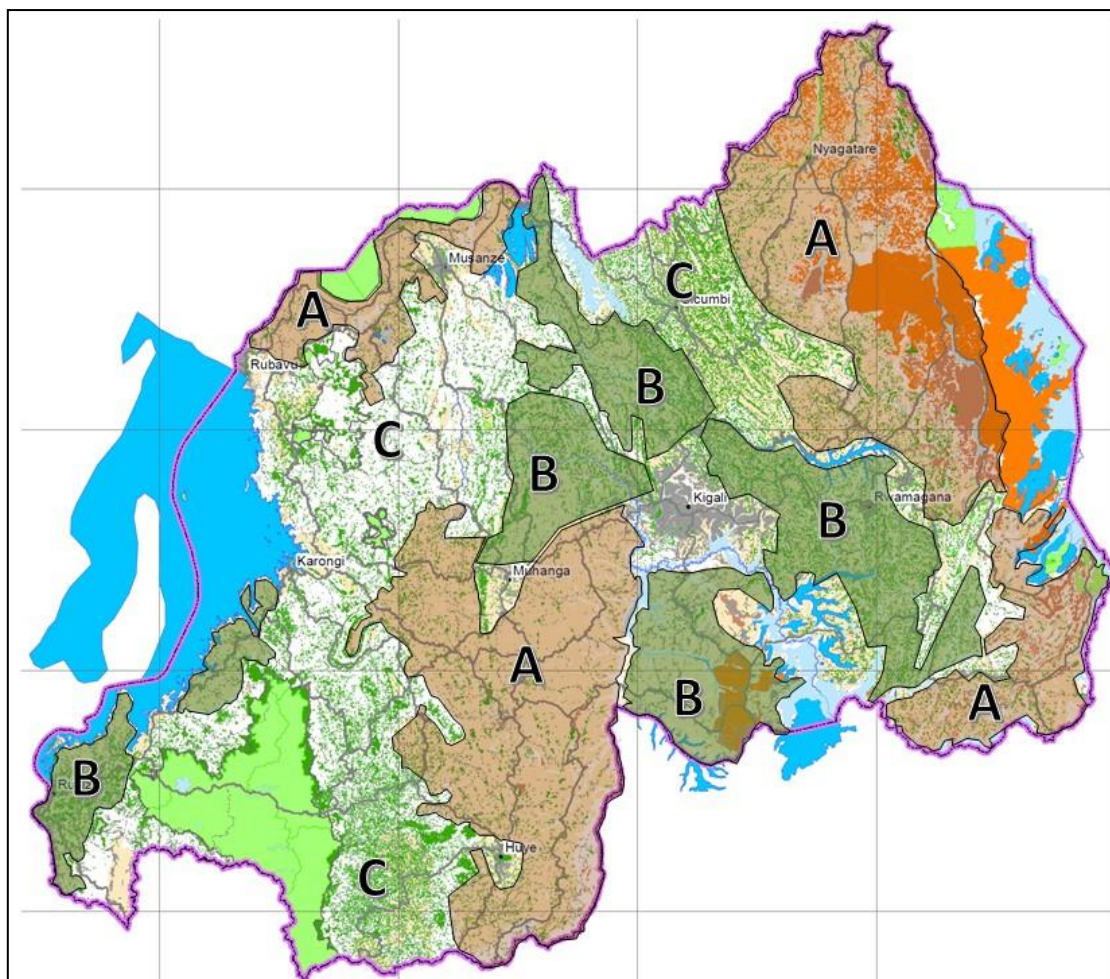
Figure 4-2 Land use categories: A, B, C

LUCA C (13,171 km²) is a blend of open landscape elements, including grasslands (1097 km²) and 4,540 km² of different forests. This amount covers almost all-natural woods and 60% of forest plantations. 1554 km² of high slopes is also included. **C** contains 2.8% of prime agricultural lands, which are small and disjointed, and 974 km² of areas not suitable for commercial use. These lands can still be cultivated in small farms, either subsistence or technically improved.

In sum, by 2019, the available agricultural lands in the country contains 63% in category A, 24% in B, and C contains 13%.

Table 5-3 presents a connection between districts and Land Use Categories (LUCA's). The first ten districts are included in LUCA A and, therefore, must be, and indeed are, the most fertile districts in Rwanda.

No.	Districts	LUCA	Total districts
1	Nyagatare	A	
2	Huye	A	
3	Rubavu	A	
4	Musanze	A	
5	Kayonza	A	
6	Kirehe	A	**11 Districts**
7	Gisagara	A	
8	Nyanza	A	
9	Gatsibo	A	
10	Ruhango	A	
11	Rwamagana	A	
12	Muhanga	B	
13	Bugesera	B	
14	Rusizi	B	
15	Ngoma	B	**7 Districts**
16	Kamonyi	B	
17	Rulindo	B	
18	Burera	B	
19	Kigali City (3D)	C	
20	Karongi	C	
21	Nyaruguru	C	
22	Nyamagabe	C	
23	Gakenke	C	
24	Gicumbi	C	**12 Districts**
25	Rutsiro	C	
26	Nyabihu	C	
27	Ngororero	C	
28	Nyamasheke	C	

Table 4-3 LUCA's A-B-C distribution among districts

4.1   Land Demands by Sectors.

The following list of land cover categories specifies in table 5-4. —the **ten economic sectors, which are the most significant land consumers.** Within the settlement groups, there are secondary land users of built areas that are included in the boundaries of settlements.

Main Land Users	Secondary Land Users	Sections of the report for 2050 Demands
1. Agriculture (commercial)		Agriculture Report
2. Agriculture (in Wetlands)		
3. Agriculture (Small farms)		
4. Grass Land (Livestock)		
5. Forest Plantation		ENR Report
6. Cities & Urban settlements		
7. Rurban Settlements	• Housing • Commerce & Trade • Public Services • Financial & Business Services • Open spaces, Parks & Sport • Tourism • Infrastructure Utilities	PUSH Report Tourism & Conservation Report. Public Utilities Report
8. Rural Settlements		
9. Industry		Spatial Economy study
10. Roads and Airfields		Transportation Report

Table 4-4 Land uses – Main and secondary

The future Demands and guidelines for the land of the **Main Land Users** have been analyzed in the reports as listed in the right column of table 5-4. Next chapters bring to the table the planning concepts and guidelines of each sector and the resulting **land demands.**

5.   Urbanization

Summary of guidelines and measures

Urbanization will continue to rapidly change with new growth poles projected to emerge besides the already planned six secondary cities and Kigali city. Future urbanization will be based on the following prospects:

- The Urban population is projected at 7.5M on the coverage area of 897 km² by 2035 and 15.4M (70%), spreading on 1470 km² by 2050.
- Kigali is planned for a population of about 3.8M
- A new layer of satellite cities (Bugesera, Rwamagana, and Muhanga) has been proposed with projected population between 800k-1M to minimize the primacy of Kigali City and support the development of growth poles. The Satellite cities are planned to include together 2.6M. Controlling and guiding urban growth in those cities is very necessary going forward.
- Musanze, Rubavu, Rusizi, Nyagatare, and Huye will continue to develop as secondary cities with population between 250 to 650 thousand people.
- Additional three secondary cities (Karongi, Kayonza, and Kirehe) were identified to maximize and support the periphery near international borders. The total of 8 secondary cities will include 3.8M.
- Sixteen more district towns, which are not included in other ranks, will be smaller in size, and their population range will be between 100,000 to 250,000 people for each. Altogether, they will consist of 3.4M.
- A layer of rurban settlements (73 nodes with population of about 24,650 each) has been introduced as linkage nodes between urban and rural areas. All together they will be limited to a total of 1.8M persons on an area of 307 km².
- The size of the urban sites and their corresponding population are limited to avoid urban sprawl. Population densities in urban areas should increase considerably. All proposed urban areas will have social and public amenities and sports centres to host local and international championships in various sports disciplines.

The proposed measures by urban categories are in table 6-1:

Urban Category	Pop. (1000's)	Density Pop/km²	Gross boundary size, Km²
1 Kigali City	3-3,8M	9,000-10,000	220-380
3 Satellite cities	650-1000	8,000-9,000	65-100
8 Secondary cities	250-650	7,000-8,000	40-65
16 District towns	100-250	6,000-7,000	10-40
73 Rurban settlements	20-100	<6,000	<10

Table 5-1 Urban categories by population, density, and size

5.1 Urbanization Concepts

The National Land-Use Development Master Plan (NLUDMP) task is to design and updated the spatial structure for Rwanda, including all future settlements and the location of all sectors' activities in a land-use plan of a national scale. All settlements, urban, rural, big or small, are part of the national spatial puzzle, including Kigali and the group of secondary cities. This section is a concise part of the "PUSH" report (Population, Urbanization, Settlements, and Housing) covering the urban components of the national habitat. The government has defined population size and urbanization levels as targets for 2050. The population growth target of 22.1M is adopted from vision 2050 (draft 12.2019). This target assumes better family planning, resulting in a decrease in annual growth rate from 3.0% to 2.0% in the next 30 years.

Twenty-two million people will be allocated among all types of settlements and distributed in all districts, following their carrying capacity and the desired role and competitiveness of the district in the national fabric. The quantitative programs in all sectors are based on this projection. Urbanization is desired by Vision 2050 to accelerate to 70%, including all types of urban settlements: Kigali, Satellite cities to Kigali, Peripheral or Secondary cities, District towns, and Rurban centres, namely emerging centers. An annual rate of 6.8% is needed to reach this target in 30 years.

The current Level of Urbanization is about 18.4%, and the annual growth rate of urbanization is only 4.4 %. Achieving this target is very challenging. Urbanization is a process of change by migration. The migration of people who move from rural to urban areas is currently the only urbanization modality in Rwanda. Migration reinforces urban centers but, at the same time, deteriorates and weakens rural settlements by lack of investments and employment opportunities. The vast movement also challenges the urban cores like Kigali by disproportional pressure on housing and services and by increasing informal residence and slums.

Urbanization Quality means livelihood, housing, education, and health, but not numbers. There is no correlation between the level of urbanization and the quality of urbanization. In many cases, the association is even negative: higher urbanization rates cause low quality. Kigali is already congested and struggles to eliminate unplanned housing/settlement. There are impoverished, densely populated areas, where four to eight people live on tiny plots with limited connection to electricity and where sanitation services are not accessible.

Research results suggest that the biggest generator of slums is a massive and unabated poor migration combined with low household incomes and a relatively high cost of living. And this is the situation in Kigali: most rural migrants are poor and informal dwellers. The preferable way to stop the migration flow is to act against centralization and create other outlets for urbanization, such as peripheral cities. The current process, which creates a progressive core and a lagging periphery, must be changed into a more equalized course.

NLUDMP identifies a primate city system in Rwanda. This phenomenon is well known, especially in Africa. It is characterized by one vast city, many much smaller towns, and no intermediate-sized ones. People move to the capital city in search of economic advantages, educational opportunities, cultural richness, and diversity of experiences that large cities provide. Primate cities overgrew and spread into the surrounding countryside. Forty-three countries in Africa have primate cities that dominate their urban system. A city becomes primate when three attributes are evident:

1. The primate city size is at least twice as large as the next largest city.
2. Primate city is more than twice as economically significant.
3. The rest of the country depends on its services: cultural, economic, political, and vital transportation needs.
4. If a country strives for decentralization, it must eliminate the primate city syndrome.

Kigali is currently a primate city. With 1.6 million people living in Kigali province, the city includes 40% of the country's urban population, while the remaining 60% live in the towns with less than 100,000 people. The city accounted for 40 percent of the country's total GDP and 61 percent of total nonagricultural GDP. Vast expansion damages Kigali's unique character. It has grown through the annexation of adjacent towns, encroaching agricultural areas. Kigali primacy is also illustrated in comparison to what other cities contribute to the Rwandan economy. The six secondary towns together account for about a third of Kigali's contribution to the national economy, i.e., 19 percent of total nonagricultural GDP (13 percent of total GDP). Kigali also accounts for 27 percent of all nonfarm jobs created between 2011 and 2014 and more than 50 percent of all legal private firms and employment in those firms.

NLUDMP's target for Kigali is to steer it from being a primate city and plan other outlets for the potential migration, by distributing more magnets in the country.   As a result, the migration pressure on Kigali will decrease, and the size of the town will excide 3.8M. As a capital, Kigali will continue to be the country's most famous city, a center of government, commerce, science, culture, and the place for headquarters of the locals as well as international most powerful businesses. National treasures like a museum, symphony, opera, and ballet will be based in the capital city. Instead of traditional light industries like textile factories, Kigali will develop High tech and Research, branches of occupation, which will fit its population profile.

NLUDMP brings to the table an additional mode of urbanization for Rwanda: "In-Situ Urbanization," which is a process in which people become urbanized where they are. It transforms clusters of rural settlements into urban centers within the original rural environment. The In-situ Urbanization is the right solution for both urban and agricultural systems. However, implementation requires a governmental vigorous promotion and investments in rural agglomerations. On the other hand, it reduces the costly movements of poor farmers to cities. It prevents social and economic pressures in existing towns. The only chance to achieve 70% urbanization rate, as Vision 2050 requires, is by encouraging in situ urbanization and prioritizing investments in the rural system to form real clusters of settlements.

Sprawl is the antipode of planning. It is a natural behavior of people who settle for their existence, preferring individual vs. public interests. The urban sprawl and rapid pace of slums or squatter housing creation are still dominant with negative results in the shrinking of agriculture, creating a land shortage, and increasing land prices. Sprawl is affected by easiness and less expensive development in vacant areas. Constraints, like topography, also cause expansion. NLUDMP suggests reconsidering the current policy of restricting construction on slopes beyond 30% by opening of a conditional use of slopes between 30-50% for construction projects subject to proper/ in depth infrastructure studies and establishing special investment requirements. One of the formations of sprawl is "Urban corridors," a concept that has become popular in various publications. NLUDMP regards this tendency as a threat to the urban system, agriculture, and the environment. Furthermore, urban corridors may be partially responsible for the social capital decline and residential segregation, compared to compact neighborhoods that foster casual social interactions among neighbors. New development in urban as well as in rural areas must imply two complementary concepts: Agglomeration and Consolidation.

Agglomeration is suitable for services and the economy. Agglomeration and economies of scale can emerge only if spatial consolidation is achieved. **Concentration and Consolidation** are the antonyms of sprawl, and it is one of the main objectives of this plan.

Current built-up areas and boundaries of villages and urban areas have lost control and expand wildly. Urban areas and rural settlements should be compact and consolidated to significant and continuous agricultural lands: the result - higher yields and higher revenue to farmers. The hierarchy of settlements is one of the most important considerations while planning a spatial **master plan.** Kigali's master plan and six secondary city programs give only an indication of the implicit assumptions about this critical issue. The superposition of plans shows that there is a gap between the ideas and the target of the urbanization level (14.7M). Kigali (3.8M) + 6 secondary cities (2.4M) are together 6.2M. A solution for the rest of the **8.5M** is needed to fill the gap. Unfortunately, this issue has passed under the radar of national policy-making till now. NLUDMP deals with this issue and presents five variants of the hierarchy, followed by a spatial structure. **The hierarchy has five ranks:** Kigali is on top, the second rank includes Satellite cities, then the group of Secondary cities, District towns, and finally, Rurban Centres/emerging centres, including the small agglomerations of small emerging towns in the rural areas.

All Cities and rurban/emerging centres are mandated to have different land uses such as habitation, commercial, tourism and conservation areas, urban farming, urban forest and landscaping, social services such as sports and recreational facilities, schools and health facilities, transport, religious facilities, etc. It is restricted to establish those above facilities outside specified urban boundaries.

5.2 The Urbanization Spatial Plan

The spatial plan proposes urban populations in each rank, accumulating to a 15.40M, which is an urbanization rate of 70%. In terms of centralization, Kigali and its satellites agglomerate to a central core of 6.4M, or 41.1%, which is reasonable centrality. (Figs. 6-1, 6-2).
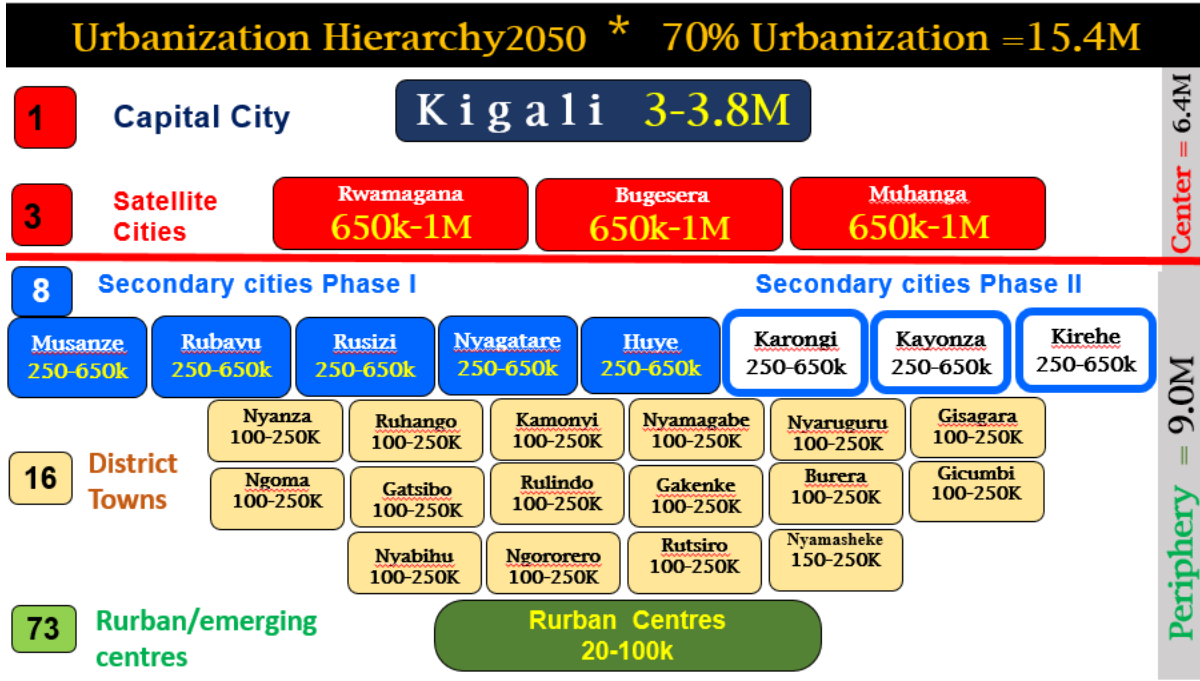
Figure 5-1 Urbanization Hierarchy 2050 - Recommended Option
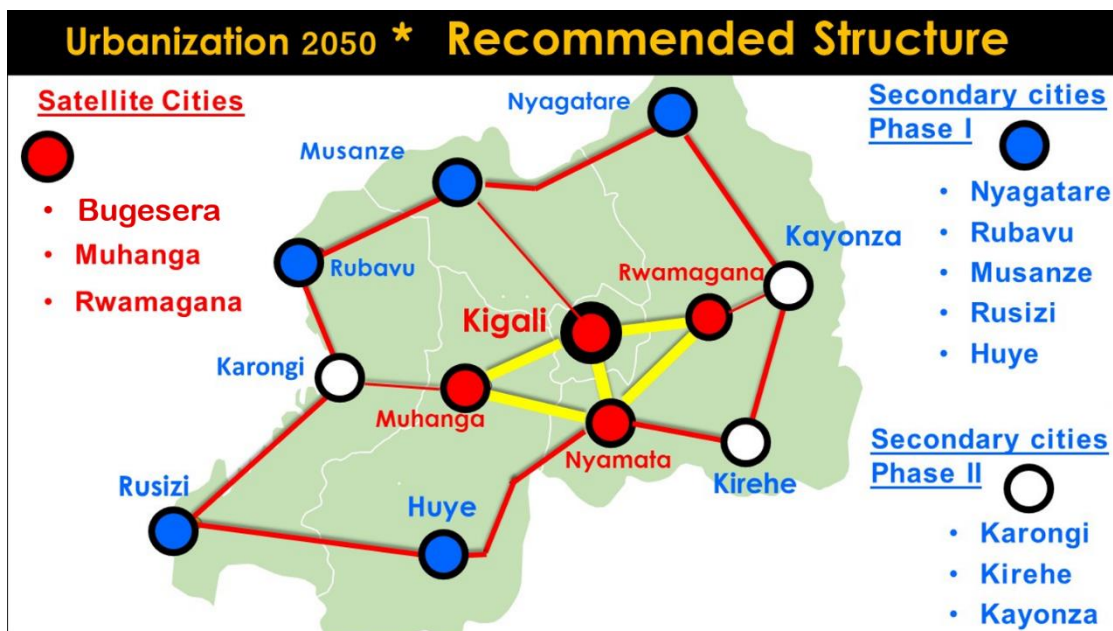
Figure 5-2 Urbanization 2050 – Positioning of major cities

The spatial plan will guide the future settlement structure by the following principles:

- **It is optimizing centralization by preventing extreme Agglomerations.** Three cities (Rwamagana, Muhanga, and Nyamata of Bugesera) play the role of Satellites. When combined with Kigali, they become a triangle, agglomerating **6.4M** people. This centralization is much healthier than the current concentration that reaches 90% dominance.

- **It is controlling the Primacy of Kigali.** The superiority of Kigali must be limited if the Government desires the decentralization of the country. Decentralization will not be valid if the "Primate city" syndrome continues. Decentralization requires larger cities of at least 0.65-1M people, which become economic growth poles. Kigali's growth must be limited to 3.8M, and migration must be restrained. It will be achieved by creating outlets for movement to different cities in the periphery (secondary cities) and within the Golden Triangle of satellite cities.

- **It is supporting In-Situ urbanization and controlling migration.** Intra Migration is a generator of Urbanization. If a particular structure of Urbanization is desired, then managed Migration will be used to accomplish it. In the case of Rwanda, the following nine targets must be achieved:

1. It is assisting in stopping the negative migration from secondary cities by **developing economic opportunities and other pull factors.**

2. The primary source of growth of secondary cities should be the surrounding villages.

3. If the first two processes are provided, the redundant large-scale migration from rural areas to Kigali will diminish.

4. The internal migration of farmers towards the eastern province to join sophisticated agriculture is very positive.

5. Migration from Kigali to places in the outskirts of Kigali, a movement that creates suburbanization, must be stopped and replaced by migration to economically based Growth Poles.

6. **It is supporting the peripheral border cities.** Eight existing towns, which are located on an external belt near the borders, are suggested to grow fast and to be regarded as Peripheral Growth Poles of **250k-650k,** or secondary cities. They will make use of their location as international border towns and optimize commerce beyond their specific location advantages and specialization. A belt of highways will connect the belt towns. The development of these eight cities will happen in two phases – five in the first phase and three in the second.

7. **It is maximizing feasibility in developing Satellite and Secondary cities.** By focusing on existing towns with good potential, and by setting reasonable population targets, the probability of implementation is increased meaningfully.

8. **It is preventing sprawl by minimizing Rurban Population.** This objective of reducing the population in small and weak emerging towns is based on stopping rurban sprawl of tiny townships and directing urbanization towards healthy cities with several hundred thousand inhabitants. As the rurban phenomenon cannot be eliminated, the plan suggests a maximum of 1.8M for this segment and a freeze policy at 73 settlements.

9. **Supporting efficient geometry for the sake of the Transportation network.** The mechanism to achieve a planned decentralization is a practical and high-level service level of transportation. De-centralization is based on economic interaction between distant poles. Cooperation can be realized only by a network of **expressways.** Currently, there is not a single expressway in the country.

5.3   Cities Land Demand

The purpose of this section is to focus on the land requirements for the **28 cities** and to find out whether the current designation of boundaries supplies the needs. The Urban Population, Density targets, and the land requirement for 2050 and 2035 are presented in Tables 10-1 and 10-2 for each one of the 28 cities. The span of densities is the core of this analysis. The span for Rwanda has been chosen by the best practice of population density in the towns around the world (Table 6-2). The colored part of the table shows the NLUDMP density span on the global list, including cities like Manila, Cairo, Sao Paulo, and St. Petersburg.

Rank	City / Urban area	Country	Population	Land area (in sq.Km)	Density (people per sq.Km)
1	Mumbai	India	14,350,000	484	29,650
2	Kolkata	India	12,700,000	531	23,900
3	Karachi	Pakistan	9,800,000	518	18,900
4	Lagos	Nigeria	13,400,000	738	18,150
5	Shenzhen	China	8,000,000	466	17,150
6	Seoul/Incheon	South Korea	17,500,000	1,049	16,700
7	Taipei	Taiwan	5,700,000	376	15,200
8	Chennai	India	5,950,000	414	14,350
9	Bogota	Colombia	7,000,000	518	13,500
10	Shanghai	China	10,000,000	746	13,400
11	Lima	Peru	7,000,000	596	11,750
12	Beijing	China	8,614,000	748	11,500
13	Delhi	India	14,300,000	1,295	11,050
14	Kinshasa	Congo	5,000,000	469	10,650
15	Manila	Philippines	14,750,000	1,399	10,550
16	Tehran	Iran	7,250,000	686	10,550
17	Jakarta	Indonesia	14,250,000	1,360	10,500
18	Tianjin	China	4,750,000	453	10,500
19	Bangalore	India	5,400,000	534	10,100
20	Ho Chi Minh City	Vietnam	4,900,000	518	9,450
21	Cairo	Egypt	12,200,000	1,295	9,400
22	Baghdad	Iraq	5,500,000	596	9,250
23	Shenyang	China	4,200,000	453	9,250
24	Hyderabad	India	5,300,000	583	9,100
25	Sao Paulo	Brazil	17,700,000	1,968	9,000
26	St Petersburg	Russia	5,300,000	622	8,550
27	Mexico City	Mexico	17,400,000	2,072	8,400
28	Santiago	Chile	5,425,000	648	8,400

Table 5-2 Population density of global cities

The span is between~ 8,000-10,000 people/ km², 10,000 for the capital and less for other towns.

The distribution of the population is based on the recommended hierarchy and economic potentials of each city. In table 6-3, column 7 specifies the land demand in km² for each town in 2050, based on desired gross densities for each category of the city (column 4). The densities range is between 7,000-10,000 people per km². The total demand for 2050 is 1,630 km². However, physical constraints, which were identified in each location, have decreased the final allocation to 1477 km² as appears in column 8. Table 6-3 shows the 2035-2050 forecast of population and city sizes.

1	2	3	4	5	6	7	8
	District	2035 Urban Pop. Target	Density People/km².	2035 Land Km²	2050 projected Urban population Target (Not including Rurban Settlements)	2050 Land Allocation by Densities Km²	Land Allocation by Local Constraints Km²
Kigali	Kigali City	2,090,000	10000	209	3,800,000	380	380
Satellite cities	Muhanga	440,000	9000	49	800,000	89	76
	Rwamagana	440,000		49	800,000	89	65
	Bugesera	550,000		61	1,000,000	111	100
Secondary cities PHASE I	Nyagatare	357,500	8,000	45	650,000	81	45
	Huye	302,500		38	550,000	69	59
	Rubavu	275,000		34	500,000	63	61
	Rusizi	220,000		28	400,000	50	65
	Musanze	247,500		31	450,000	56	56
Secondary cities PHASE II	Kayonza	220,000	8,000	28	400,000	50	38
	Kirehe	165,000		21	300,000	38	28
	Karongi	275,000		34	500,000	63	53
District Towns	Gisagara	137,500	7,000	20	250,000	36	22
	Nyanza	165,000		24	300,000	43	36
	Ngoma	110,000		16	200,000	29	43
	Nyaruguru	137,500		20	250,000	36	26
	Gatsibo	137,500		20	250,000	36	32
	Nyamagabe	137,500		20	250,000	36	36
	Ruhango	137,500		20	250,000	36	31
	Kamonyi	165,000		24	300,000	43	43
	Rulindo	110,000		16	200,000	29	29
	Gakenke	82,500		12	150,000	21	21
	Burera	110,000		16	200,000	29	29
	Gicumbi	82,500		12	150,000	21	15
	Rutsiro	82,500		12	150,000	21	21
	Nyabihu	82,500		12	150,000	21	21
	Ngororero	82,500		12	150,000	21	21
	Nyamasheke	137,500		20	250,000	36	25
Total	Total	7,480,000		897	13,600,000	1630	1477

Table 5-3 Urban Population, Density targets and land requirements for 2035-2050

5.4   City Land Demand – Parallel Analysis.

The land demand for cities has also been calculated in a parallel study, based on housing and dwelling demands. The methodology is as follows:

3,850,000 Urban apartments will be needed in cities in 2050. A standard housing typology has been developed in PUSH report to save the land and reduce construction expenses. Five housing types were matched with Settlement Categories, recommending a lower density of 24-40 Apartments per Hectare in smaller settlements and high-rise of 48-90 APH in Kigali and satellites. Based on this, the total demand for cities' gross areas was calculated as 1660 km², almost equal to the estimation by the best practice densities. Hence, NLUDMP recommends sticking to the lower number based on local constraints, 1477 km². This compact area is also supported by the consolidation overruling principle in this plan, illustratively shown in   Fig. **6-3.**
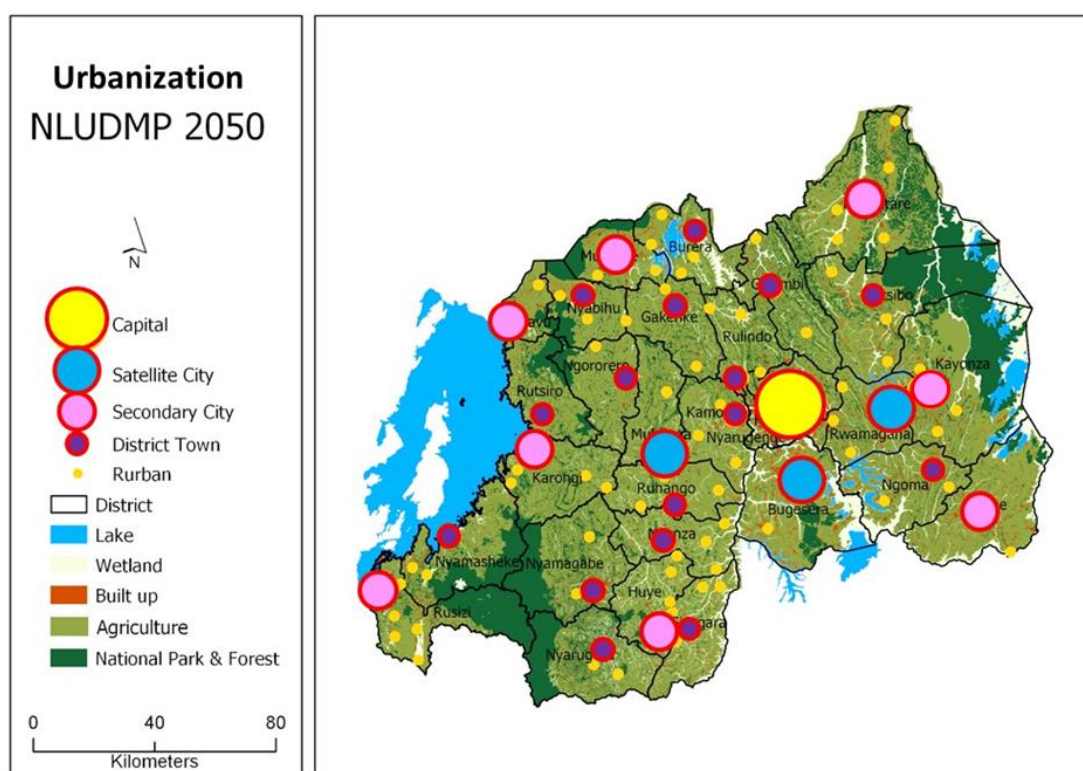
Figure 5-3 Urbanization 2050 – Location of Urban Settlements

5.5   Cities Boundaries

Fig. 6-4 shows the designated urban areas for the 28 cities between 2013-2018 elaborated land use master plans.   The boundaries are categorized following their rank in NLUDMP hierarchy. The categories have the following colors: Kigali – red, three satellites – purple, eight secondary cities – blue, 16 district towns – yellow.
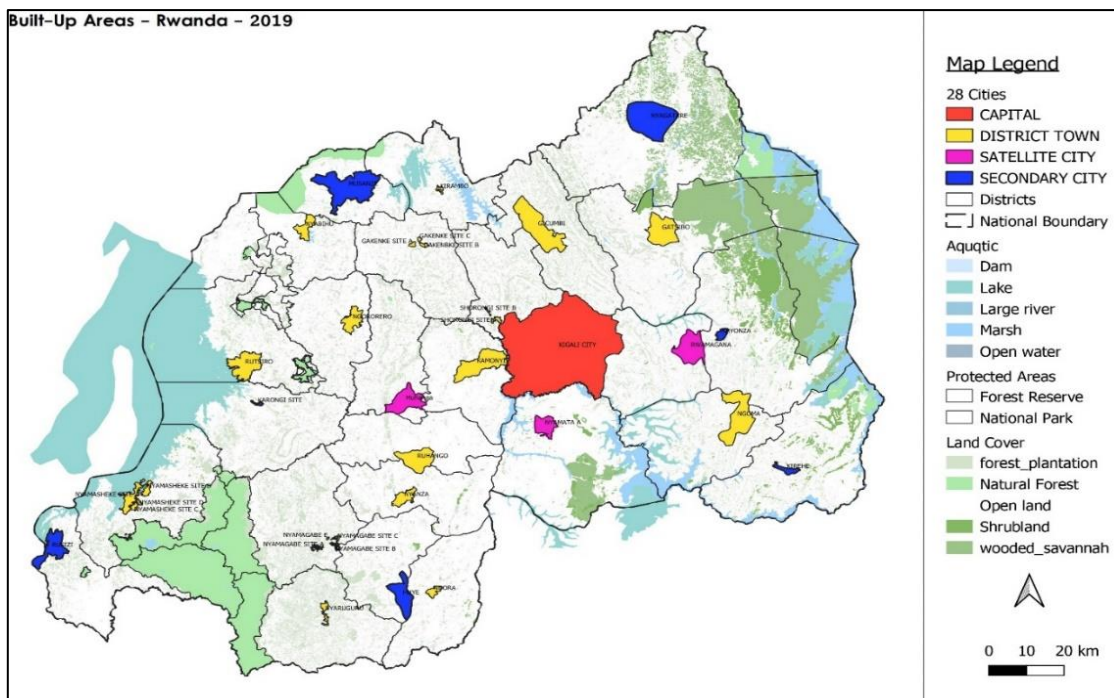
Figure 5-4 Urban master plans designated Areas for the 28 cities

Are designated city areas aligned with the calculated demand? The answer is given in Fig. 6-5, in which the sizes from the table are transformed to squares on the same scale as the map. The squares were superimposed on the current designated boundaries, highlighting the discrepancy between the two. The results of the comparison between real needs and designation are: Many cities boundaries are still small and can grow until they fill up the 2050 square. These cities have a free path for expanding. Other cities of non-consolidated land use patterns that have already overpassed their planned size will be guided to prepare a new master plan.
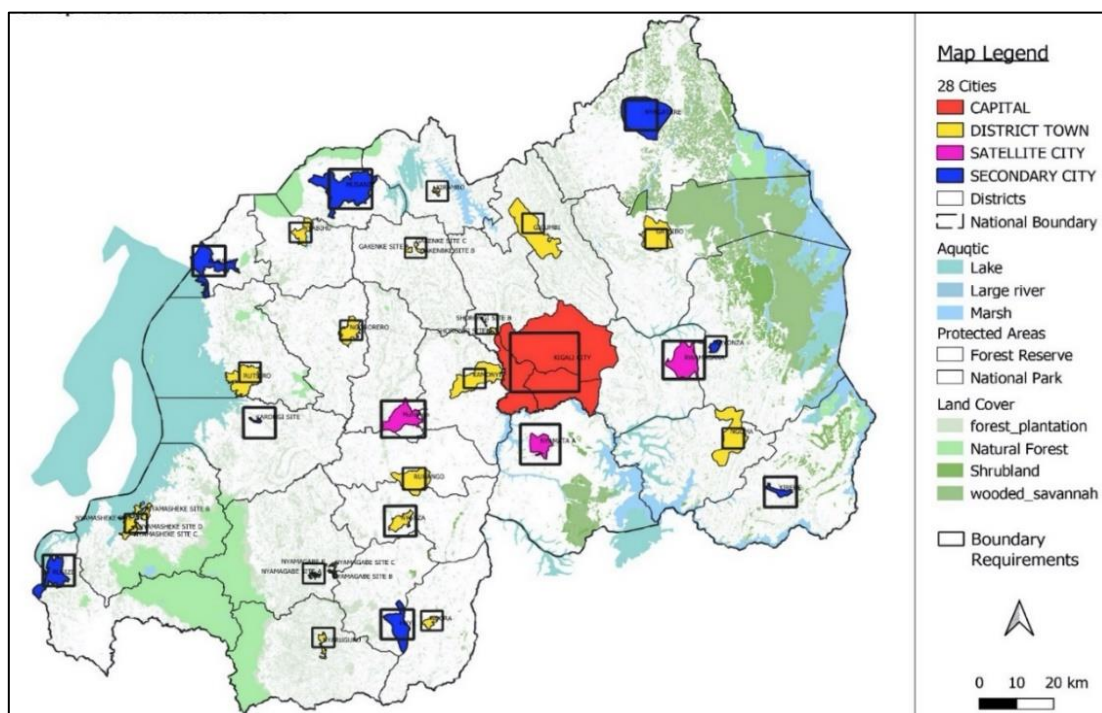
Figure 5-5 Redundant Designated Areas

5.6   Short-term Cities Boundaries

After calculating required land size of 1477km² for 28 cities and 307 km² for 73 rurban settlements/emerging centres, all existing urban plans boundaries identified between 2013-2018 have been analyzed, reviewed and new updated boundaries were drawn taking into account existing realizations.

The boundaries for long term needs of 30 years will be too big and cause disjointed development and invite pressures from landowners to sprawl within the vast territory. Therefore, NLUDMP recommends the designation of boundaries only for a period of 15 years (2035), in which the expected urban population will be 7.5M, and the land requirement for urbanization is 897km for 28 cities and 307 km for rurban centres. At the same time, a schematic more extensive boundary of 1477 km² should be protected as a reserve for the next 15 years, allowing only transitional uses like agriculture or forest/agro-forestry plantation.

6.   Rurban Centres

Summary and Actions: Consolidate and Freeze.

Rurban centres are emerging centres of linkage between rural and urban. The spatial distribution of existing Rurban Settlements or emerging centers is an overwhelming phenomenon, especially in a small country. **73 rurban settlement**s and about 400 other trade centers are sprawled everywhere. It is an expression of the uncontrolled movement from agricultural villages into the lowest level of urbanization, a harmful kind of "In Situ" urbanization. Instead of moving to established towns, people choose to settle close to their original environment, either for residence or trade and service activities. The Rurban sprawl weakens the towns and minimizes their potential to grow and become proper district town or secondary cities. The sprawl of Rurbanization must stop, and its capacity should be minimal.

Urgent actions are needed to **Consolidate and Freeze the rurban sprawl:** NLUDMP argues that the maximum population in 2050 should not be beyond 1.8M (450,000 HH), or 12% of future urbanization. The Best tools to achieve this purpose are limiting the boundaries, increasing density, and freeze the number of populated settlements and trade centers. The Guidelines for the districts are:

1. The area size for rurbanization in a district will be finite and divided between its rurban participants in a given NLUDMP list, presented below.
2. The names and boundaries polygon of each rurban Settlement was proposed reflecting the given sizes but will be further improved according to the ground environmental constraints at local level planning.
3. The population targets will be applied in a land-use master plan for the district and a local subdivision plan for the settlement itself.
4. The number of rurban settlements will be absolutely frozen to the number 73.
5. The solution for the 400 trade centers has 3 steps: Step one – Freeze. Step two – choose what trade centers can transform to become new umudugudu, as part of the rural reform, decreasing the number of imidugudu to 3000. Step 3 – the rest informal trade centers which do not fit the criteria of becoming Imidugudu, will have to be frozen until disappeared gradually and land become for Agriculture or forests.

The spatial distribution and size of existing Rurban Settlements and those which have been suggested for designation are in Fig. 7-1.

 Hence, the program is based on a massive restructuring of the rurban system.
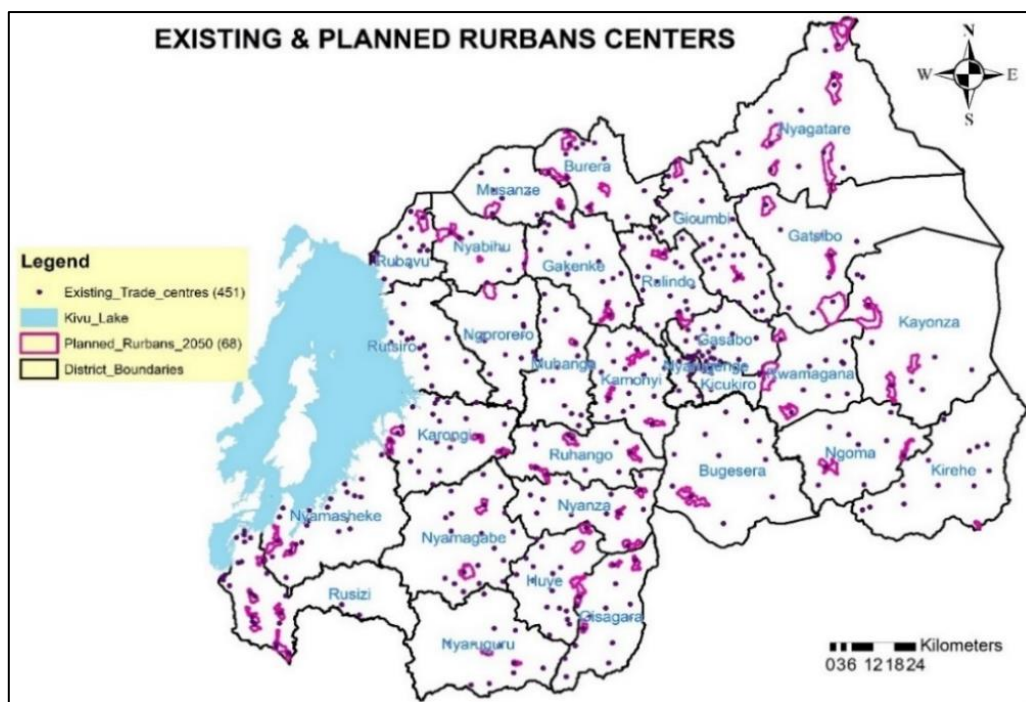
Figure 6-1 Current Rurban sprawl

Table 7-1 shows that the maximum population in Rurban Settlements will stand on 450,000 dwelling units. Housing will use two types of dwellings, 247k of "A+" type and 203k of "A" type. The residence needed land for both is 15,375 Hectares.

	DU	A+	A	B	C	D	
Rurban	Dwelling Units	247,500	202,500	-	-	-	450,000
	DU/Hec NET	10,313	5,063	-	-	-	**15,375**
	DU/Ha Gross	24	40	48	63	90	

Table 6-1 Rurban Areas Parameters

The gross size of Rurban settlements will be the residence area **153 km² /0.5 = 307 km².** Parameter 2 comes from the need to consolidate the aggregated settlements and create denser Rurban fabrics.

6.1   Rurban spatial distribution and boundaries

Table 7-2 is a **guideline for districts** on how to continue planning Rurbanization in districts. It includes in column 3 a complete list of those settlements which have been chosen to remain formally Rurban Centres. Column 4 gives the total population numbers, and column 5 shows the population of the 28 cities (Total 13,600,000) in each district. Columns 6 and 7 specify the Rurban population and the number of rurban settlements in each district. NLUDMP has also provided reference rurban boundaries to be used in the district land use planning.

The resulting average gross density in the entire rurbanization sector is 1,800,000 / 307 km² = <u>5,850 people per km²</u>, which is lower than the total density in the district towns. Hence, Table 10-3 presents the gross land allocation for rurban settlements in each district, based on that density.

The table does not include 400 spontaneous trade centers, which cannot be part of the consolidated urbanization system. A trade center should either be transformed into one of the 3000 new Imidugudu as part of the rural reform or relocated when they do not meet the location criteria of the new Imidugudu.

1	2	3	4	5	6	7	8
Urban Category	Disrtricts	Rurban Settlements	2050 District Target Pop.(K)	2050 28 cities Pop. (K)	Rurban Pop.	# Settlements	Land Demand km²
Kigali City	Nyarugenge-Gasabo-Kicukiro	-	3800	3800	-	-	
Satellite cities	Muhanga	1. Remera	1000	800	24,657	1	4.2
	Rwamagana	2. Muyumbu-Nyakariro	1350	800	98,628	3	16.9
		3. Nyagasambu					
		4. Karenge					
	Bugesera	5. Ruhuha	1400	1000	49,314	2	8.5
		6. Rweru					
Secondary cities	Nyagatare	7. Matimba	1000	600	123,285	5	21
		8. Karangazi					
		9. Rwimiyaga					
		10. Mimuri					
		11. Rukomo					
	Huye	12. Rusatira	750	550	73,971	3	12.6
		13. Arrete-Kinazi					
		14. Karambi					
	Rubavu	15. Kabumba	550	500	24,657	1	4.2
	Rusizi	16. Giheke	475	550	123,285	5	21
		17. Bugarama					
		18. Muganza					
		19. Gashonga					
		20. Mushaka					
	Musanze	21. Byangabo	700	450	49,314	2	8.4
		22. Kinkware-Kampara					
Secondary cities	Kayonza	23. Kabarondo	900	400	73,971	3	12.6
		24. Rwinkwavu					
		25. Karubamba-Video					
	Kirehe	26. Rusumo	525	300	49,314	2	8.4
		27. Nasho					
	Karongi	28. Birambo	750	500	98,628	4	16.9
		29.Shyembe					
		30. Mugonero					

		31. Mubuga					
	Gisagara	32. Mamba 33. Gikonko 34. Kibirizi 35. Save	450	250	98,628	4	16.9
	Nyanza	36. Busoro 37. Butansinda 38. Ntyazo	500	300	73,971	3	12.6
	Ngoma	39. Rukira 40. Sake	550	200	49,314	2	8.4
	Nyaruguru	41. Cyahinda 42. Munini	375	150	49314	2	8.4
	Gatsibo	43. Kiramuruzi 44. Muhura 45. Ngarama	750	250	73,971	3	12.6
	Nyamagabe	46. Kaduha 47. Gasarenda	500	250	49,314	2	8.4
	Ruhango	48. Kinazi 49. Byimana 50. Gitwe-Buhanda	600	250	73,971	3	12.6
District Towns	Kamonyi	51. Remera-Rukoma 52. Musambira 53. Mugina	600	300	73,971	3	12.6
	Rulindo	54. Bubangu 55. Kinihira 56. Base	575	200	73,971	3	12.6
	Gakenke	57. Ruli 58. Rushashi	537	150	49,314	2	8.4
	Burera	59. Kivuye 60. Gahunga-Kinoni 61. Kirambo 62. Cyanika	500	200	73,971	4	16.9
	Gicumbi	63. Rutare 64. Gaseke	587	150	49,314	2	8.4
	Rutsiro	65. Kivumu 66. Kayove 67. Boneza	550	150	73,971	3	12.6
	Nyabihu	68. Sashwara-Jenda 69. Vunga 70. Gasiza	600	150	73,971	3	12.6
	Ngororero	71. Kabaya	525	150	24,657	1	4.2
	Nyamasheke	72. Ntendezi 73. Bushenge	550	250	49,314	2	8.4
					1,799,961	73	307.7
	Total	73	22 M	13,6 M	24,657 people / Settlement		11.4 Average

Table 6-2 Rurban Settlements and cities - a complete list
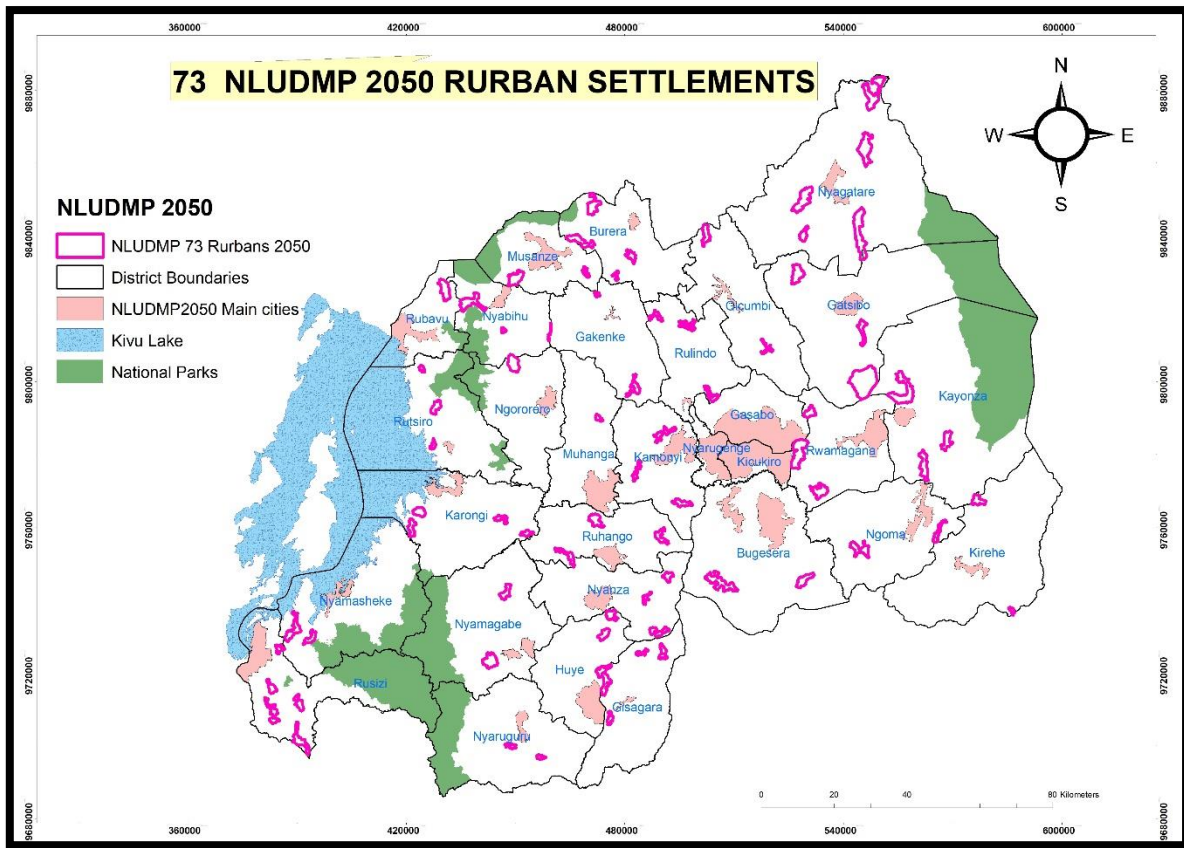
Figure 6-2 Cities and Rurban Centres Map

7.   Rural Settlements

<u>Summary of recommended measures:</u>

The rural population contained in 2019 about 13,661 villages and 82% of the Rwandan people.   Too many Imidugudu and scattered homestead in rural areas eliminate economies of scale; therefore, the transformation of rural settlement structure is the most needed in Rwanda. The following actions are proposed:

- Urgent actions are needed to **Consolidate and Freeze the rural settlements sites sprawl.** Rural settlement will feed urban areas. Therefore, the 2050 projected population of 6.6M (30%) will be clustered into about 3000 settlement sites. An average of 1 or 2 settlement site(s) per cell is required. All total rural settlement gross boundaries should not exceed 1241km^2 by 2050 from about 1500 km^2 of 2019. Housing density in rural settlement sites will increase considerably.
- The Imidugudu system will be restructured into organized clusters, and this process will need to be undertaken continuously throughout the next 30 years.
- Progressive elimination of the village as an administrative entity is suggested to remain with the Umudugudu as a social and economic entity.
- High density housing models are very recommended in rural areas, including exploiting the underground. Decrease the size of rural residence from 615m^2 to 300m^2 and the dwelling models of 4x1 and 8x1 (and other high-density models) to be promoted. Dwelling models that utilize less than 300m^2 are also encouraged.
- Avoid any new housing and utility development out of settlement boundaries.
- Mind-set change on the use of land in Rwanda for all levels (emphasis on young generation)
- New development must imply Agglomeration and Consolidation principles:
    - The number of HH per rural settlements must grow by three to four times, from 172 today to 550 HH.
    - Each rural settlement site at cell level will have public and social amenities such as sports, recreational and leisure spaces, school and ECD, community health post, roads, market, cowsheds, etc. The specific location for these social facilities will be determined by detailed site plan.
    - The arable land per rural settlement will be around 420 Ha on average.
    - Individual farming in small holdings of around 0.4Ha will have to stop, and different kinds of economic cooperations will be organized instead to reach 1.5Ha per HH in the future.
    - Five production units of 110 HH and about 84 Ha will be established in each settlement.
    - Yields improvements will be achieved dramatically due to the agglomeration of forces and economies of scale.

In most parts of Rwanda, excluding the eastern province, there is a **mixed-use of agriculture and housing** at the level of Imidugudu. This mixed pattern is indicative of the sprawl phenomenon and very low residential density in rural areas of the country. Arable and other lands, on which about 14,000 Imidugudu are currently scattered, are about 11,000 km². The rural Population is 10,621,000M and 2,360,000 HH. The average size of an Umudugudu in Rwanda is, therefore, 80.5 Ha, containing 777 people on average, which is about 172 households.

The gross land size per household is, therefore, 0.46 Ha, Including the house and farm. This land distribution among farmers is going to change in 2050. Land allocation for Agriculture is limited to 1,243,300 Ha. The subdivision of this area among 6,6M rural inhabitants or 1.650M HH shows an increase from the current size in 65%, 0.76 Ha per HH. However, the geographical distribution of the rural population will change significantly. The assumption is that it will distribute proportionally to the future agricultural lands in the LUCA's (table 8-1): LUCA A population will grow by 41% due to the availability of prime lands. LUCA B remains static, and the massive change is in LUCA C, where the population decreases in more than a million, to 17.6% of its current population. These results indicate two main movements: First, a very profound migration of farmers from C to A searching for new agriculture opportunities. Secondly, C also appears as the primary source of Urbanization, either in situ or by migration to cities in A and B.

	TOTAL	LUCA A	LUCA B	LUCA C
Rural Population 2019	10,621,730	3,303,355	1,860,774	5,457,601
Rural Households 2019	2,360,000 HH	734,000 HH	413,500 HH	1,212,500HH
Rural Population Capacity 2050	6,600,000	4,158,000	1,584,000	858,000
Rural Households Capacity 2050	1,650,000 HH	1,039,500 HH	396,500 HH	214,000 HH
LUCA Growth Rates HH		1.416	0.958	0.176
Agri lands -2050	1,261,600 Ha	796,600 Ha	306,200 Ha	158,800 Ha

Table 7-1 distribution of rural population 2050

Four negative factors characterize the current situation and the simulated future in rural settlements: 1. Informal sprawl of farms, which tore agricultural lands to small disjointed pieces. 2. The approach of Individuality, resulting in minimal cooperation, cause a continuous decrease in the size of parcels. 3. Too many Imidugudu eliminate economies of scale. 4. Traditional production causes meager yield.

	Rwanda	Israel
People per Umudugudu	736	945
Households per umudugudu	172	250
Land / umudugudu	110 Ha	1410 Ha
Land size per Household	0.46 Ha	5.64 Ha

Table 7-2 Comparison of densities in Rural areas between Rwanda and Israel

The impact of these negative factors is clear: commercial agriculture cannot develop. For comparison, in a typical Israeli village (Table 8-2), live almost 1000 people or 250 households. The average area per HH is 5.44 Ha, 8.5 times bigger than in Rwanda. If the yield is ten times higher in Israeli farms, then the potential production per HH is eighty-five times higher. This analysis leads to the conclusion that a drastic change is required in the agricultural/rural sector.

The next section will generate four strategies for change:

Strategy 1 – Farms expanding by consolidating diffracted agricultural lands.

Strategy 2 – Restructuring Imidugudu and rural settlement.

Strategy 3 –Decreasing the number of Imidugudu and Eliminating scattered homesteads.

Strategy 4 –Decreasing the size of the rural residence.

7.1   Farms Expanding by consolidating diffracted agricultural lands.

Land allocation for Agriculture is limited to 1,243,30 Ha. The typical farmland of 6,6M people or 1.650M HH in 2050, will not change dramatically and will reach an average size of only 0.75 Ha. This result appears in table 8-3, in the column of the expected "scenario 1". 0.77 Ha is tiny, and will not allow sufficient livelihood to individual farms. Modern Agriculture strives for more substantial holdings. Five Ha. is recognized today as a minimum size to support commercial Agriculture. In "Scenario 2", in which 5 Ha lots are assumed as an optimal average, the agricultural population will have to drop to 1.017M, which is 4.6% of the total expected population. This scenario is not valid because of the other side of the coin, in which urbanization will have to reach within 30 years, an impossible ratio of **95.4%**.

	Scenario 1	Scenario 2
Rural Population **2019**	10,621,730	
Rural Households **2019**	2,360,384 HH	
Rural Population **2050**	6,600,000	1,017,000 – 4.6%
Rural Households **2050**	1,650,000 HH	254,250 HH
Available Agri lands	1,243,300 Ha	1,243,300 Ha
Land / HH	0.77 Ha	5 Ha

Table 7-3 Land allocation for Agriculture

The solution is provided by Scenario 3, which is also presented in the agriculture chapter.

Scenario three suggests three types of farms in various sizes, which suit three options of farming (Table 8-4):

1. the highly commercial fully irrigated big farms of 5 hectares per household.
2. The not irrigated commercial farms of 0.6 hectares pe HH, which will be aggregated into larger, more productive groups.
3. The small subsistence farms, which will unfortunately still exist, but in one-third of the current percentage.

Table 8-4 specifies the quantitative attributes of the three types of farms

Farms	Total Land	Farmers	Households	Land/Farmer	Land/HH
Commercial - fully irrigated	600,000 Ha	168,000	120,000	3.57Ha	**5.0 Ha**
Commercial – **not irrigated**	351,400 Ha	820,000	586,000	0.43 Ha	**0.6 Ha**
Subsistence	291,000 Ha	1,307,000	944,000	0.22 Ha	**0.31 Ha**
Total	1,242,400 Ha	2,243,300	1,650,000		0.75 Ha

Table 7-4 Scenario 3: Farm types

7.2   Restructuring Imidugudu

The impressive Modern **Umudugudu movement** (IDP Model village) is trying to find solutions and is already showing good results. The construction of **Umudugudu in IDP model village**, an organized-geometrical pattern, based on economic and functional criteria, brings a promising fresh wind to the old traditional establishment of settlements.   Each Umudugudu is nicely planned; the layouts are compact and practical, which help consolidation.

The Imidugudu achievement on a national scale is still mild and require improvement, but they are in the right direction. Further development of Imidugudu should integrate all socio-economic levels of population and thus follow also these **four stages program:**

Stage 1: A land should be selected within the formal rural settlement site boundary. An existing trade centre with utilities and social-public menities (with good landscape) is a priority site for rural settlement. In addition to this, each rural settlement site at cell level is mandated to have public and social facilities and services such as sports, recreational and leisure playground, school and ECD, community health post, roads, market, cowsheds, etc. The specific location for these social facilities will be determined by detailed site plan.

Stage 2: A Vacant site within existing rural settlement boundary or trade center should be identified to host new housing. Building on new land outside the rural settlement boundary is restricted.

Stage 3: A complex of Imidugudu is built on the vacant land. The rural settlement/umudugudu should be of mixed-income and mixed-use to avoid segragation and ensure sustainability.

Stage 4: The relocation of families takes place, old houses should be destroyed to avoid continuous use of those houses, and the area should be used for agriculture development or afforestation.

7.3   Decreasing the number of Imidugudu and Eliminating scattered homesteads

The current enormous amount of 14,000 Imidugudu must be drastically reduced to **3000 consolidated rural settlement**s, less than one-quarter of the current number. At the same time, the number of farms per rural settlements will grow by three to four times, from 172 today to 550 HH. Hence, the arable land (**1,243,300 Ha**) per rural settlements will be around 414 Ha on average. Individual farming in small holdings of around 0.7 Ha will have to stop, and different kinds of economic cooperations will be organized instead. For example, five production units of 110 HH and about 84 Ha will be established in each settlement. Yields improvements will be achieved dramatically due to the agglomeration of forces and economies of scale. These parameters lead to a specific new distribution of Imidugudu and the rural population among districts.

7.4   Decreasing the Size of Rural Residence

A significant change is also required in the size and spatial arrangements of the residency component of rural settlements. The target lot size per HH should follow two parameters: Dwelling type "A" and a residential density of 40 dwelling units per Ha. The result is **250 sq. m. per household.** Hence, this target cannot be expected to be fully applied. If 20% of the stock will remain in the current size of 500 sq.m, then 80% of the new Imidugudu in 4x1 or 8x1 style will be in the size of **300 m².** Guideline: from now on, only lots of **300 m² would be applied.**

The accumulated net residential areas in the new compact Imidugudu system will be 49,500 Ha, 495 km². The gross area will be **495 km² x ~2.5 = 1241 km²,** including roads, open space, agricultural processing facilities, and public services. Hence, the average size for one umudugudu is 0.4km².

7.5   Spatial Distribution

Table 8-5 is a **guideline for districts** on how to continue planning the rural system in their territory. Column 4 gives the total population numbers, and column 5 shows the population of the 28 cities in each district. Columns 6 and 7 specify the Rural population and the number of Imidugudu in each district. Columns 8 gives the complete list of Total Area Sizes Per District, based on an average size of 0.4 km² per umudugudu. More than 5000 available rural settlements sites' boundaries from RHA are a mess and chaos to be considered as final. Therefore, another advanced multicriteria evaluation of those sites is to be conducted to ensure best 3000 rural sites are selected to be enforced and implemented.

1	2	3	4	5	6	7	8
Districts Types	Districts	LUCA suitability	Total Pop. 2050	28 cities Pop.	Rural Pop.	Imidugudu	Total Area Size in each District Km²
Kigali City (N-G-K)		C	3,800,000	3,800,000			
Satellite cities	Muhanga	B	1,026,500	800,000	200,000	91	38
	Rwamagana	B	1,119,500	800,000	240,000	109	45
	Bugesera	B	1,206,500	1,000,000	180,000	82	34
Secondary cities Phase 1	Nyagatare	A	1,182,500	650,000	400,000	136	75
	Huye	A	979,500	550,000	350,000	159	66
	Rubavu	A	846,500	500,000	320,000	145	60
	Rusizi	B	732,500	400,000	200,000	91	38
	Musanze	A	803,000	450,000	300,000	136	56
Secondary cities Phase 1	Kayonza	A	799,500	400,000	320,000	145	60
	Kirehe	A	636,500	300,000	310,000	141	58
	Karongi	C	786,000	500,000	180,000	82	34
District Towns	Gisagara	A	676,000	250,000	320,000	145	60
	Nyanza	A	729,500	300,000	350,000	159	66
	Ngoma	B	473,000	200,000	220,000	100	41
	Nyaruguru	C	483,000	250,000	180,000	82	34
	Gatsibo	A	649,500	250,000	320,000	145	60
	Nyamagabe	C	483,000	250,000	180,000	88	34
	Ruhango	A	649,500	250,000	320,000	145	60
	Kamonyi	B	579,500	300,000	200,000	91	38
	Rulindo	B	499,500	200,000	220,000	100	41
	Gakenke	C	373,000	150,000	170,000	87	32
	Burera	B	489,500	200,000	210,000	105	39
	Gicumbi	C	393,000	150,000	190,000	96	36
	Rutsiro	C	356,500	150,000	180,000	92	40
	Nyabihu	C	429,500	150,000	200,000	91	40
	Ngororero	C	336,500	150,000	160,000	73	39
	Nyamasheke	C	483,000	250,000	180,000	82	38
Total			22,002,000	13,600,000	6,600,000	3,000	1,241

8.   Housing

Summary of housing needs and construction

The target in the Housing sector is a steady annual increase of building on one hand and access to housing mortgages on the other. A second target is to develop new local construction materials and housing typologies. The achievement of these targets will be the backbone for the roll-out of affordable and decent housing countrywide.

An assessment of the current and future Housing stock was conducted: The country has today about 2.8Million housing units and needs 5.5Million (150,000 dwelling units to be constructed annually) to cater for 22.1M by 2050. Start by replacing and upgrading existing informal settlements and densifying existing cities and centers before using the new land.

The NLUDMP proposes that given the future demographic trends and the high housing needs that require a large housing stock and space, it is strongly recommended to develop in vertical housing infrastructure in urban and rural areas in the form of multi-family apartments and socio-economic infrastructure (industries, schools, health facilities, public administration, religious buildings, etc.).

The incremental development of the building is encouraged. At each stage of construction, the building must be considered strictly as a finished product.
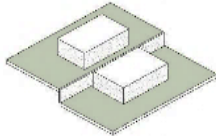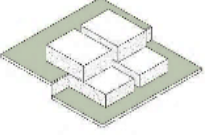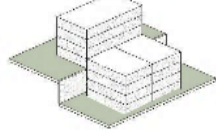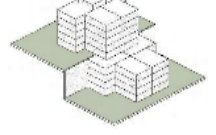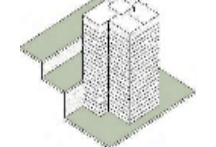
The NLUDMP recommends considering mixed-use housing urban development in which a real estate in a city or suburb can blend different functions such as residential, commercial, cultural, institutional, etc. into one block. These functions should be well integrated physically and functionally. Flexibility regarding type of housing shall be recognized (for example single units, semi-detached, low houses and apartment blocks).

The NLUDMP recommends the consideration of mixed-income approach whereby low, medium and high income earners should be settling together in the same neighborhood to minimize settlement segregation.

The NLUDMP also takes into account the efficient and optimal use of land by encouraging the exploitation of the underground , including, but not limited to, transport facilities, cemeteries, industrial facilities, parking lots, business development infrastructure, offices and archives, etc.

The National Land Use MP proposes five categories of housing to be considered by local-level planning to achieve the desired consolidation and agglomeration.

Dwelling units needed in Rwanda by 2050:

Total 2050		5,500,000 units (2.5M in 2019)
A+		**1,656,000 units**
1		830,000 Buildings
A		**2,175,000 units**
1-2		550,000 Buildings
B		**1,000,000 units**
3-4		11,000 Buildings
C		**370,000 units**
5-9		40,000 Buildings
D		**245,000 units**
10-22		11,000 Buildings

Construction Volume from 2020-2050 will be: 2.7M New + 1.8M Replacements = 4.5M dwelling units, the annual average construction will have to supply **150,000 Dwelling Units.**

Housing land use is the largest land consumer in every settlement. Therefore, it is essential to base future demands on desired and sustainable housing types that fit the lifestyle of future Rwandans . Within this context, the size, model, and tenure of dwelling needed for 2050 are essential.

Six purposes drive this chapter:

1. Characterization of housing types in 2050 by spatial and architectural parameters.
2. Match between housing types and settlements categories, for maximum suitability.
3. Assessment of the demands for housing types, based on population targets in each district.
4. Measurements of land requirements for residential areas in 2050, by the district.
5. Extrapolating the land requirements for residential areas to land requirements for entire cities.
6. Feeding all this information into 2050 National land-use master plan, making room for settlements of all kinds.

Housing Types

Five basic dwelling types are presented in the following six figures.

A table of parameters is attached to each type, specifying the number of levels, the number of apartments per house, the lot area, the net density (measured by the number of dwellings per one hectare.)

The gross density of the concerned neighborhood is also specified, after the acquisition of 40% of the lots for public facilities and infrastructure.

Type A+ is the most common type of detached or semi-detached houses, one or two levels high, on a lot of 500 sqm for two households. This type, when built in a sprawl, has a net density of 40 dwelling units (apartments) per hectare and in terms of a whole neighborhood gross density of 24 DU/Ha.

Housing Types 2050

	Levels	Max Capacity per building	Lot Ha	DU/Ha NET	Effeciency	DU/Ha Gross
A+	1	1-2	0.05	40	60%	**24**

Figure 8-1 Housing Type A+

Housing Types 2050

	Levels	Max Capacity per building	Lot Ha	DU/Ha NET	Effeciency	DU/Ha Gross
A	2	2-4	0.05	80	50%	**40**
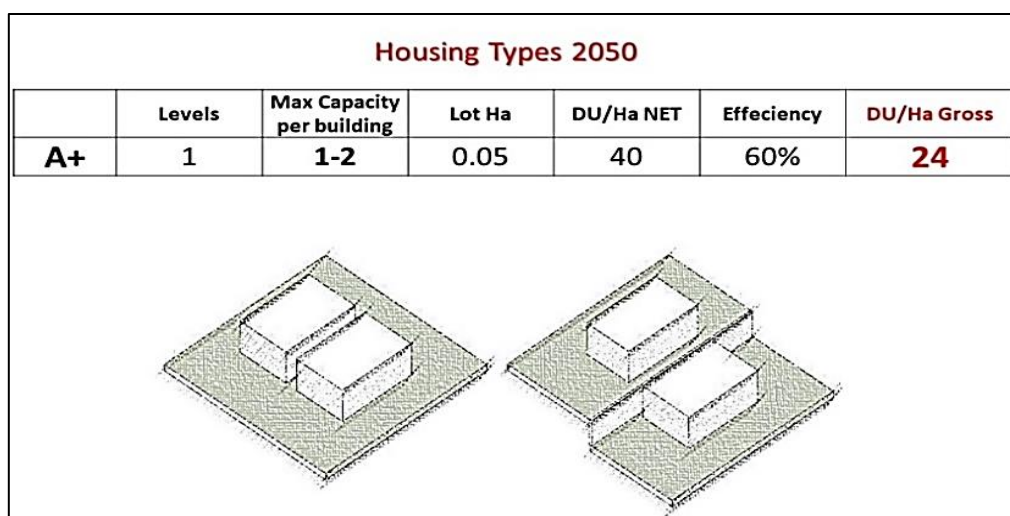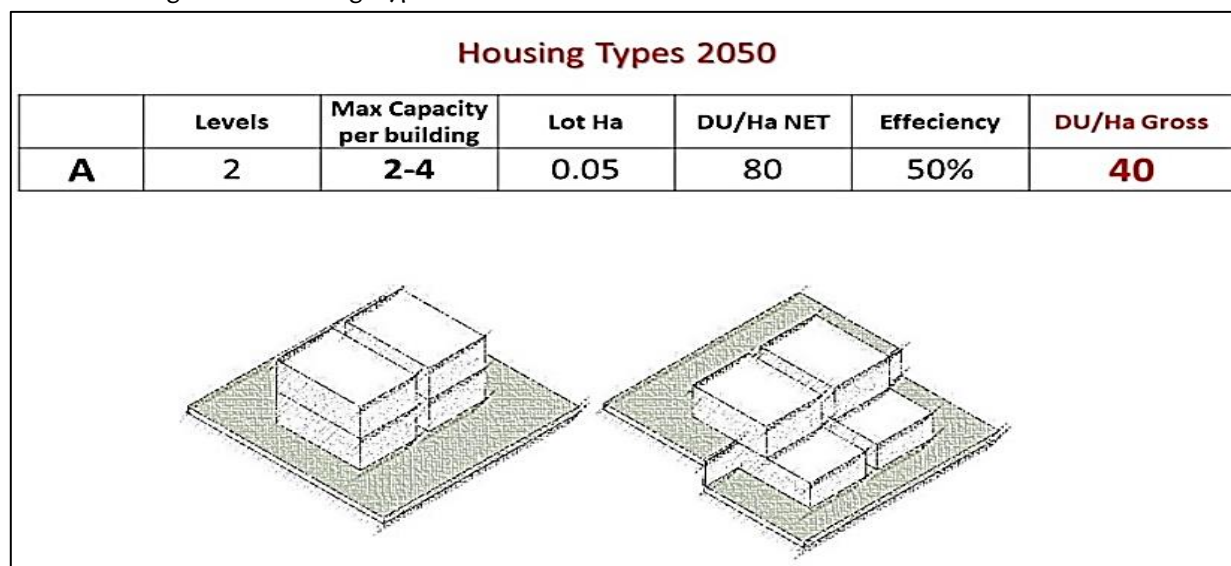
Figure 8-2 Housing Type A

Type A is based on the same lot but consolidates four dwelling units in 2 stories and a net density of 80 dwelling units per hectare and gross density of 40   DU/Ha. Both A and A+ can be fitted to suit various topographies.

Housing Types 2050

	Levels	Max Capacity per building	Lot Ha	DU/Ha NET	Effeciency	DU/Ha Gross
B	3-4	5-12	0.1	120	40%	48
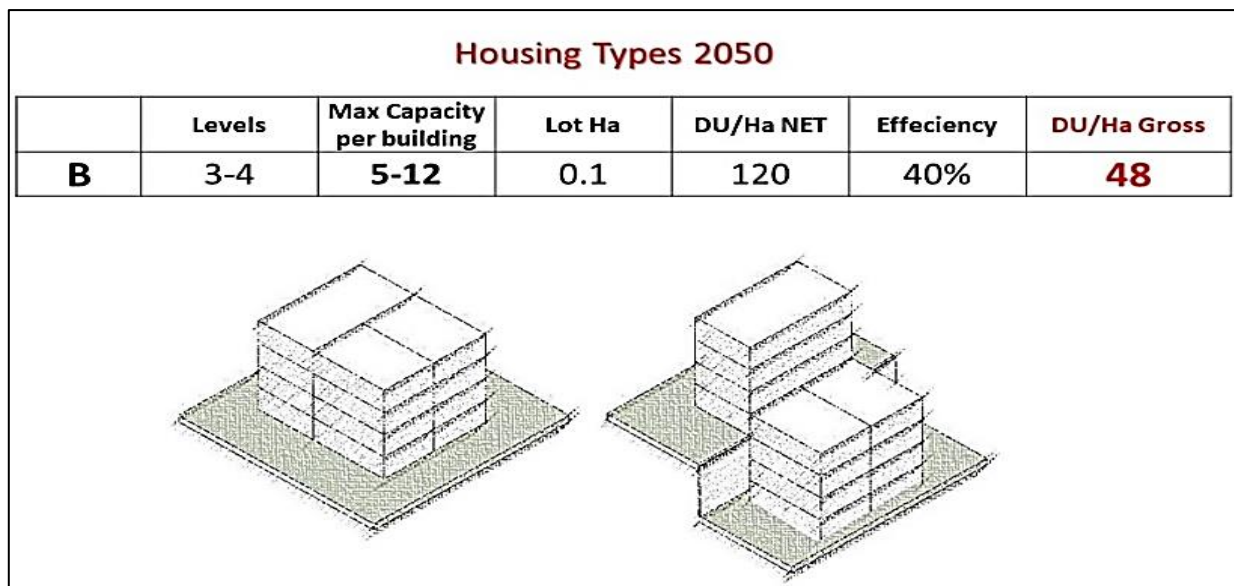
Figure 8-3 Housing Type B

Type **B** represents a typical multifamily house of up to 12 DU in 3-4 floors. The net density is 120 on lots of 1000 sqm. This type is the cheapest among the multi-family dwellings, as it does not require an elevator and can be fitted almost everywhere.

Type **C** represents a typical multifamily high rise building up to 9 floors. The net density is 180 on lots of 2000 sqm. This type is the cheapest among the multi-family houses and fits almost everywhere. Its gross density is also reasonable at 63 DU/Ha

Housing Types 2050

	Levels	Max Capacity per building	Lot Ha	DU/Ha NET	Effeciency	DU/Ha Gross
C	5-9	36	0.2	180	35%	63
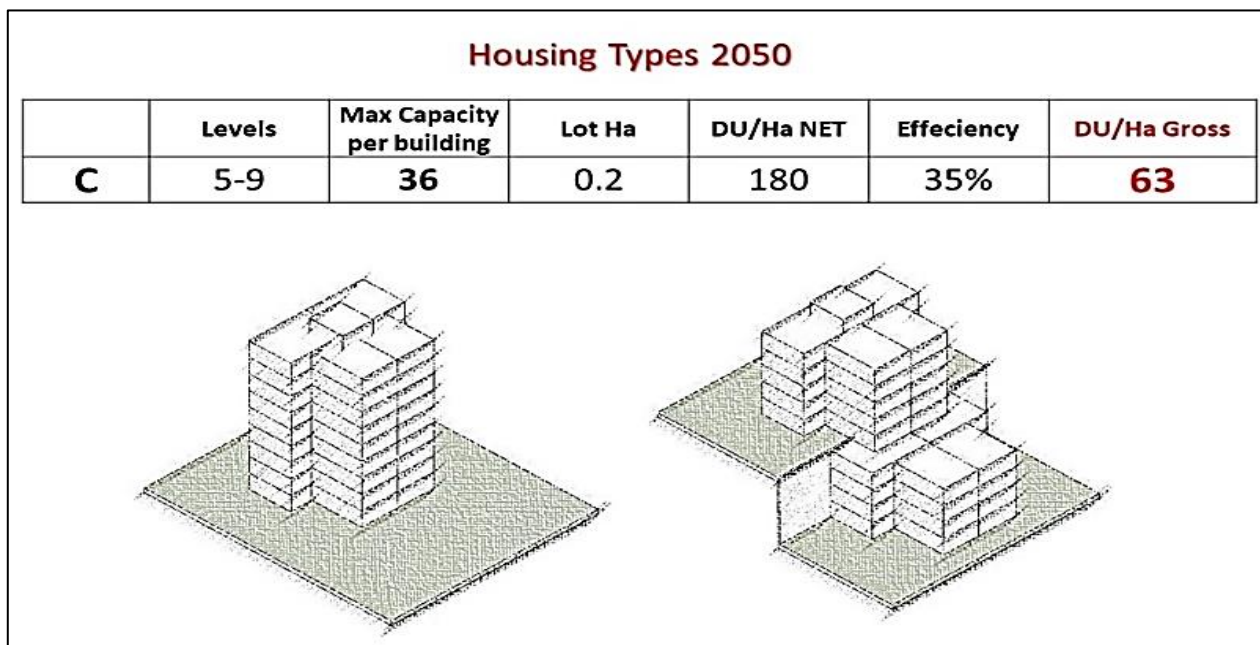
Figure 8-4 Housing Type C

Housing Types 2050						
	Levels	Max Capacity per building	Lot Ha	DU/Ha NET	Effeciency	DU/Ha Gross
D	10-22	90	0.3	300	30%	90

Figure 8-5 Housing Type D

Type **D** is the biggest structure in the housing repertoire, rising to 22 floors. The net density can reach 300 DU/Ha on lots of 3000 sqm. It ideally suited to flat topography but can also be built on a sloped site but is usually constrained by visual considerations. This structure is expensive, mainly due to maintenance, and therefore it is not feasible for affordable housing.

Five housing types are matched with settlement categories, recommending a particular distribution of types for each settlement category. A and A+ will be more frequent in Rurban and Rural, while D appears only in Kigali and Growth poles. Type B is the dominant one in urban areas, and A is also common.   The matching table is also exhibited in graph form. (See Table 9-1 & Fig. 9-6)

Matching Housing Types and Settlement Types						
	A+	A	B	C	D	
Kigali	5%	25%	35%	20%	15%	100%
Satellites	10%	35%	35%	10%	10%	100%
Secondary Cities	19%	40%	30%	7%	4%	100%
District Towns	35%	35%	25%	5%	-	100%
Rurban	52%	45%	2%	1%		100%
Rural	50%	50%			-	100%

Table 8-1 Matching Housing Types and Settlement Types
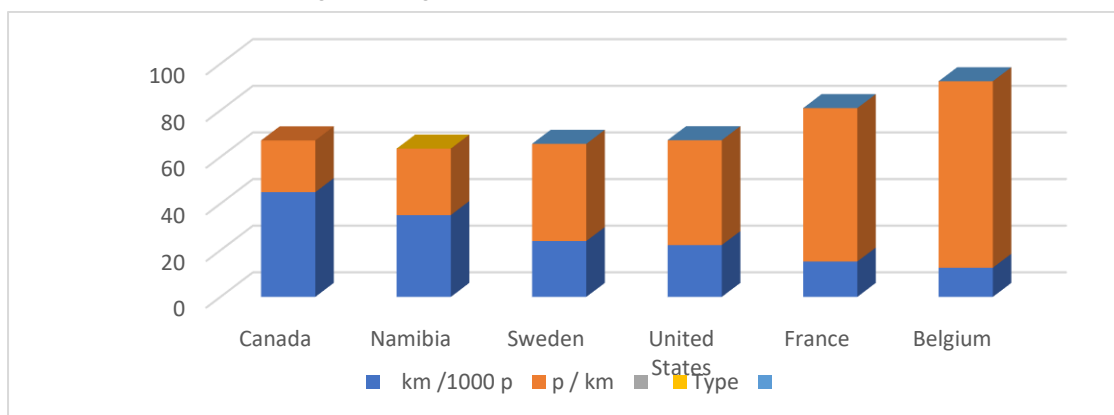
Figure 8-6 Distribution of Housing Types by Settlement Types

9. Agriculture

The Summary of measures for Agriculture

The main challenges for Rwanda's agriculture are:

- The need to raise productivity to provide food and income to the growing population
- Land scarcity, and competition over land.
- The need to shift from subsistence farming towards commercial farming within an industry-services based economy.
- The challenge of consolidating small farms and settlements to improve productivity.

Agriculture yield model was developed and informs that to feed the 22.1M population by 2050, brings the following land demand scenarios:

1. If current Yield situation continues, land demand will be 103,000 km² (4 times of the country surface).
2. If the best global yield is developed, 15 times high of current yield, land demand will be 14,500 km². **This third scenario is the only realistic one.**

- Agriculture suitability mapping has been prepared, and available agriculture lands were identified and mapped. NLUDMP recommendation is to protect agriculture lands of more than 12,433km² and possibly up to 15,000 km² to have room for sustainable food security.
- The farmers should be not more than 30% of the projected population with less than 10% of agriculture contribution to the GDP and this does not mean reducing the size and value of farmlands, but rather more and more increasing the economic growth of other sectors like Industry and services. The average Land per farmer ratio should be around 1.5 hectares in a consolidated form.
- Scattered homestead to be eliminated gradually- consolidate/agglomerate in few settlement sites to decongest agriculture zones and thus allow the use of technology in agriculture.

Agriculture plays a significant role in Rwanda's national planning. One of the pillars of Rwanda's VISION 2050 is Agriculture nearly 15 times more productive than today, high value, and market-driven. 30% of Rwandans (6.6M people from about 1.65M households) will live in rural settlements, and 17.5% of employment will be engaged with agriculture, namely 2,294,693 farmers, 1.4 farmers per rural household.

As a result of the future employment matrix and the amount of agricultural land, three typical farms will exist in Rwanda:

1. <u>Highly commercial fully irrigated farms</u>, with 600,000 hectares of prime land.

2. <u>Commercial-not irrigated farms</u>, covering 351,400 hectares of prime lands and wetlands.

3. <u>Subsistence farms</u>, on 291,900 hectares of secondary, sloppy, and not suitable lands.

In table 10.1 these three types of farms are characterized by five parameters: Total Land (Ha.) in Rwanda to each kind, the future number of farmers and households in Rwanda in each type, size of land for each farmer, and each family in a farm type.

Farm Types	Total Land (Ha.)	Farmers	Households	Land/Farmer (Ha.)	Land/HH (Ha.)
Highly Commercial Irrigated	600,000	168,000	120,000	3.57	5.0
Commercial not irrigated farm	351,400	820,000	586,000	0.43	0.6
Subsistence farm	291,000	1,307,000	944,000	0.22	0.31
Total	1,242,400	2,243,300	1,650,000		0.75

Table 9-1 Three types of farms - 2050

The results of the analysis show that only 168,000 farmers will be employed or will be owners of the prime irrigated farms. The average size of a farm in this type will be five hectares. The consolidation of these farms to large estates will be encouraged. The second type of farms will still be commercial but not fully irrigated. The challenge of their 820,000 farmers is to consolidate their farms (by partnerships or cooperatives) to achieve higher yield due to the advantage of size. Unfortunately, subsistence agriculture will not be eliminated within a period of 30 years. 944,000 households will still be in this situation, 6% of the Rwandan population in 2050, while in 2016, the percentage was 17.4, three times higher.

The farms' table will serve as a goals matrix in this analysis, providing the measures and actions for achieving the goals. Agricultural land in Rwanda plays a dual role in creating income and foreign currency through the export of agricultural products (mainly coffee and tea) and in producing food for the local population.

Given the size of the country, population, and the limited arable land, a central question is whether it is possible to feed the local population (today and in 30 years from now). It is the central question that this report addresses. The food needs of the growing population of Rwanda were analyzed based on three scenarios regarding agricultural yields' development, to calculate the size of the agricultural land needed for protection within the NLUDMP. **In a business as usual situation, given the current crops' yields – the farmland in Rwanda will not be sufficient to feed 22.1 million people in 2050.**

In a realistic scenario where 80% of farmers are commercial, and the consumption of livestock products rises to 10% of the diet, the farmland in Rwanda is still not sufficient to provide food for 22 million people.

Provided that the yields in Rwanda improve to the best practice, agricultural land rise to 12,433km^2, and feed for livestock is imported from other countries, the farmland of Rwanda could theoretically offer food for 22.1 million people.

Given the topography, climate, and competition over land, this scenario is uncertain. Rwanda will fulfill in 2050 its vision of a nation that enjoys food security, nutritional health, and sustainable agricultural growth from a productive, green, and market-led agricultural sector.

The main challenges for Rwanda's agriculture are:

- The need to raise productivity to provide food and income to the growing population
- Land scarcity, and competition over land
- The need to shift from subsistence farming towards commercial farming within an industry-services based economy
- The small farms and the need for farmland consolidation.

Currently, the agricultural sector in Rwanda constitutes just over a third of the economy; it accounts for only under half of goods exports and employs over two-thirds of the working population. The agricultural sector has been growing by over 5% per year since 2000. Livestock has seen accelerating growth and is currently the fastest growing sub-sector at 8.3% / year (Rwanda National Agriculture Policy, 2018). There is an on-going structural shift in the economy from subsistence agriculture towards non-farm sectors. In Rwanda, as in other East African countries, the performance of the agricultural sector does not match the increase in demand for food arising from demographic development (EAC Vision 2050).

Quantitative programming is motivated by one of the main tasks of this plan: preparing room for future population, settlements, economic activities, transportation, and services. Quantitative programming is supported by forecasting models on the one hand and by planning goals on the other. The main objective of this section is to conclude what are the food needs of the growing population of Rwanda, and what is the size of the agricultural land needed to provide these needs.

The feasibility of sustainable food security in Rwanda, given the size of arable land and population, is the central question to be asked here.

If the answer is even with significant improvements in the farming practice and agricultural yields – the country will fail to deliver in the long run the right amount of food to the local people. Hence, planning efforts should focus on creating alternative sources for food. The possibility of food imports should be studied, taking into account that Rwanda is landlocked, with (currently) no sound railway system. The model analyzes the links between the energy calories need per person/day for a healthy life, crop production, agricultural yields, and agricultural land required to produce them. The programming is under the following assumptions:

All means should be taken to protect the existing agricultural areas. Urbanization and the development of villages should be compact and dense so that cultivated land will not be substantially reduced.

Cash crops are needed economically, but agricultural land is required first of all to feed the population. NLUDMP proposes an equilibrium between cash and food crops: 56,200-64,600 hectares and possibly an expansion by using sloppy hills of the Western region for cash crops cultivation.

9.1   A Model of Agricultural Land Demand

This section presents a dynamic model that was developed by NLUDMP 2050 team. The model allows planners and policymakers to analyze how much agricultural land is needed in Rwanda, currently and in the future, according to the size of the population and its nutritional needs. The model computes the number of people and their dietary needs (calories, protein) into hectares of agricultural land. The main achievement of the model is the linkage made between the population's needs for food and the area needed to provide them. The planning team is proud to supply Rwanda's policymakers with this tool, which is a "playground" for decision making.

The methodology for the model is as follows:

Assessment of the future population.

Assessment of food needs.

It is identifying the nutrient content of the major crops and livestock products that are produced (or could be beneficially produced) in Rwanda.

Assessment of the yield of each crop/livestock branch, in the current situation and in future scenarios where yields are improved.

A decision on the balance of various crops and livestock products in the population diet calculation of the agricultural land needed to feed the population of Rwanda in 2050.

The following presents a detailed methodology of each phase of the analysis.

Assessment of the future population

The median forecast of population growth in Rwanda is about 22.1 million in 2050 (Vision 2050). The main indicative lessons for agricultural planning, giving the population realm of Rwanda are:

Room for a population of 22.1 million in 2050 must be prepared right away.

The food needs of 22.1 million people should be the basis for agricultural planning. The requirements should be studied and "translated" into the size of land that should be protected against construction, fragmentation, and environmental degradation.

The urbanization process should not, as far as possible, come at the expense of agricultural land. Urbanization should be integrated with farming perspectives so that the urban population could enjoy a stable food supply.

2. Assessment of the population's food needs

Food needs could be addressed via several parameters: energy (calories), specific nutrients such as proteins, recommended balanced diets – such as published by the USDA (United States Department of Agriculture). Our model will relate to energy (calories), protein intake, and dietary recommendation (USDA). The different parameters give different results, and policymakers should choose the best suitable setting.

Energy: the model is based on a daily intake of 2,500 Kcal as a minimal, however satisfying diet.

Protein: the model assumes a daily intake of 56 gr. Which again is considered minimal, however satisfying. One should note that crops, and not only livestock products, are an excellent source for protein.

The model is based on the advice of the USDA, where fruit and vegetables are calculated into the model according to their recommended intake, which is related to vitamins and minerals and not energy or protein.

3. Identifying the nutrient content of major crops and livestock products

USDA has a vast database on the nutritional content of foods (USDA national nutrient database for standard reference). This database was used to extract data on the calories and protein content of various crops and livestock products.

4. Assessment of the yield of each crop/livestock branch

Data on the current yields of the major crops in Rwanda is given in the detailed report on agriculture and also an accurate calculation of the optimal yields (the international best practice). It should be noted that various scenarios regarding the crops' returns can be developed. It may be assumed that a portion of Rwanda's farmers will continue to be subsistence farmers, having low yields. In contrast, other farmers will become commercial farmers with higher yields (even if not optimal).

5. The decision on the balance of various crops and livestock products

Healthy diets are diverse diets. It is not fit to eat only one food, healthy and nutritious as it may be. Therefore, the model is based on 11 crops and four livestock products, presenting the significant plants and animals that are raised in Rwanda's agriculture.

For the convenience of the analysis, two assumptions have been made: A. that each of the ten energy crops will contribute 10% of the population's diet. B. that fruit and vegetables that are required for their vitamins and minerals will be delivered at the recommended minimum level of about 400 gr/capita/day.

Poultry meat and eggs will each take account for 30% of livestock products. In contrast, milk and fish will each take account for 20%. However, the overall balance between crops and livestock products will be considered on different levels, as detailed in the following section.

All of the above are optional decisions. For example, in the global diet, livestock products account for about 17% of energy intake. However, there are countries and cultures in which livestock products account for a much more significant portion of the diet or a much smaller portion. Rwanda's decision-makers will have to decide what is the right part of the different ingredients of the menu.

6. Calculate the size of agricultural land needed to feed the population

Once the parameters are identified or decided on – finding out how much agricultural land is required to feed the people of Rwanda in 2050 is a matter of calculation. Several scenarios for the year 2050 were developed under different assumptions. Of course, other assumptions can as well be incorporated into the dynamic model.

Assumptions for all scenarios: Population in 2050: 22.1 million. Diets: 2,500 Kcal / capita / day.

Level 1 - Business as usual Assumptions:

- Source of food: crops only (resembles the current situation for most Rwandans; the current daily intake from livestock products is only 6 gr.).
- Yields: according to the current situation in Rwanda, most of the farmers are subsistence farmers with meager returns.

Level 2 – sub-commercial agriculture Assumptions:

- Source of food: 90% from crops, 10% from livestock.
- Yields: 20% of farmers are subsistence farmers with low yields; 80% of farmers are commercial farmers with optimal returns.

In the last year's agriculture in Rwanda grew 5% per year. If this trend continues until 2050 – agriculture will be 4.5 times larger than today. If most of the growth will be accounted for the increase in yields – this scenario may be considered realistic.

Level 3 - commercial agriculture assumptions:

- Source of food: 85% from crops, 15% from livestock (similar to the global average).
- Yields: according to the optimal returns of the best-producing countries. This means that all Rwanda farms are commercial and achieved the best yields possible. It should be noted that given the climate, topography, and spatial development patterns of Rwanda, this scenario is highly improbable to realize. However, it is useful to look into it as a benchmark of the best possible situation and study its meaning.

All scenarios will include about 56,000 ha reserved for **cash crops** (coffee, tea) as currently exist in Rwanda. The Model Results:

Level 1: Business as usual:

Land needed to feed 22M people is **10,297,327 Ha (102,973 km²).** In a **Business as usual scenario,** about 10 million hectares of agricultural land will be required to feed the population of Rwanda in 2050, compared to the available agricultural area of about 1.2 million hectares.

Level 2: Sub-commercial agriculture:

The land needed to feed 22.1M people is 3,515,427Ha (35,154 km^2), compared to the available agricultural area of about 1.1M hectares. This scenario seems to be the most realistic, given the current growth rate of agriculture in Rwanda.

Level 3: Commercial agriculture:

Land needed to feed 22M people is 1,510,487 Ha (15,104 km^2). The situation could be improved if the feed required for livestock rearing is not produced locally, but imported from other countries.

In this case, about 1.3 million hectares of agricultural land will be needed to feed the population of Rwanda in 2050, which more or less matches the size of the farmland in Rwanda in 2050, according to the availability. (12,424 km²)

The realization of full food independence, given the potential for agricultural land, depends on increasing crops yields to the global best practice, rearing livestock in best practice and feeding them with imported feed, and full protection of the available agricultural land, against sprawling, uses.

As stated earlier in this report, this scenario is highly improbable given the climate, topography, and spatial development patterns of Rwanda. However, it seems that this unlikely scenario is the only

option for achieving food security based on local agricultural resources. It illustrates the importance and urgency of protecting the given agricultural land of Rwanda.

9.2   Livestock

Livestock products are excellent for closing dietary gaps in protein consumption and producing higher-value products. However – at a very high cost to the land and other natural resources. The availability of sufficient animal feed is a crucial element in raising livestock yields. This means that agricultural land should be protected for the production of feed for farm animals. There are two main options for feeding livestock: (1) Grazing pastures, (2) Feeding the livestock in intensive farms, mostly grains (wheat, maize, soybean). Livestock productivity will be lower in comparison to intensive feeding, and the land needed is much larger than the area required for growing grains intensively. Are pastures an optimal option for land use giving land scarcity in Rwanda? It seems that the answer depends on the alternative possible use of the land. The answer can be definite only in as much as the area is not suitable for urban development or farming. Another option is to combine grazing in areas designated for conservation (nature reserves and forests) when this dual land use is possible. Feeding livestock grains in intensive farms results in higher productivity. It means that feed will be produced on agricultural land, or imported from other countries. High-yield livestock consumes a high amount of feed.

Fish is an exception in that it can be intensively produced with a relatively low amount of feed. There can be two main strategies for raising fish: aquaculture in fish ponds – intensive management with high yields, but also high feed requirements (2 kg grains / 1 kg fish-meat). The other option is populating lakes with fingerlings and catching them later as they mature. Given a large number of lakes in Rwanda, this seems like a good alternative. It should be noted that the process of populating fish into natural lakes should be planned and managed from an ecological point of view. Enlarging the fish productivity of the lakes, when properly planned and executed, may improve on their ecosystem.

Even under the best scenario, livestock feed may take around 200,000 hectares, about 18% of the currently available agricultural land in Rwanda. The balance sheet advises to use Agriculture land for mostly food production for the local people, and livestock rearing to be based on feed imports (especially raw materials) as much as possible. However, the country will continue to establish animal feed industries, as promoted by NST1 and Vision 2050. One should differentiate between the place where the grains are produced (in agriculture) and where they are processed for rations that could be fed to livestock on intensive farms (feed mills). Rwanda may import the grains but have local industries that will process them into the feed rations, thereby increasing their economic value. It seems impossible for Rwanda to grow food both for humans and livestock on its limited agricultural land.

An alternative option is to designate the agricultural land in Rwanda to the production of food (for humans) only, whereas grains for feed will be imported. It means that Rwanda will not be dependent on food imports for the basic needs of the population (vegan diets), but rather only on the more affluent livestock products.

9.3   Agricultural Yields

The yields in Rwanda are currently meager. As in many East African countries, low productivity is stemming from the lack of access to markets, credit, and technology. States should continue to invest in the transformation of farming into modernized agriculture through mechanization, irrigation, vertical farming technologies, improved seeds, and use of fertilizers. Food insecurity is perpetuated by unstable climatic conditions such as floods, droughts, famine, and diseases. Developing early warning systems and technologies can pre-empt such disasters and assist in the mitigation of their impact on agriculture and food supply. Improvement in technology, infrastructure (drainage, irrigation), farmland consolidation, vertical farming technologies, market access, etc. can dramatically improve crops' yields.

Greenhouses are an excellent technique for achieving sustainable intensification of fruit and vegetable production. Using greenhouses, one can increase the yields between 3-5 times per land unit, while saving up to 50% on the water for irrigation and pesticides. Greenhouses also provide employment and income from small farms (about 0.5 hectares of greenhouses can provide income for about five employees). However, it requires significant investments in construction and equipment and good agricultural know-how. It is recommended that Rwanda will aim at having up to 10% of the farming land in greenhouses by 2050, supporting the farmers with funds for the needed investments and professional instruction.

Urban agriculture – farming small plots in the cities, between the houses and on balconies and roofs – is an essential way for supporting the urban dwellers with food security, especially with fresh produce such as fruit and vegetables. All efforts should be taken to instruct urban dwellers regarding the possibilities of growing food on the available spaces. However, livestock rearing in urban areas should not be allowed due to sanitary and health risks.

Still, it should be considered that this improvement is not without a ceiling. An analysis of the best international yields for each crop was conducted. The best global yield was calculated as the average yield of the ten countries with the highest returns worldwide, for that crop, based on the FAO data (Table 10-2). One should note that the climate and topography of Rwanda are challenging. Therefore, even if all economic and social conditions are improved – it is uncertain that Rwanda's farmers could reach these best international yields. However, "Vision 2050" details even higher yields than the best global yields as the goal to be achieved in 2050. The comparison of the current yields in Rwanda, the best international returns, and "Vision 2050" projected yields are presented in the table below.

One should be careful in setting too ambitious goals that are impossible to fulfill, thereby neglecting the need to protect the farmland against development that might jeopardize the food security of future generations.

Crops	Yield current situation ton/ ha	Advanced yield ton/ ha	Best international yield ton/ ha
Beans, dry	0.9	2.4	4.5
Bananas	8.9	27.1	55.5
Maize	1.3	5.1	18.7
Sorghum	1.2	4.4	12.7
Sweet potatoes	6.5	17.2	29.2
Potatoes	8.4	24.3	46.2
Cassava	7.6	17.2	25.3
Pumpkins, squash	5.1	18.7	56.1
Soybeans	0.5	1.5	3.4
Taro (cocoyam)	4.1	12.6	25.6
Fruit and vegetables	8.4	22.8	40.0
Land to feed 22 M. people	103,000 Sq. Km	34,000 Sq. Km	15,000 Sq. Km

Table 9-2 Comparison of current, advanced and best international yields

The following section discusses the feasibility of food imports. An alternative to local production of food, via the local agriculture, is food imports. The international trade in food products is intensive, and many countries are not self-sufficient in terms of food production and supply. The promotion of the regional agricultural business, between the states of East Africa, is a highly valuable strategy for reaching local food security and sustainable growth of the local agricultural sector.

Opening space for inter-state trade of agricultural commodities and ensuring improved functioning of cross-border trading and strengthening regional cooperation is indeed a central goal of the EAC Vision 2050. As each country has its unique comparative advantage, cooperation and inter-state trade would contribute to the East African community at large. The development of an EAC Strategic Plan on Agriculture and Food Security, as suggested in EAC Vision 2050, is a highly beneficial strategy. However, given the fragile conditions of agriculture in Rwanda, one should be careful in considering basing the entire supply of food in Rwanda solely on food imports. Several parameters have to be taken into account: Rwanda is landlocked, which highly reduces its options regarding trade partners. Even if the food is imported from other countries – Rwanda will be dependent on its neighboring countries that have a harbor through which the imported food could reach Rwanda. The main option is to introduce food via Tanzania's ports, as the other countries bordering Rwanda are also landlocked. Parameters to be considered are the quality of transportation lines (roads) from Tanzania's harbors to the population centers of Rwanda, and Rwanda's international relations with Tanzania.

When considering importing food that is produced in neighboring countries only, attention should be given to their level of economic and agricultural development, their political stability, and institutional strength. Political instability and conflicts are a significant threat to agricultural production, and therefore it is not recommended to rely on food imports from unstable countries. Given these criteria, it seems that, again, Tanzania is the first option for food imports, as the other neighboring countries are either politically or institutionally unstable. The question remains whether it is advisable to trust food imports for providing food security to Rwanda's population. Developing the local agricultural

production and protect the land is advisable so that the population's food security will not be compromised even under conditions of regional instability.

9.4 Agricultural Planning and Land Shortage

As was presented in the previous sections and, even under a very optimistic scenario, Rwanda will find it difficult to support its population food needs, given the population growth rate and limited available agricultural land. The feasibility of food imports is uncertain. Therefore, about 13,000 Sq. Km consolidated lands should be designated and protected for agriculture. Unfortunately, this will probably remain a theoretical number due to the shortage of land and other needs and preferences. Despite the potential for increased productivity, agricultural production is expected to be limited due to the availability of land. With the continued development of the country, Rwanda will therefore need to explore other innovative approaches in agriculture, such as the use of vertical farming technologies to increase crop yields on a smaller area.

NLUDMP 2050 needs to set rules and guiding terms for the protection of agricultural land. The development of its production capacity so that Rwanda could provide food security to its inhabitants in 2050. It means the following for the national agricultural planning:

- The existing agricultural land should be protected against scattered housing and degradation due to soil erosion and improper management.
- Every means should be taken to improve agricultural productivity and crops' yields. It includes farmland consolidation, irrigation projects; drainage projects; construction of terraces on hills' slopes, vertical farming; instruction/education for farmers' professionalism; agricultural education research, and development at the regional level. Most of all, climate-resilient options should be implemented, such as improved bench terraces, agroforestry, improved seeds, drainage, irrigation.
- Where priorities are necessary, the efforts for agricultural development should concentrate on the best suitable land for agriculture.
- It is advisable to plan the agricultural sector so that Rwanda's agricultural land will mostly be used for food production for the local people. Livestock rearing will be based on a feed of the local processing industry as much as available and optional feeds from imported raw materials. For agriculture to provide for food security - the land needed for agriculture will have to increase.

9.5 Agricultural Land – The Supply in Practice

Agricultural land allocation is based on the following principles:

- **Protect as much agricultural land as possible**, mainly by planning other land uses in a dense and compact pattern. However, this national plan leaves room for the installation of certain infrastructures that support agricultural productivity such as the non-residential - farmhouse, warehouse, drying yards, processing mills and feeder roads in the consolidated farmland.
- **Prioritize the better and most suitable agricultural land for agricultural projects**, aimed at increasing yields, productivity and agricultural incomes.

It is not possible to protect all the needed agricultural land. Other land uses, such as forest plantation, urbanization, industry, and transportation, need room as well. Hence, the development of these land uses must be as compact as possible, so that the majority of land will continue to be available for

agriculture. Setting the boundaries of agricultural land is an essential tool for its protection. The magnitude of agricultural land that should be specified in the land use balance sheet of NLUDMP 2050. The majority of the best suitable agricultural land is in the eastern and south-eastern parts of Rwanda, where the area is relatively flat. This land should be protected as carefully as possible from construction. Agricultural development projects should be promoted on this land, such as drainage, irrigation, terrace building, consolidation, and farmers' cooperatives formation, agricultural research and extension services.

10. Manufacturing and Industrial Development

The Summary of development principles:

The development of the manufacturing sector is of high priority and will follow the following concepts and measures:

- The total number of formal employees in districts which specialize in manufacturing will reach 1.4M employees, 20.6% of full employment in those districts.
- Specialization in industrial parks will be according to district/regional competence. This will improve safety and standards.
- 40% of manufacturing employment, 560k, will be in Industry Parks.
- Spatial distribution and optimal sizes of industrial parks were determined. Only 13 Industrial parks for 2050 are needed. Every province is strategically represented. 11 Cities/districts and 2 in the city of Kigali (Gasabo and Kicukiro) were identified for industrial parks location. The size growth rate of industrial parks will be an average of 7% annually, reaching 88 km² in 2050. The pace will be smaller in the first 15 years, only 6%, increasing to about 8% between 2035 and 2050.
- The past practice of planning industrial parks in every district through local urban development master plans will be forbidden.
- Other districts not included in the list of Industry parks will be allowed to plan only agro-processing mills and Agakiriro, which require small areas.
- The land allocation for industry parks will cover 29 km² in 2035 and 88 km² in 2050.
- The vertical construction of industrial buildings is highly encouraged to save the land.
- Small-scale mining exploitation will change to a regional mineral processing hub.
- Designation of mining sites will be done after undertaking a cost-benefit analysis of the sites, in which mining activities are proposed versus current or alternative land uses.
- Adding value to minerals within Rwanda is preferable before exporting them.

The Manufacturing sector in Rwanda is still small but quite competitive and currently occupies 11 KM² of industrial parks. The industries are primarily engaged in the production and processing of wood, tobacco, cement, textiles, agricultural products, small scale beverages, soap, furniture, shoes, plastic goods, tea, and coffee. Others include chemicals, construction, printing, paper, engineering, and methane gas. Thus, the economy is heavily dependent on the primary sector, with industry strongly tied to the processing of primary products. The manufacturing industry in Rwanda has undergone significant changes in the past ten years, owing to increased industrialization and government involvement in manufacturing industries. These changes have generated new implications for the country's industrial sector, thereby necessitating revaluation of industrial policies, especially regarding government involvement.

Rwanda's commitment to Manufacturing is rooted in the Vision 2050, In which "Made in Rwanda" will be a recognized brand locally and internationally. Kigali will have solidified its position as the regional trading hub and the gateway to East and Central Africa.

Rwanda's industrial parks will operate at full capacity with state-of-the-art infrastructure, dedicated power lines, modern water and drainage systems, and high-speed internet connectivity. Each industrial park will be linked to modern cargo and handling facilities. Bugesera International Airport will serve as the primary hub for producers to access the globe with daily flights and will become a major cargo hub. The advanced food industry will be developed. Rwanda will intensify efforts to build linkages between production and processing by ensuring that domestic supply chains are efficient. Investment in the sourcing of raw materials will be improved by encouraging industrialists to develop their own agricultural blocks and partner with out-growers.

Districts will have expanded areas marked as an industrial park with land being designated for this. By 2050, Kigali Special Economic Zone Phase III and new industrial parks in Bugesera, Huye, Musanze, Rwamagana, Muhanga, Nyagatare, Nyabihu/Rubavu, and Rusizi Districts will be developed and fully operationalized as State-of-the-art industrial parks. It will increase the serviced area available in Industrial Parks from the current 10-12 sq.km to 88 sq.km by 2050 once all Industrial Parks and industries are completed.

From the perspective of employment, the industrial sector will pass a revolution. The number of workers in manufacturing will be 2,4M and 700K in mining. Construction will employ 1.7M workers. 40% (560K) of the workers will be engaged in Industry parks. 60% will be spread in the urbanized areas in a small scale manufacturing. The consumption of land in the parks is according to density norms: **64 employees per Ha,** and the allocated properties for industrial parks will be 8,777 **Ha.**

10.1 Industry Parks

The distribution of the future system of industrial parks will be affected by the manufacturing potential of the districts. NLUDMP team visited all districts, conducted discussions on their future prospect and vision, and summarized the result in table 11-1. Not all districts will be part of the manufacturing structure of the country. For those who are already in the field and for those who will probably join in the future. In table 11-1 the right column shows the current areas for each district/city. The districts to which a blue rectangle is attached are those in which new parks should be considered due to their tendency towards manufacturing and all other 17 districts with X should be considered with no industrial park allowed,but rather an agroprocessing mill and handcraft workshop can be opted according to their potentials.

District	Economic Specialization and employment	Ha.
Kigali City (2)	Kigali is the capital of trade and financial services, manufacturing, and high tech. As the national capital, it is also the ultimate center of government and public services of the highest rank	276 Ha
Muhanga (1)	The driving sector for Muhanga will be Mining. Trade, finance shall be equally essential to support mining activities. Due to its consideration as a Satellite city, infrastructure services and construction will be on the rise.	63 Ha
Rwamagana (1)	Rwamagana will develop a large manufacturing hub. As a satellite city, more construction and related infrastructure developments will be expected. Commercial agriculture and processing will be equally important as the district have suitable soils for Agriculture.	80 Ha
Bugesera (1)	Trade, Transport, and Tourism will be the main drivers of Bugesera due to the new International Airport. As a planned satellite city, Construction, Infrastructure	330 Ha

	services, and Hi-Tech will also be essential. The growth of the financial sector will be inevitable.	
Nyagatare (1)	The Center for Commercial Agriculture and Processing. Its location at the border with Uganda and the housing part of Akagera National Park, Liverstock, Trade, and Tourism will be instrumental in shaping the district's growth.	50 Ha
Huye Nyanza (1)	Huye will be the 2nd Public Service led city after Kigali. It will remain an academic hub of the country that will be supported by Hi-Tech.	50 Ha
	Both districts are the heart of cultural tourism in Tourism; more cultural and historical sites are being developed to create a firm cultural and historical heritage corridor. Cross border trade given their strategic location to Rwanda- Burundi border shall be equally important.	
Rubavu Rusizi (2)	Trade, Tourism, Agribusiness and Transport shall be the economic powerhouse for both Rubavu and Rusizi towns. Water sports, marinas that will facilitate business transport. Manufacturing and Mining sectors are expected to flourish, with the methane gas extraction. The Finance sector linked to foreign currency exchange and fluxes of transfer and offshore savings will be paramount	95 Ha
Musanze (1)	Musanze shall remain the major tourism hub for the country with Gorilla tourism expected to remain a significant contributor to the overall tourism revenues, MICE another product being introduced to create a complete tourism destination. Finance and Manufacturing are the other sectors expected to grow, given the cross border business opportunities.	167 Ha
Current Total		1,111 Ha
Nyabihu (1)	Agriculture and Mining will be the core economic activities. Nyabihu has access to Volcanoes National Park creating tourism opportunities	☐
Kirehe (1)	Kirehe will rely mainly on cross border trade and Commercial Agriculture. The Rusumo border shall get busier once the planned railway route from Tanzania to Kigali is complete, trade and logistics shall grow at a double-quick match. With the proposed improvement in irrigation, agriculture yields shall increase, and subsequently, Processing Industries shall be established.	☐
Karongi (1)	Tourism and Trade shall lead the line. Its access to lake Kivu and the adulating landscape makes it an ideal holiday destination for tourists. Its location between Kigali-Muhanga-Rubavu provides an opportunity for trade and manufacturing. Public Service and Finance shall be other vital sectors.	☐
Kayonza	The Tourism, Mining and Logistics Hub of Rwanda. Kayonza is at the junction of two major entry points into Kigali from Uganda and Tanzania borders. Its close proximity to Kigali makes Trade another very viable sector.	✗
Ngoma	Commercial Agriculture and Agribusiness will be at the helm of its transformation. Its location between Kayonza as the eastern cross border junction and Kirehe the Rusumo border entry point makes it a strategic trade center.	✗
Gatsibo	Commercial Agriculture and Processing and Tourism sectors have more potential. Gatsibo has suitable land for agriculture and the land scape is favorable for mechanized farming. It also has access to Akagera National Park and a new proposed northern gate entrance into Akagera shall go through Gatsibo creating more tourism business opportunities. Mining is another sector with great potential.	✗
Kamonyi	The main activity shall be Mining. Due to its closeness to Kigali, Construction and infrastructure services are also expected to grow as it will be expected to offer low housing facilities for low income earners working in Kigali or Muhanga.	✗

Ruhango	Mining and agribusiness will be at the core of the town. Its location between Muhanga and Huye but also not far away from Kigali indicates the great possibility for both financial and public sectors to flourish supporting and facilitating Mining and agriculture.	X
Nyanza	The District is the heart of cultural tourism. More cultural and historical sites are being developed to create a firm cultural and historical heritage corridor. Cross border trade given its strategic location to Rwanda- Burundi border shall be equally important.	X
Gisagara	Agriculture and cross border trade will be the main activities. Mining, Manufacturing will be the secondary economic activities due to the small deposits of mineral and quarry deposits available.	X
Nyaruguru	Religious Tourism Base. Home to the famous Kibeho sanctuary Notre Damme with its historical background related to the apparition of the Virgin Mary. Kibeho attracts over 50,000 people every year from religious pilgrimages, 14 hectares of land has been demarcated for tourism development. There is also great potential for mining and light manufacturing.	X
Nyamagabe	Trade and Tourism shall be the main economic activity for the District Town. The neighboring Nyungwe Forest National Park and closeness to the newly created Gishwati-Mukura National Park will create more business opportunities leading to the growth of this center.	X
Nyamasheke	Trade and Tourism shall be the main economic activity for the District Town. The neighboring Nyungwe Forest National Park and closeness to the newly created Gishwati-Mukura National Park will create more business opportunities leading to the growth of this center. Mining sector exhibits great potential.	X
Rutsiro	Forestry, Agriculture and Mining will be the core economic activities. Rutsiro is an entry point to the new Gishwati- Mukura National Park creating tourism opportunities.	X
Nyabihu	Agriculture and Mining will be the core economic activities. Nyabihu has access to Volcanoes National Park creating tourism opportunities	X
Rulindo	The district will be predominantly Forestry, Commercial Agricultural Processing and Mining sector led.	X
Gakenke	The town will rely on cross border trade between Uganda and Rwanda. Mining and manufacturing will be also very important.	X
Burera	The town will rely on cross border trade between Uganda and Rwanda. Mining and manufacturing will be also very important. Commercial and Agri-business will also be important as Burera District is best to supply Irish potatoes production.	X
Gicumbi	The town will rely on cross border trade between Uganda and Rwanda. Mining and manufacturing will be also very important.	X

Table 10-1 Current potentialities and areas of industrial areas for each district

The following table 11-2 presents the **distribution** of industrial parks and the total employment, in manufacturing and high-tech, and the land demand in each district, which has an interest and conditions in Manufacturing.

District Category	District	Population in Industrialized Districts 2050	Formal Employment 2050 - 53.2%	Employment in Manufac. & High-tech		Emp. In Industry Parks 40%	Gross Area (Ha) Industry Parks By 2050	Gross Area (Ha) Industry Parks by 2035
					#			
Kigali	Kigali City	3,850,000	2,048,200		421,929	168,772	2637	879
Satellite cities	Muhanga	1,000,000	532,000		109,592	43,837	685	228
	Rwamagana	1,350,000	718,200		147,949	59,180	925	308
	Bugesera	1,400,000	744,800		153,429	61,372	959	330
Secondary cities	Nyagatare	1,000,000	532,000		109,592	43,837	685	228
	Huye	750,000	399,000		82,194	32,878	514	171
	Rubavu	550,000	292,600	20.6%	60,276	24,110	377	126
	Rusizi	475,000	252,700		52,056	20,822	325	108
	Musanze	700,000	372,400		76,714	30,686	479	160
	Kirehe	525,000	279,300		57,536	23,014	360	120
	Karongi	750,000	399,000		82,194	32,878	514	161
District town	Nyabihu	429,500	228,494		47,070	18,828	294	98
	Total	**12,779,500**	**6,798,694**		1,400,531	**560,212**	8753	2918

Table 10-2 Manufacturing and high-tech distribution - Employment and land Allocation 2035-2050

The factors in this distribution are:

- The total number of formal employees in "manufacturing districts" is 53.2% = 6,798,694.
- The percentage of employment in manufacturing & High-tech is 20.6% in average = 1,400,531 employees.
- 40% of manufacturing employment will be in Industry Parks = 560,212 employees.
- The factor which connects employees and land areas in parks is 64 workers per Ha.
- The growth rate of industrial parks will be an average of 7% annually, reaching 88 km² in 2050. But the pace will be smaller in the first 15 years, only 6% and will increase to about 8% between 2035 and 2050.
- The allocation result will be 29 km² in 2035 and 88 km² in 2050.

10.2 Mining

Mining is one of the critical drivers of economic development. It will continue to grow due to the growing world demand for minerals and metals, which is assumed to double. As a result, the Government of Rwanda established a mining board to re-design the mineral sector to deliver higher-level results. The Rwanda Mines, Petroleum, and Gas Board (RMB) has a responsibility to re-design the industry to transform mining resources into crucial drivers of Rwanda's growth. Mining has hence been integrated as a critical driver for Rwanda's national economy in the government's seven-year program. The sector's target is to transform the mining sector by delivering large quantities of the

mining industry and increase exports. Employment in 2050 will reach a goal of **705,657 (6% of entire jobs).**

This is the reason why the mining sector is going through a transition, moving from small-scale exploitation with limited links to the rest of the economy to being a primary foreign currency earner and become a regional mineral processing hub, adding value to minerals mined in Rwanda and the region before exporting them. Some of the key achievements:

- Campaigns on professional mining practices and fighting illegal mining practices were part of the efforts to trim down the number of accidents in the sector.
- Mining and safety standards have been developed and disseminated to all mining actors in ensuring safety in the mines.
- Mining licenses have been suspended and revoked for not meeting health and safety standards.
- Miners were encouraged to switch from artisanal mining to modern mining. Mining laws and regulations have also been reviewed and gazetted. Law N° 58/2018 seeks to promote professionalism and growth of the mining sector while giving a new lease of life to the mineworkers whose safety at work has been the cause for concern. The law also tackles licensing, illegal mining, and the safety of the communities that surround mines. It stipulates penalties, including jail terms and fines, to mining companies or individuals who illegally operate the business.
- Mines inspections and monitoring were conducted by decentralized control.
- It was providing for the demarcation of potential mining areas that are economically viable to promote investment in mining. The new law was reviewed in consultation with different stakeholders in the mining sector, including mining associations and other members of the private sector.
- Mining has been taken into consideration the environment management. Some of the provisions include progressive rehabilitation of the mining site during the course of the mining project and developing tailings and waste management facilities.

Investments in mining

The Mining sector in Rwanda has untapped potential that presents lucrative investment opportunities in the entire value chain from exploration to value addition. Partnerships between global mining companies and local mining companies have also been encouraged as the latter operates on a small scale. At the same time, many of them own mining concessions with excellent potential for mineral deposits. Hundreds of these local companies are open to considering partnerships and joint ventures. There is a significant opportunity for investors to establish processing plants needed to beneficiate, smelt, refine, or transform the minerals as metals or value products. Another area of investment opportunity in the mining sector in Rwanda is locally assembling and manufacturing mining equipment. There are untapped opportunities in this area, given the significant number of mining operators in the country.

The chief minerals produced in the country are:

- Tin, tungsten, and tantalum (3Ts), of which the country is ranked among the top producers worldwide.
- Gold, gemstones, and rare earth elements,

- Industrial minerals.
- Precious stones.

The recent mineral export earnings show an upward trend; US$149.1 million in 2015, US$ 166 million in 2016, and U$373 million in 2017 surpassing coffee and tea earnings and making it the second-highest foreign exchange earner of the country after tourism.

<u>International Activities</u>

Rwanda is among the top producers of tantalum ore, producing more than half of the needed quantity onto the global market. Rwanda was approved as a member of T.I.C.

Rwanda implemented Traceability and Due Diligence System, an international requirement designed to prevent illegal trade in minerals, particularly cassiterite, coltan, wolframite, and gold from Eastern and Central Africa. Tag managers are deployed at mining concessions to seal and record minerals produced in order to monitor and contain potential illegal dealing in metals efficiently.

<u>Prospects:</u>

- Revenues from Rwanda's mineral exports are targeted to be US$800 million in 2020, and detailed exploration works will continue including drilling to determine and characterize mineral resources in the country.
- Establishment of gemstones cutting, polishing, and trading hub in Rwanda to act as a center for processing and trading as well as a laboratory for testing precious stones is underway.
- The geological and mineral information management system will be carried out.
- Strategic investors will be attracted, using adequate data as being generated through exploration programs in the framework to professionalize the mining sector.

11. Transportation

Summary of recommended development measures:

Rwanda has a very dense road network coverage, which explains the scattered nature of its human habitat. The existing road network of 37,896 km (44,669Km including paths) has been analyzed, and a new road hierarchy is proposed to achieve the desired vision 2050. The distribution of land transportation networks is based on the new NLUDMP fabric of settlements and on the consolidation principles which the plan adopted, which will reduce the cost and length of roads.

NLUDMP brings to the table the following reinforcements for land transportation of internal and international connectivity: 730 km of Expressways, 805km of an Arterial belt, connecting all secondary cities, and 505 km of 3 railway lines, connecting Rwanda to its neighboring countries.

The full land transportation system is presented in Table 12.1

Type		Length in km	Total length in Km	Buffers
Expressways	Western Express	335	730	30m×2=**60m**
	Eastern Express	208		
	Central Express	187		
Arterial belt network	all	805	805	22m×2=**44m**
Railways	Western Line	115	505	30m×2=**60m**
	Eastern Line	265		
	Upper Central Line	125		
Feeding Roads	District 1	13,669		12m×2=**24m**
	District2			

Water transportation will include eight ports through lake Kivu which will increase tourism as well.

Air transportation will need seven upgraded airports - 2 international ones (Kigali and Bugesera), one regional airport in Kamembe, and five internal airfields.

Given the landscape of Rwanda which is very strategic to promote tourism and rapid transport, NLUDMP recommends the development of flyover and cable cars infrastructure facilities.

The NLUDMP recommends the use of underground while developing the infrastructures facilities.

Table 11-1 Land Transportation System

The socio-economic development of any country depends on different pillars, among which the transportation sector is playing a vital role. The movement of people and goods is made possible through various transportation modes. Besides, Trade, as well as tourism activities, might not be optimized without an effective transportation system. There are three main transportation modes in Rwanda, namely air transport, land transport, and Inland water transport.

Since Rwanda is landlocked, land transportation remains the predominant mode. For regional and international connectivity, Rwanda is linked by road to both Mombasa and Dar-Es-Salaam ports at an estimated distance of 1670 km and 1430 km, respectively. The lack of a railway network constitutes the significant drawbacks of transportation. It is resulting in high transport costs.

Rwanda to achieve its socio-economic development objectives, it is paramount to modernize transport infrastructure and services integrated with other sectors' development framework. The transport development strategies should aim at reducing travel time to facilitate doing business.

In addition to expanding road infrastructure, there is a need to develop railway and water transport infrastructures as well, to ensure integrated multi-modal transport, resulting in less transport cost, thus making Rwandan industrialization competitive regionally and internationally. This section of the National Land use Master Plan discusses transport future orientations and the required land to accommodate transport infrastructures.

11.1   Land Transportation

Road Classification

According to RTDA and the study conducted by them in 2019, the length of the road network is 37,896 Km, excluding the 'Added links' and 'Footpaths.' These additional links are adding 6,773 km, totalizing 44,669 km. Currently, the road network is subdivided into four categories, namely:

1.   National Roads: 2,748km
2.   District Road Class 1: 3,906 km
3.   Draft District Road Class 2: 9,763 Km
4.   Other Roads or Unclassified Roads: 21,479 Km

A more detailed subdivision is in Table 12-2 below, and a map is in Fig 12-1.

Type of Road 2019	Length in km	%
National Roads (Paved)	1,390	3.7
National Roads (Unpaved)	1,358	3.6
District Roads Class 1 (Paved)	113	-
District Roads Class 1 (Unpaved)	3,793	10
Paved District Roads Class 2	509	1.4
Unpaved District roads class 2	9,254	24.5
Subtotal	16,417	
Other Roads or Unclassified Roads	21,479	56.8
Total	100	100

Table 11-2 Road network in Rwanda

Table 12-2 indicates a significant gap in all-season(paved) roads, especially for district roads. It constitutes a hinder to mobility and accessibility, thus affecting doing business and industrialization. It is then imperative to continue paving roads in parallel to updating to high-speed roads.

Road density is the ratio of the length of the entire road network to the land area of the country. **The section above indicates a road network of** 37,896Km extended to 44,669Km when other links, including paths, are considered. The Rwandan land area is 22,633 Km², excluding the water bodies and wetland of 3,705Km². On the other hand, the Rwandan population is estimated at 12.5 Million, among which 18% are in urban areas. Three parameters measure the road density:

Taking the road network to be 37,896 Km, below is the current situation:
1. 163 km per 100 km²
2. 3.0 km per 1000 people
3. 330 people per km of road
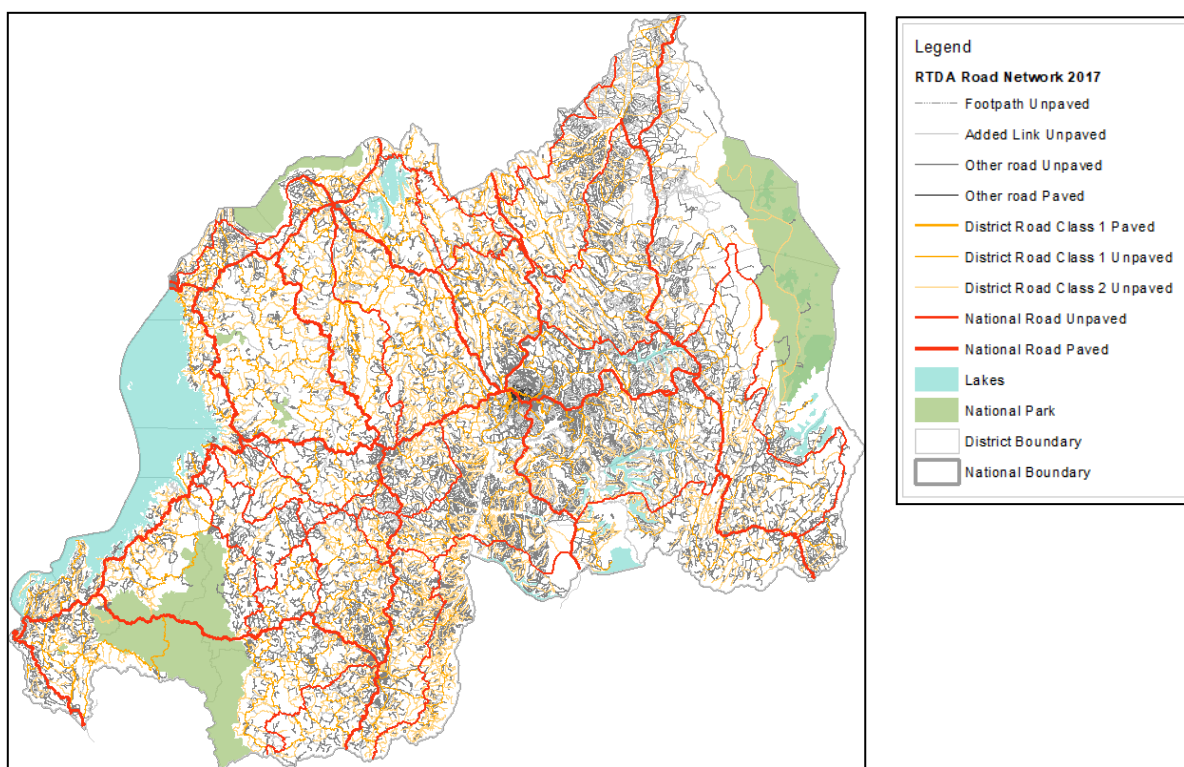
Figure 11-1 2019 RTDA Road Map

The spatial expression of this network density is a road grid of **1.28 km/1.28 km,** and an average distance from any given point to a highway is **0.64 km.** The road density demonstrates that Rwanda has good road network coverage as per Table 12-3 below. **If the network were all-season roads, Rwanda would have uninterrupted accessibility and mobility.**

	km /1000 p	p / km
Canada	44.92	22.2
Namibia	35.09	28.5
Sweden	23.95	41.7
United States	22.22	45
France	15.18	65.8
Belgium	12.5	80
Europe	10.14	98.6
Brazil	9.92	100.8
South Africa	8.23	121.5
U. Kingdom	6.33	157.9
Chad	4.21	237.5
Russia	3.64	274.7
DRC	3.21	311.5
Cote d'Ivoire	3.08	324.6
Rwanda	3	330
Germany	2.81	355.8
Tanzania	2.67	374.5
Israel	2.59	386.1
Burundi	2.27	441.4
Kenya	2.08	480.7
South Korea	1.87	534.7
Nigeria	1.6	625

Table 11-3 Global Road Density

To pave the way to the achievement of Rwanda's vision 2050, an upgrade of as many as possible existing roads to an all-season network is essential. Introducing a high-speed road system connecting economic growth poles and borders is necessary as well. In addition to trade and logistic chain, railways and water transport is paramount. Furthermore, transport services should be smart and modernized to use minimum travel time integrated with land use/settlement.

Safety

Transport infrastructures are essential to everyday lives. Predominantly, Rwanda's transport services are ensured by road[1] infrastructure.

Various road safety initiatives have reduced the number of road accidents with fatalities and severe injuries.   But despite the efforts to improve road safety, there is still a need for further interventions across the country. These include providing safe space for vulnerable road users such as pedestrians and cyclists, constructing proper sidewalks, bicycle paths, and pedestrian traffic signals. However, this consumes more land.

Transport Aspirations

Currently, land transport is dominated by road infrastructure, with only 5.3% paved while the railway line is still at the planning phase.

Considering the proposed Spatial Structure and Settlements Hierarchy, NLUDMP brings to the table some reinforcements for transportation improvements contributing to Rwanda's economic transformation by 2050. The reinforcement proposals are based on the target of improving internal and international connectivity in speed and volume of traffic while keeping a high level of safety. The reinforcement will be made on National roads and district roads as per road classification following the functional hierarchy as per Fig. 12-2 below.
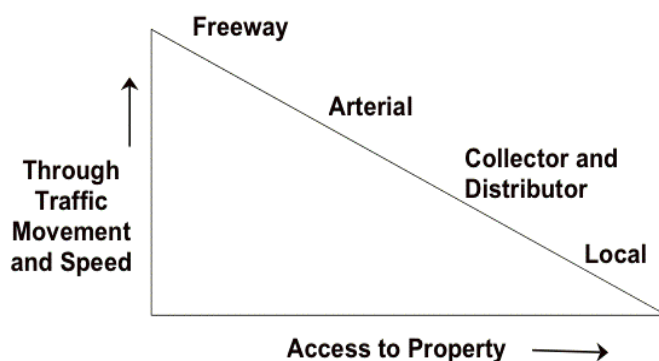
Figure 11-2 Road classifications and Functional Hierarchy

Expressways

An expressway is defined as a highway planned for high-speed traffic, having few, if any intersections, limited points of access or exit, and a divider between lanes.

There are no expressways of this characterization in Rwanda yet.   However, in the future, the expressways will play a significant role in connecting Kigali city, secondary, and satellite cities, which will host the majority of the urban population in Rwanda by 2050. The expressways, together with the improved arterial and collectors roads, both rural and urban, will play a significant role in achieving the objective of raising the country to high-income status. The implementation of expressways and arteries should be led by two criteria: 1. Transferring the Population, Urbanization, settlement, and Housing (PUSH) spatial scheme into road alignments, which allow all the interactions in the system to

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[1] Rwanda Transport Sector Review and Action Plan – AfDB.

operate. 2. Future corridors of expressways and arteries will use as much as possible current national and district one route.

The scheme in Fig. 12-3 presents the concept and general alignment of the proposed expressways. The program provides a Blueline, connecting Tanzania to Uganda through Kirehe, Kayonza, and Nyagatare; an orange line connecting the northern and southern provinces, passing Rubavu, Musanze, and Kigali. From Kigali, the orange expressway branches in two directions: To Muhanga, Ruhango, Nyanza, up to Huye. The second branch goes to Bugesera Satellite and airport up to Nemba and Burundi. The Greenline intersects both lines providing access between all linking significant logistics hubs in Karongi as well as in Rwamagana and Kayonza, serving agriculture potentials in Eastern Province.

Also, the expressway is planned around the City of Kigali as a ring road to decongest the city. Furthermore, a highway should connect the city of Kigali and the airport located in Bugesera as well as serving the town that will be developed near the airport. The buffer for expressways should be estimated at 60 m.
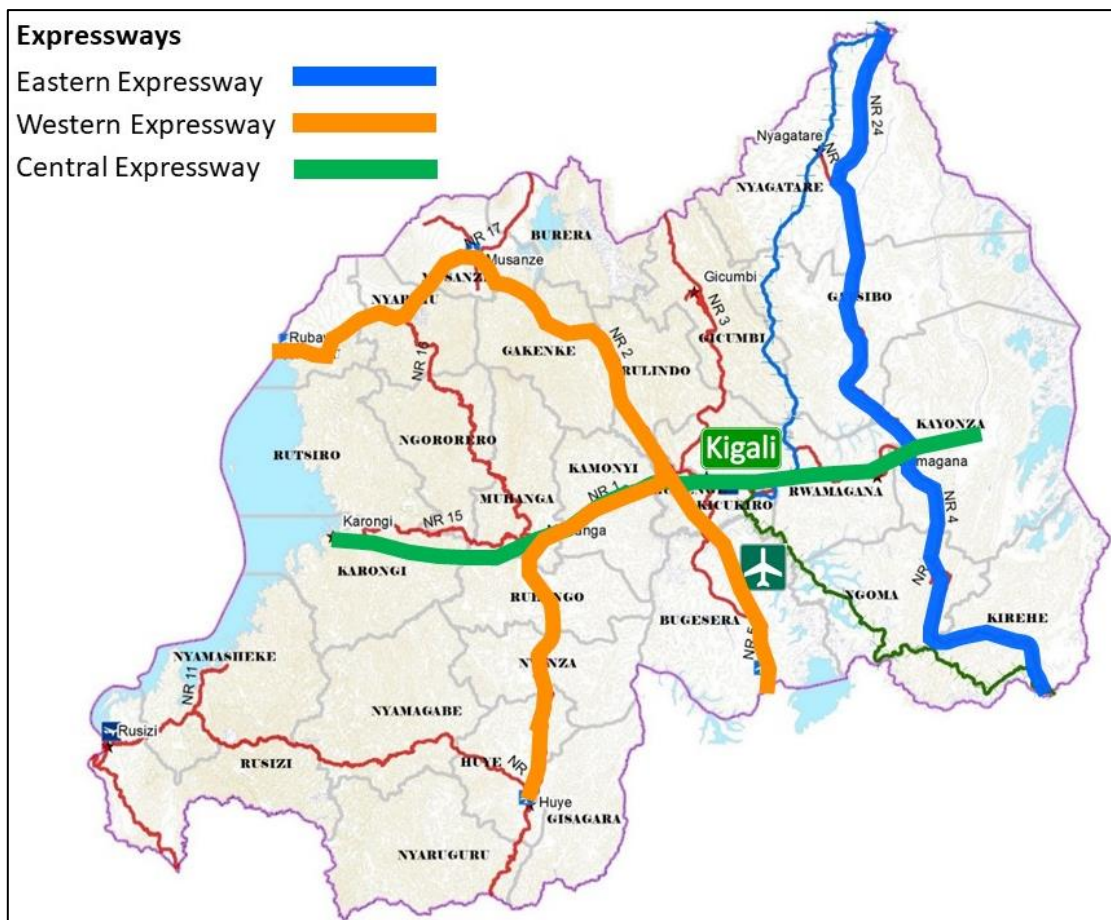
Figure 11-3 Alignment of Expressways, Western, Central, and Eastern Line

Arterial Belt Network

The belt network provides accessibility between peripheral secondary cities and connectivity to the expressways and railways. The belt offers smooth and fast access to the proposed Expressway and

Railway systems to the port's facilities, creating a more seamless connection in the intra-national trade and logistics system. Fig. 12-4 indicates the proposed belt system across the country.

The buffer for the belt system should be the 44m. The arterial road which passes Nyungwe national park will remain a two-lane road keeping the current alignment unchanged to ensure sustainable management of Nyungwe natural forest.
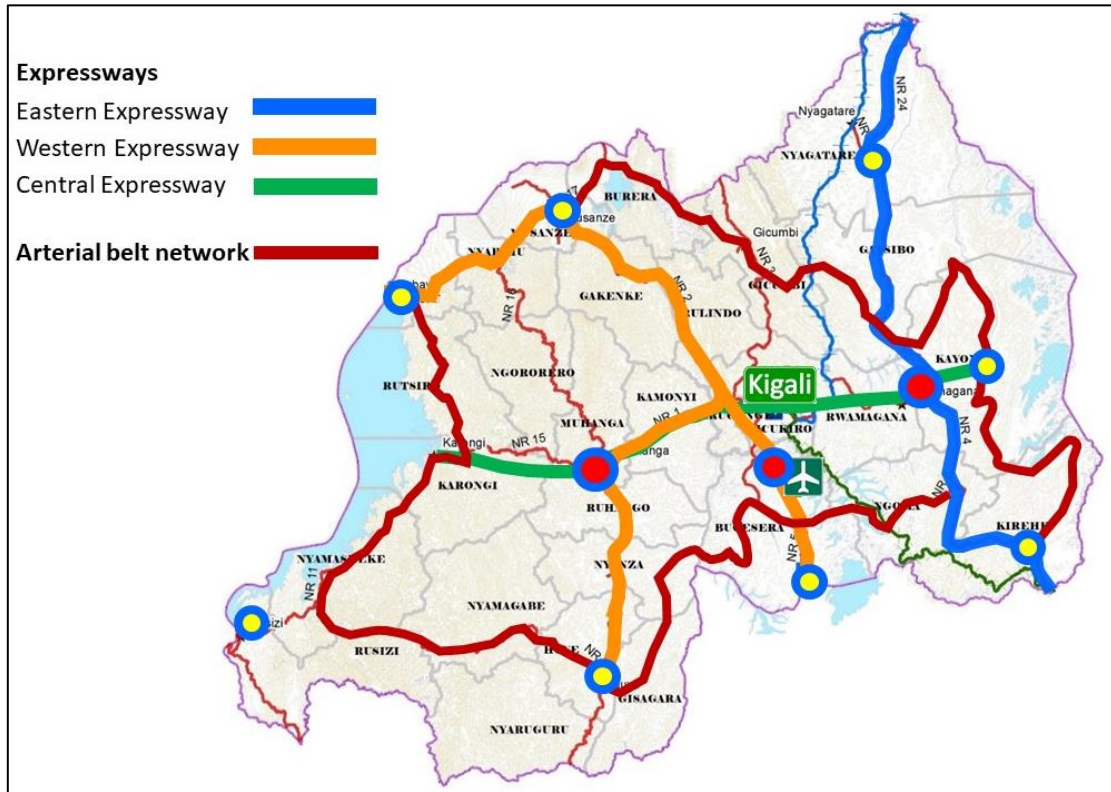
Figure 11-4 Alignment of Arterial Roads – in sepia color

Feeding Road System

The feeding system should comprise predominantly district roads segregated into collectors and local/neighborhood roads as per the hierarchy of coverage. These roads connect the last mile through district roads feeding the national expressways and belt road system. Besides, the feeding road system will play a significant role in connecting to the railway system and ports, thus providing an integrated multi-modal transport.

This system will open up commercial and service opportunities for rural areas that make farming production a more profitable business. The roads connect the last consumer to the producer focusing on providing all-season mobility to production use areas not limited to farms, mining concessions and manufacturing zones.

In urban areas, the arterials system enables to reduce congestion and improve public transport and safety. The connectivity should start with neighborhood roads through the different hierarchy of district roads then connects to national highways.

The roads should be paved to promote qualitative livelihood in urban areas. Also, the design of the roads should take into consideration promoting trade and safety of no motorized mobility. It is very

important that the development of the urban feeder system be guided by settlement patterns to optimize the investment through integrated land use, promoting less travel time.

The buffer for the arterial, district, and local roads system should be 44 m, while 24 m should be used to the other road types. Within buffer zones of roads, agriculture practices and forestry should be allowed but new hard structures and buildings should be restricted with special considerations to be given within settlements.

11.2   Dry Ports

Rwanda is a landlocked country with no coastline or maritime claims. It, therefore, relies on the ports of Mombasa in Kenya and Dar es Salaam in Tanzania for most of its imports and exports. One key priority for the GoR is to operationalize the Kigali Logistics Platform, bonded warehouses, and work with the private sector to develop international transport and logistics companies.

A dry port is an inland terminal directly connected to a seaport providing services for handling, temporary storage, inspection and customs clearance for international trade.

A dry inland port can speed the flow of cargo between ships and major land transportation networks, creating a more central distribution point. Inland dry ports can improve the movement of imports and exports, moving the time-consuming sorting and processing of containers inland, away from congested seaports.

Efficient dry ports are those that are located on quick land transportation infrastructure, especially those which supply international connectivity like expressways, cargo trains, airports, and waterways.   The multi-modal transportation in this plan supports the development of dry ports by providing a variety of opportunities for optimal locations.

11.3   Railways

Railways are a driving force for economic development, especially for landlocked countries such as Rwanda, where import and export use land transport to reach the seaports. At present, there are no railway lines – whether those linking different parts of Rwanda or those relating Rwanda with neighboring countries. GoR is committed to connecting Rwanda to the region, and significant efforts were made with partner states on a joint implementation framework. Railways remain the key infrastructure pillar as approved by EAC Head of States in 2013.

Two regional railways are currently in the pipeline (Figure 11-5):

- Dar es Salaam – Isaka - Kigali with 139Km from Rusumo to Kigali passing Kirehe, Ngoma, Bugesera to Kigali with a branch line to the airport in Bugesera.
- Mombasa-Nairobi-Kampala-Kigali with 148Km from Kagitumba (Mirama Hills) passing along Muvumba River before reaching Ngarama - Nyagahanga, crossing Lake Muhazi to Nyagasambu and Kigali.
- Kigali-Muhanga-Rubavu-Goma/DRC, a line of 150Km length, which is at the conception phase.

There is also a plan to expand regional railway connectivity to connect Rwanda with DRC via Goma. This plan is not yet in the implementation pipeline.
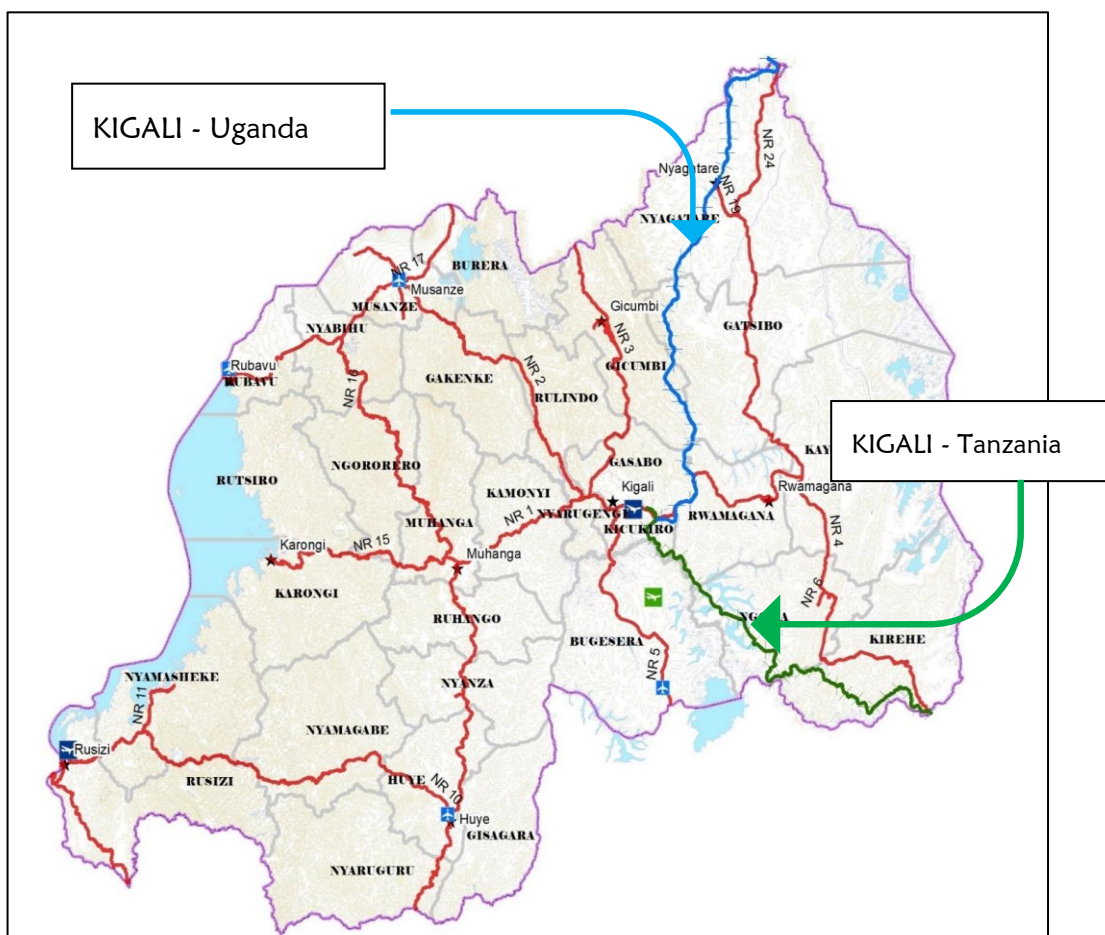
Figure 11-5 A section of the approved alignment of Kampala-Kigali-Tanzania trajectory

NLUDMP Upgrading Concepts

Following transport aspirations by 2050, this master plan proposes in additional to the current two regional railway corridor Eastern line in red, two other lines (Fig. 12-6):

- A Western line is suggested, connecting Kigali–Muhanga, and then to Rubavu and Goma in DRC. The color is Purple
- The Upper-Central line in Black is a local line from Kigali to Muhanga. This East-West line is a connector between the two North-South lines tying all growth poles to each other.
- The Eastern as mentioned before is showed in red
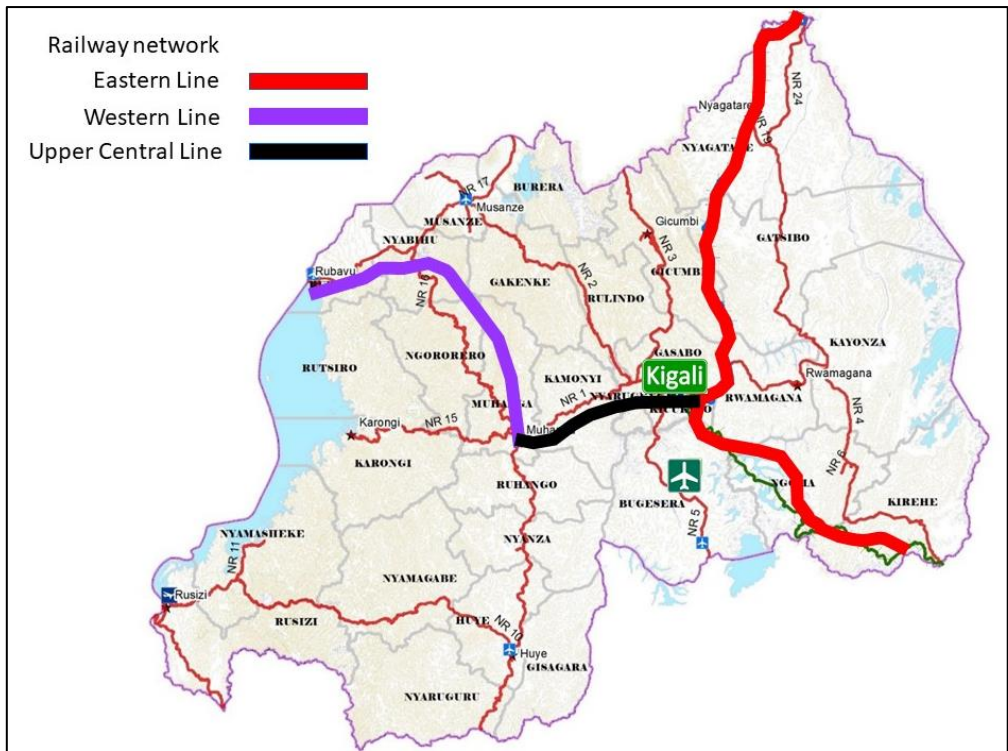
Figure 11-6 Railway lines

The whole picture of land transportation infrastructure –expressways, arterial roads, and railways, is summarized in the Juxtaposition of Railways and roads in Fig. 12-7
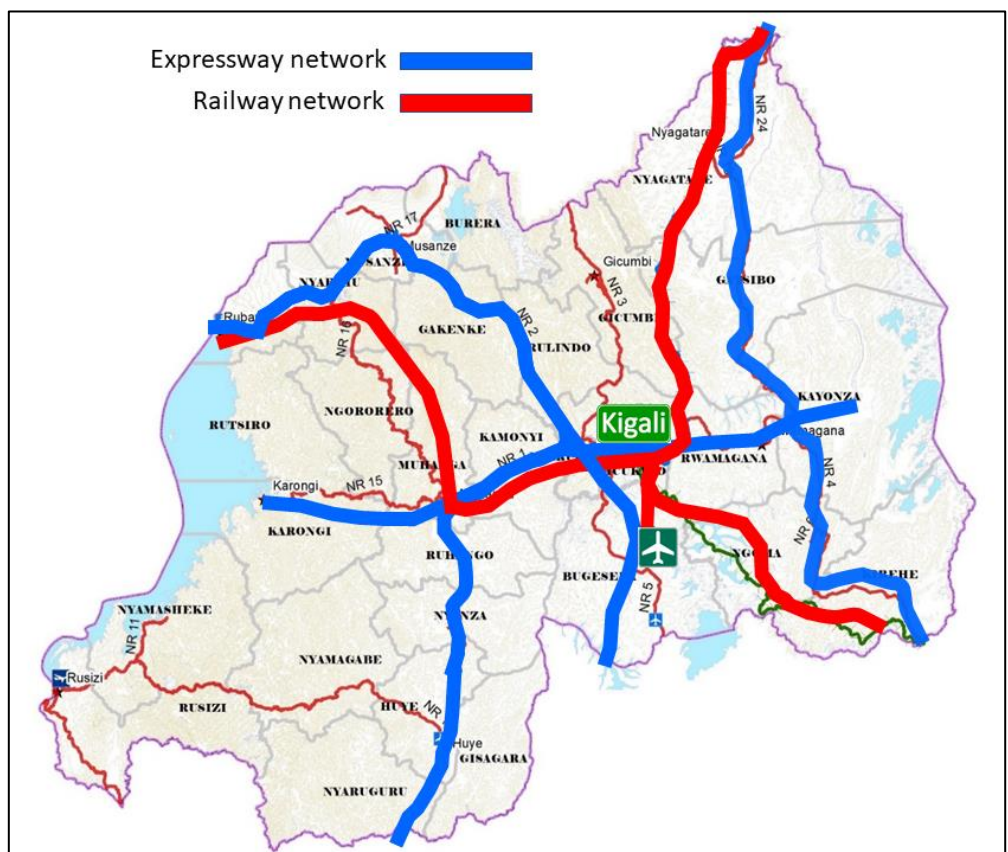
Figure 11-7 Juxtaposition of the Railway and roads 2050

11.4   Water Transportation

Inland Water Transportation refers to the use of inland water bodies to move people or goods from one place to another using boat, canoes, and ferries.

Water transport is a vital part of the multimodal transport concept. The railway will soon reach Mwanza and Kisumu. The navigability of Akagera will considerably reduce the transport cost as cargo to and from Rwanda will be transported through Akagera then railway towards the Indian Ocean as another cargo transport alternative.   Hence, inland water transportation in Rwanda remains undeveloped mainly due to the nature of the water bodies and limited infrastructures to support the operation. However, Inland water transport has the advantage of being cheap, energy-efficient, relatively safe, and environmentally friendly. Also, water transport contributes to the diversification of tourism attractions and is a cross-border trade and logistic alternative.

To fully exploit Rwandan water bodies in line with transportation, Rwanda has started investing in studies and construction of ports on Lake Kivu. The navigability of Akagera River connecting Rwanda to Lake Victoria was assessed.

For the lake Kivu transport project, eight ports (Rusizi, Karongi, Rubavu, Nkora, Nyamirundi, Nkombo, Kirambo, and Rugali) were identified in five districts. Financing for the construction of four is fixed for operation in 2022.

Currently, water transport on Lake Kivu is the only meaningful water transportation of passengers and goods. Tourists and passengers visiting hotels situated on Kivu Belt as well as leading brewery in the Country (Bralirwa) and a cement factory, all use the Lake Kivu for transport and leisure along the lake. The navigability of the Akagera River was studied in 2009. The study specifically investigated navigability from Kagitumba to Lake Victoria, with the conviction that river transport can interface with lake transport, linking Rwanda to Kenya, Tanzania, and Uganda. Preliminary findings demonstrated technical feasibility for navigation with some engineering works. In addition, integrated regional logistics is essential to justify the investment. It is envisaged to construct a port at Kagitumba as the point of entry for Rwanda.

Even though investment has started in Lake Kivu and Akagera river, other lakes and rivers are being explored too: Muhazi, Ruhondo, Rweru, Sake, Mugesera, Nyabarongo and Rusizi rivers. The land required for ports is estimated to 2 ha each, thus as a start, eight ports will be developed on lake Kivu and one more in Akagera river.

11.5   Air Transportation

Air transport is the fastest mode of transportation. It is best suited for long-distance movement of passengers, perishable products, and high-value, low-volume/low-weight products. The main cargo commodity in the region (River Nile basin region) transported by air includes fish, cut flowers, fresh fruits and vegetables, and precious metals.

Kigali International Airport (KIA) is presently the primary airport serving Kigali and the central air gateway to all destinations in the country. It serves as a transit airport for Goma and Bukavu in the Eastern Democratic Republic of Congo and other international destinations.

Rwanda's airports have, over the years, received a consistent annual passenger traffic growth rate of 13%, and this denotes the need to consider the expansion of the airport facilities. GoR has started to

enter into shareholding agreements with other internationally highly recognized air services providers to invest in modern air transport infrastructure.

The air transport in Africa is expected to grow more rapidly following the signature of international agreements such African Continental Free Trade Area (AfCFTA) and Single African Air Transport Market (SAATM), thus the need to develop modern air transport infrastructure. The air transport infrastructure consists of international airports and airfields, whose current situation and plans are mentioned in the following sections.

Regional and International Airports:

The Kigali International Airport, sometimes referred to as Kanombe International Airport, is located on the outskirts of Kanombe, southeast of Kigali, about 10 km from the Central Business District of the Rwandan capital. Kigali International Airport has three terminals (the terminal building, passenger terminal and cargo terminal) and two heliports. It can handle a capacity of 1.5 million passengers per year. The airport has a 3500m x 60m runway and occupies 259 Ha.

The Bugesera International Airport (BIA):

The state-of-art airport is planned to be developed 27Km from Kigali, having an immediate capacity of 7 million passengers per year, expanding to 14 million passengers per year by 2032. The airport envisages being developed in 1600 Ha and be the hub for regional and international air transport.

Kamembe regional Airport, with a runway of 1630m, has been upgraded to meet international standards for the satisfaction of commuters and other air transport users. The airport is constructed on 70 ha and serves flights from Kigali linked to various national carrier connections.

Other airfields and helipads: There are more five airfields (Table 12-4), namely Huye, Rubavu, Gabiro, and Musanze, designed to support internal air mobility. The airport at Nemba is planned to be upgraded for training academy purposes. These airfields occupy a total area of 45 ha.

Airport	Infrastructure	Length - m	Area - Ha
Kigali	Paved	4,800	259.00
Huye	Paved	930	26.30
Gabiro	Unpaved	800	20.00
Rubavu	Paved	1,070	50.70
Kamembe	Paved	1,630	70.30
Nemba	Unpaved	1,200	44.80
Musanze	Unpaved	1,600	17.60
Total ex. KIA		**7,230**	**229.40**

Table 11-4 Airports and airfields in Rwanda as of 2019 to be modernized by 2050

11.6 Land Allocations for Transport Infrastructure

Land transportation

The following areas are needed to reserve land for transport infrastructures:

- **Railways** with a total length of **505km** (Western Line 115km, Eastern Line 265km, Upper Central Line 125 km).
- **Arterial Roads** length is **805 km,** and **Expressways** range is **730km** (Western Line 335 km, Eastern Line 208km, Central Line 187km).
- **13,650** km **of District road** is taken from the current situation, assuming that modern standards will pave them.
- **The length of local feeders is also calculated, accumulating to 22K km.**
- **The total length of the land transportation network is 37,185 km of roads + 505 km of railways.**
- Land use areas for each component are calculated by multiplying the planned length by the proposed right of way, according to Table 12-5.
- The land needs for the full land transportation system is 821 **Km².**

Type		Length of parts km	Total length km	Right of way	Km²
Arterial belt network (widened)			805	22x2	**35**
Expressways (new)	Western Express	335	730	30x2	**44**
	Eastern Express	208			
	Central Express	187			
Railways (new)	Western Line	115	505	30x2	**30**
	Eastern Line	265			
	Upper Central Line	125			
District Roads (upgraded)	District 1	13,650		12x2	**273**
	District2				
Other roads	Feeders	22,000		12x2	**440**
Total roads		37,185			**821**

Table 11-5 Area size requirements for roads and railways

Air transportation

The size of the Kigali new airport is 16 km². The rest six airfields have a total length of 7230 m, a rate of 3.3 km² per 1000m. The length of the runway is required for planning purposes, so the allocated area for the airfields will be 24 km², and together with Kigali, it would amount to 40 km².

Water transportation

The land needed for nine lakeports is around 2/3km² per each port, altogether six km².

Hence, the land need for the entire transportation infrastructure is **867 km².**

12. Tourism

Tourism is considered one of the vital sectors that are significantly contributing to the socio-economic development of the country through revenues generated by the industry in Rwanda.

The Economic Development and Poverty Reduction Strategy II (EDPRSII 2013- 18), the National Tourism Policy and Strategy (2009), and the Sustainable Tourism Master Plan (2009, revised in 2014) complete the strategic tourism planning framework for the nation that guides this report. The Tourism Sector is a significant contributor to national economic drive to achieve Rwanda's Vision 2020, NST1, SDG's 2030 and Vision 2050. It is recognized as an essential economic sector with the potential to boost domestic economic growth and development, contribute to poverty reduction, job creation, export growth, and prosperity through revenues generated from the tourism industry. This is because the tourism sector can generate much-needed revenues as the country's largest source of foreign exchange with reported receipts of US$438 million in 2017 and expected to generate over US$800 million by 2024, according to figures and estimates provided by Rwanda Development Board (RDB, 2018) and NST1 projections.

The tourism strategy estimates that, on average, an independent traveller spends an average of US$1,760 in Rwanda, while travellers on pre-paid packages, on average, spend over US$3,260. It translates into an average of 5 days spent in Rwanda by leisure tourists (RDB, 2018). Therefore, to increase tourism revenues, the Rwanda Development Board targets to increase the length of stay in Rwanda from five to nine days, by giving tourists many alternatives and choices of destinations and attractions. As for the duration of stay increases, it is projected that the tourist spending will also increase, making it possible to achieve the NST1 set target of US $800 million by 2024. To achieve this target, the Government of Rwanda has come up with critical initiatives to revitalize and develop the tourism sector, fast-track tourism investments in critical areas, attract strategic tourism investors and partners in the tourism industry.

Notably, Rwanda's tourism industry contributed up to 30% of Rwanda exports and 5% of GDP (RDB, 2017). This tourism contribution translates into economic wealth and employment for the citizens, and is a major driving force for infrastructure development, from hotels to restaurants, conference facilities, and entertainment venues. Furthermore, the economic benefits accrued from the tourism include contributing to the enhancement of related services such as accommodation services, food and beverages, retail trade-in souvenirs and transport services, all of which offer local populations opportunities to benefit from tourism growth and development directly.

Based on these visible economic benefits of tourism, the Government of Rwanda (GoR) has invested more resources through RDB, the government agency charged with promoting and developing the tourism sector to market Rwanda through various campaigns in a bid to attract more high-end visitors who can stay longer and spend more money in the economy. Strategic campaigns such as Visit Rwanda, Arsenal, and PSG sponsorship deals are aimed at luring more people to Rwanda and increasing its competitiveness.

More to this, the GoR has invested heavily in air transportation (Rwandair) to ease the connectivity from major tourist destinations, especially main hubs (London, Brussels, Mumbai, and Guangzhou), as well as a connecting destination for South, East, and Central Africa. Rwandair plans to open new routes to major hubs such as New York and has already started flying to Tel Aviv.

To complement the leisure tourism, the GoR invested in the building of the Kigali Convention Centre intending to create new tourism segments such as MICE (Meetings, Incentives, Conferences, and Exhibitions) to attract business tourists to Rwanda as well as international events and conferences. The adoption of the MICE strategy is aimed at transforming Rwanda into a major hub for regional and international conferences on the African Continent. This strategy has started to attract new businesses and complementary products, which are already boosting the tourism industry.

Rwanda's Vision 2050 articulates the long-term vision for the "Rwanda we want" and the enabling pathways to achieve this ambition. Tourism under the service sector will continue to play a significant role in direct and indirect contributions to Rwanda's GDP. Rwanda will endeavor to attract investors to diversify its current high-end tourism offerings with a strategy anchored on high-end sustainable tourism. Continuous efforts will be channelled towards diversification and leveraging on both comparative and competitive advantages of the country.

12.1 Contribution of Tourism

The direct contribution of the tourism industry to GDP in 2018 was 5.7% compared to 5.2% to Rwf 383.0 billion (US$ 463.6 million) in 2017. From 2018-2028 it was expected to contribute 6.1% per annum: over RWF 1731.6bn (US$ 885.5 million), 5.0% of total Rwanda's GDP in 2028 (WTTC, 2018). Equally, Rwanda's tourism industry's direct contribution to employment rose to 135,828 (2.9%) compared to 132,000 jobs generated in 2017. Tourism employment is expected to increase by 4.2% annually, creating over 181,000 jobs in 2028 (WTTC, 2018).

Tourism has been Rwanda's largest foreign exchange earner for over a decade and has continued to grow at an average rate of over 10% per year. The indirect contribution of tourism to Rwanda's GDP rose by 6.8% from 6.2%, RWF 933.5 billion (US$ 1,129.9 million) in 2018. The industry is projected to increase significantly to 12.5% of Rwanda's GDP in 2028 (WTTC, 2018). In total, the tourism industry's contribution to employment indirectly grew by 3.9% (346,500 jobs) compared to 333,500 jobs in 2017. It is expected to rise significantly at 3.1% per annum, generating 469,000 jobs by 2028 (WTTC, 2018).

12.2 Tourism Programs

Some assumptions have been made in planning the future of tourism segments that will drive the tourism sector and contribute to the overall national GDP of Rwanda. Understanding what will be the best competitive products and services that will underpin the industry based on current segments and the plans for growth and development for Rwanda. Total Tourism Contribution will be expected to be 20% based on the overall country's GDP of 274,472 Billion US Dollars (WTTC, 2018), with the direct contribution being 10% accounting for 27,447 Billion US Dollars (Table 13-1). It is projected that to achieve this target; tourism will grow at around a 4% rate per year from the current 1.2% growth rate per annum. Share of Tourism GDP, the percentage of Tourism GDP per market segments, and the share by national parks.

Years	GDP Worth	GDP Per Capita
2018	9.509 Billion US Dollars (World Bank, 2019)	791 USD
2050	274,472 Billion US Dollars	12,000 USD

Table 12-1 Share of Tourism in the GDP

Based on the 2050 Rwanda's Vision, the new tourism segments that will shape the future of the tourism industry shall include MICE, Medical, Education, Water-based, Adventure, and Religious tourism. The projected 2050 contribution of each tourism segment is shown in table Table 13-2.

Tourism Segments	Expected total GPD Contribution (%)	International	Domestic
Meetings, Incentives, Conference & Exhibition (MICE)	25%	20%	5%
Wildlife	20%	12%	8%
Cultural and Historical	15%	5%	10%
Religious	7%	3%	4%
Medical	5%	5%	-
Educational	3%	3%	-
Adventure	10%	8%	2%
Water-Based Tourism	15%	8%	7%

Table 12-2 Share of Tourism Segments 2050

12.3 Tourism Investment Areas

In line with RDB's vision to diversify the tourism sector, all provinces based on their respective masterplans or strategies would be required to develop tourism attractions and sites as well as encourage investments in areas beyond the current tourism hotspots. The current Destination Management Areas (DMAs), as defined and demarcated by RDB will play a significant role in the future of tourism development in Rwanda. Each DMA's development plan should take into account specific distribution and allocations to suit the purpose of its intended objectives. Based on the 2050 Rwanda's Vision, new tourism segments will shape the future of the tourism industry, mainly sport, medical, education, water-based, urban, and adventure tourism. These segments reflect Rwanda's aspirations of becoming a high-value tourism destination hub through diversification. Even though some of these segments may not necessarily be land-based.

They will need to be integrated into future tourism development due to demographic changes and local needs. The development of these segments will require planning, spatial allocation, as well as strategic linkages to other socio-economic development plans of Rwanda. Most importantly, Kigali City and all the Satellite and secondary cities in Rwanda will be compelled to allocate some of those

segments in their programs. They will also be required to create green space for recreation and leisure activities. Tourism potentiality in Rwanda will even lie in how the destination will continue to evolve in terms of innovative products and tourism services, new infrastructure that will support tourism growth (amusement parks, sports facilities, and community halls). Growing secondary cities will present some great opportunities for business related to tourism as each city will be an integrated hub for diverse tourism activities as well as products. Below each province is highlighted based on their strongest tourist, cultural, and heritage areas to be developed in the course of the next few years. It is known that not all lakes or waterways will be suitable for tourism activities. Some areas of interest for tourism development will be subject to several factors such as environmental impact assessment, accessibility, and compatibility with other economic activities of Rwanda. Key tourism zones like national parks, islands and Tourism strategic lands around lakes and high-end zones for hotels and leisure will take **3,525 Km² (13% of country surface)**.

Table 13.3 below shows the land size of tourism areas for 2050 and Figures 13-1 to 13-4 the schemes of the Tourism Investment Areas.

Resources		Total Area (size)
National Parks (Akagera, Volcanoes, Nyungwe and Gishwati Mukura)		2611 Km²
Lakes Islands		16 Km²
Eco-tourism land around lakes		886 Km²
Functions	Tourist parcels outside national parks, allocated for tourism development.	**12 Km²**

Table 12-3 land size of tourism areas for 2050
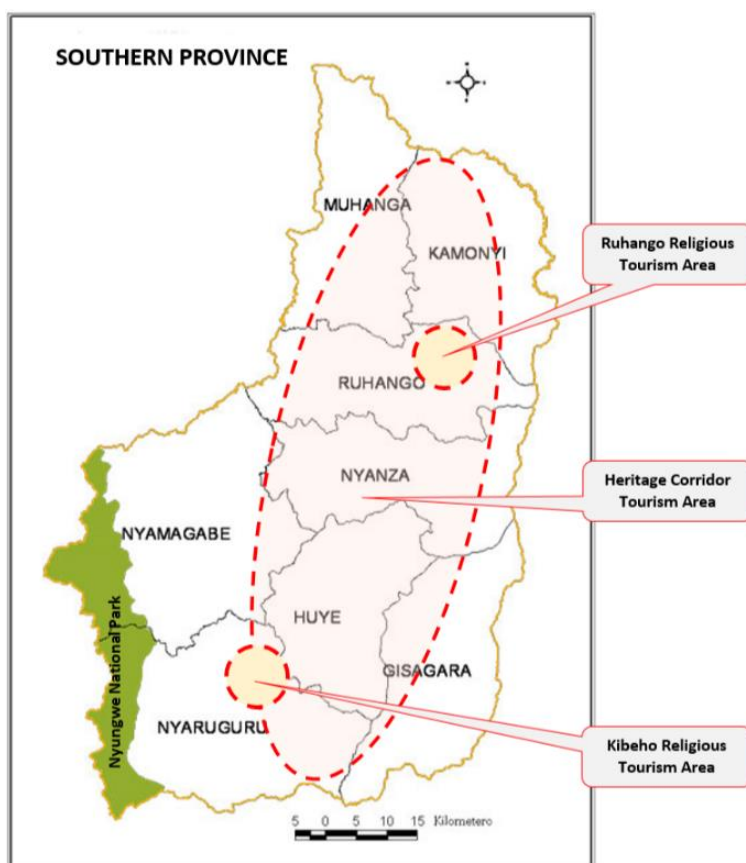
Figure 12-1 Southern Province Tourism Investment Areas
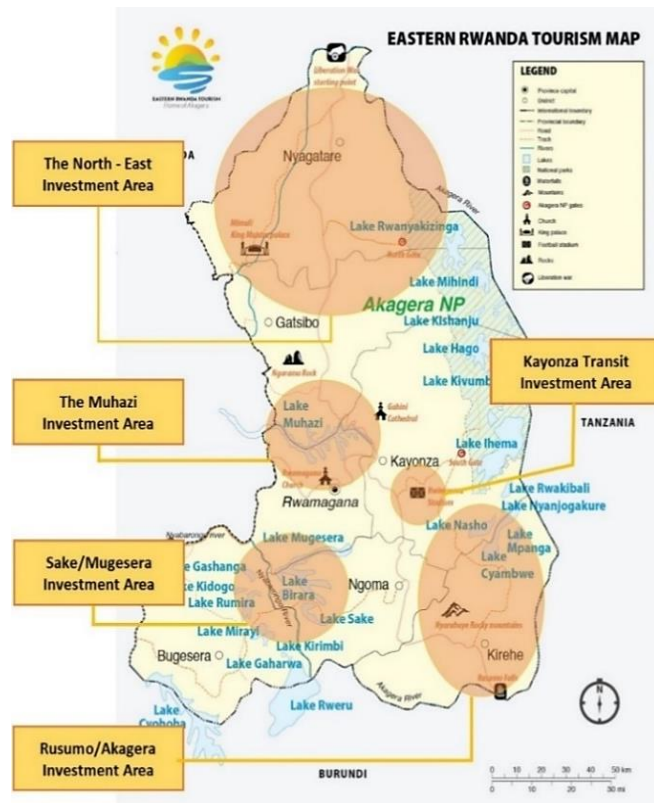
Figure 12-2 Eastern Province Tourism Investment Areas
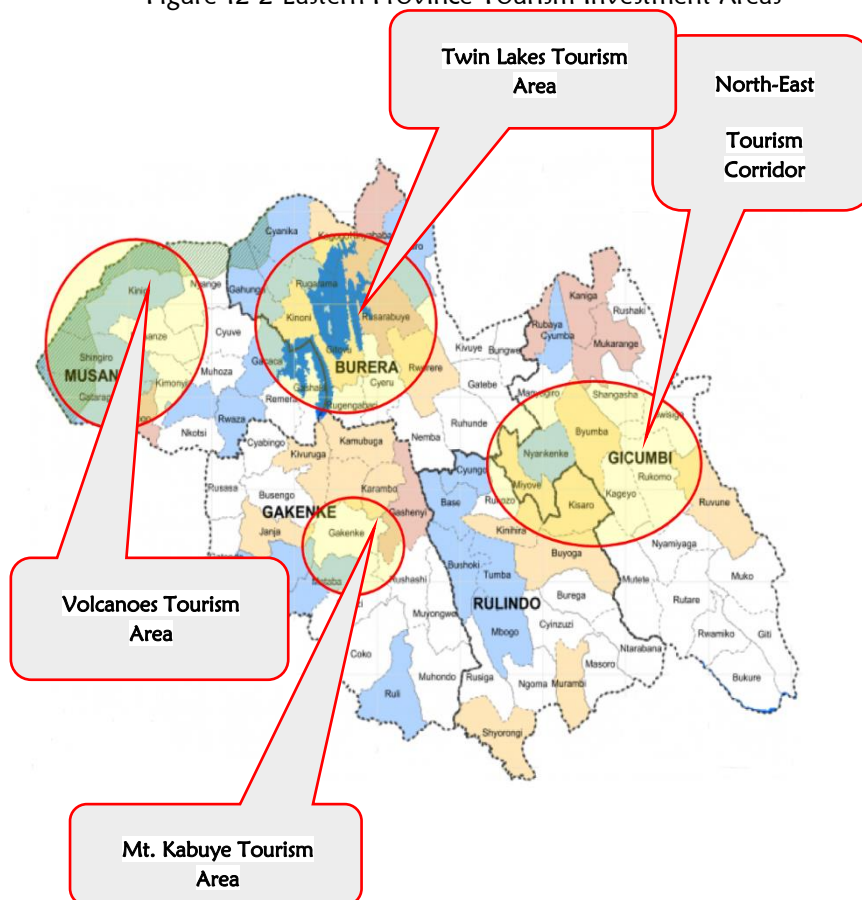
Figure 12-3 Northern Province Tourism Investment Area (2019)
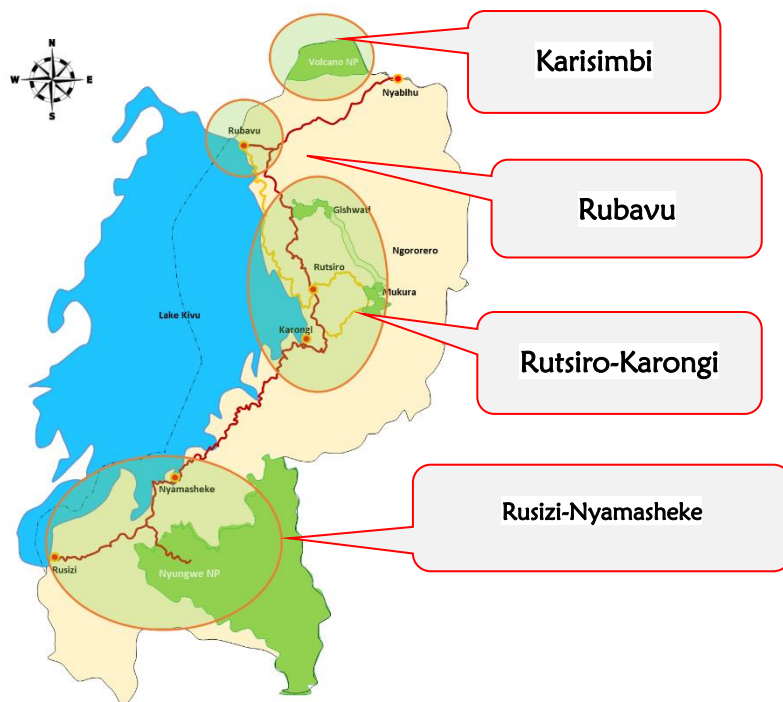
Figure 12-4 Western Province Tourism Investment Area (2019)

12.4 Competition for Tourism Land Allocation

Two key sectors will present considerable threats to tourism development, and it is worth highlighting that for land allocation, the government will need to signal the pace of growth for the tourism sector to determine how developers and investors should develop the industry.

Nature ecological Intensification:

For tourism purposes, a knowledge-based intensive process that will require optimal management of nature's ecological functions and biodiversity must be applied. This concept is borrowed from agriculture, and one can see how this can be applied to tourism. For instance, in some protected areas, one can ascertain how the diversity of forest types and management could be utilized to supplement the needs of, for example, wood or other non-wood forest products. Diversified forests could significantly strengthen the needs of agriculture. In the case of Rwanda, high levels of plant diversity could be associated with higher diversity in terms of birds, small mammals, which could supplement the needs of the growing population of Rwandan by 2050.

Human settlement and urbanization:

Can growth be green and sustainable? In the case of tourism and human settlement as well as urbanization in Rwanda, adverse negative environmental impacts have to be considered. Tourism is an essential sector for implementing growth strategies, advocating for qualitative development. However, in the next few decades, as much as there is going to be a significant increase in the number of people living in cities, one needs to question also what will be the sustainable limits. We propose

that for tourism and conservation for Rwanda, one explores the "right-sizing" notion, slow steady, back to nature, the eco-friendly, small-scale controlled solution to tourism challenges of tomorrow. Therefore, we propose:

"Rwanda should create an ultimate destination where human relations are the focal point for tourism development and a basis for socio-economic development and interactions among the citizens. A destination, where locals and visitors not only co-exist but interact around shared experiences of the local hood."

Beyond bed-nights, headcounts, and tourism revenues, new metrics should be applied in measuring the industry's value (economic, social, and environmental) in Rwanda. Each of the destination management areas should be planned in synergies within the framework of the development of Rwanda. The vision ought to be local-focused and centered with value addition to their communities. Human settlement and urbanization will happen in and around key tourism attractions, and land allocation will need to reflect that aspect of locals as well.

12.5 Conclusion

In planning what the future of the tourism sector will be by 2050, one has to appreciate the complexity of the tourism sector in its entirety. In Rwanda, the tourism sector will be a mixture of public and private resources that will create synergies to drive the industry. Like many other emerging tourism decisions, Rwanda sits squarely at the right place to plan land allocation guided by its strategic vision and ambitions. Key elements that will be around the key corridors to be developed Kigali City, Satellites cities (Bugesera, Muhanga and Rwamagana) and eight secondary/peripheral cities – Rubavu, Nyagatare, Rusizi, Huye, Muhanga, Karongi, Kirehe, and Kayonza. Public investments will be required to provide infrastructure such as water supply, distribution of electric power, roads and airports, these are considered prerequisites. Products to be developed around some key tourism hot spots will require special attention in terms of investing in these necessary infrastructures that will have a direct impact on private investment in infrastructures such as hotels, restaurants, cafes as well as attraction and recreations facilities.

Rwanda tourism priorities that will drive Vision 2050 should be anchored around these key areas:
- Very well focused **Nature Tourism and eco-tourism.**
- **Complimentary destination** to Kenya and Tanzania (in products and services – education and medical).
- Regional & World **Leisure tourism** (sport and water-based activities).
- **Domestic Leisure market** based on the growth of population & purchasing power
- **MICE tourism** (international conferences, events, and exhibitions}, based on Infrastructure credibility, good governess & business growth.
- **Cultural heritage tourism including heritage museums, local art centers, memorial sites, and open-air heritage sites.** For this reason, it is important to enforce the Protection of view on landscape (some construction may hide views on beautiful natural or artificial features: lakes, rivers, valleys, mountains, volcanoes, magnificent bridges or construction) as well as the heritage protection of monuments and historic sites must be protected from destruction.
- Excellence in hospitality and service (World-class skills and competences).

13. Public Services

Summary of developmental measures

Public services and utilities will improve when people move from where they are today to agglomerations where utilities are centralized. Provision of utilities to sprawled hamlets must be eliminated. Utilities will be supplied to consolidated settlements: 1,500 MW power, Access to water will be scaled up to all in planned settlements, Water supply systems in rural areas and daily water production capacity shall be increased from 182,120 to 303,120 m3/day

Health Facilities by 2050

- Community health will be organized in clustered rural settlements sites.
- Health posts (0,06ha each): 3000 for future proposed imidugudu (496 in 2019)
- Health centers (0.2Ha each): 2 / sector =832 (499 in 2019)
- District hospitals (2Ha each): 2 / district = 60 (36 in 2019)
- Provincial Hospital (3Ha each): 2 per province=8 (4 in 2019)
- Referral hospitals (4Ha): 10
- Any new health facility to be built within urban and rural settlement boundaries and vertical construction of buildings should be mandatory.

Primary education by 2050

- Average class size: 35 pupils/class (77 pupils/class in 2018)
- Average school size: 840 pupils (861 pupils in 2018)
- Classrooms: 90,150 (32,548 pupils in 2018)
- Schools: 3,756 schools (2,909 schools in 2018)
- Required size for a nursery school: 0.5Ha
- Required size for a primary school: 1Ha

Secondary education will be reformed in quality and quantity.

- Enrolment rate will be: 90 % (39.3% in 2018)
- Average class size: 35 pupils/class
- Average school size: 840 pupils (381 pupils in 2018)
- Classrooms: 109,576 (17,972 Classrooms in 2018)
- Schools: 4,566 schools (1,728 schools in 2018)
- Required size for a secondary school: 1.5Ha
- Required size for vocational and technical school: 2Ha

The total number of classrooms will increase four times from 50,500 to 199,726. The total number of schools will only double from 4637 in 2019 to 8,322 by 2050. As a result, existing schools will have to expand vastly, and vertical construction of school buildings is required. Constructions can be developed incrementally according to the means available but, each phase shall look as a complete building.

Any new school will be built within urban and rural settlement boundaries. Every school is mandated to have sports playgrounds.

Note that required size for higher education and universities is 3Ha. Land allocation for all types of education facilities is 9,014Ha.

All public services have been regarded as secondary land uses due to their location within Prime Land Uses, like cities and other settlements. Land demand for these functions is already included in the Gross area of settlements in the balance sheet. This principle is beyond the simple definition: It is within the boundaries of settlements. Every school or another public facility must be located in a planned site according to a local plan. Random locations act against the principles of agglomeration. Every utility such as electricity, water, and ICT, which is developed in a city, is a pull factor for urbanization. Efforts must be made to encourage people to move from where they are today in a scattered mode to agglomerations where utilities are centralized. The current habit of bringing services and utilities to sprawled hamlets or establishments must come to an end.

In the allocation of spaces for settlements, either urban, rural, or rurban, the rate for public areas is according to professional norms. Residential densities include beyond dwelling also local facilities and services. The proportion between the housing lots and the entire area of a neighborhood is 2.0-2.5, ensuring enough space for roads, public amenities and services such as schools, health, administration, cultural and religious facilities, cemeteries, infrastructure utilities, sports and recreational facilities, urban farming, urban forestry and landscapping, and open spaces, etc. The same multiplier applies to the proportion between the residential areas and the entire city area. This secure multiplier public uses in city levels like high schools, universities, hospitals, industry, commerce, main roads, and open spaces for the general public. Hence, this multiplier is a fundamental guideline in NLUDMP, which all land-use planning must adopt.

The NLUDMP has also taken into account the existing challenges of **the large allocation of land to cemeteries and this remains a serious challenge even in the future.** Thus, the NLUDMP proposes that, according to the law, reuse of land from cemeteries to other economic activities be emphasized and at the same time plan to re-shape the future national legal system to accommodate and enforce cremation or incineration practices. It is absolutely necessary to develop strategies and technologies in funeral services to ensure efficient use of land.

13.1 Administrative Transformation

1. A significant change from a five-level hierarchy in 2020 to a four-level Hierarchy in 2025 is suggested. The "Village" becomes redundant due to the decreased number of Imidugudu and the increased size of the settlement itself. The administrative cell will take over the functions of the administrative village.
2. The current and the future service level hierarchy will be affected and changed accordingly, as presented below (Table 13-1, 13-2):

2020 4 Levels Hierarchy	Provinces	Districts	Sectors	Cells	Villages
Total 2020	5	30	416	2,148	14,837
Population/level-average (Total 12,724,327)		424,144	30,587	5924	857
Elements/ level		14 sectors	5.16 cells	6.9 villages	1
Average area/level-average		82,670 Ha	5962 Ha	1,155 Ha	167 Ha

Table 13-1 Current administrative Hierarchy

2025 3 Levels Hierarchy	5 Provinces		
	Districts	Sectors	Cells
12,724,327 people	24,801 km² of dry land		
Total 2050	30	416	2,148
Average Population	424,144	30,587	5,924
Elements / level	14 sectors	5.16 cells	1
Average area/ level	82,670 Ha	5962 Ha	1,155 Ha

Table 13-2 2025 Administrative three levels of Hierarchy

13.2 Service Levels

The constitution assigns executive powers to local government over services, often implemented in partnership with other government and non-government agencies. Only essential and primary services in health and education are within the responsibility of local organs.

- **Administrative services:** Environmental management, Social protection, Civil status register, Local economic promotion, Municipal planning, building regulations, Involvement of community organizations in matters of local government, local economic development, and tourism. Housing construction permits, Environmental protection.

- **Infrastructure services:** Rural electrification, Water, sewage, and sanitation services. Rural road construction and transport.

- **Public services:** Health services, Primary and Secondary education, Police, Cemeteries, Crematoria, sports and recreational facilities and religious facilities. It also included: Public works and transport.

14.   Education Facilities and Infrastructure

The education level, in Rwanda, remains low despite the policies such as mandatory education for primary schools (6 years) and secondary schools (6 years). An average Rwandan is expected to complete an average of 10.6 years of schooling. However, the mean number of years that a Rwandan spends on education is 3.3 years, which is much lower than the expectation. Some of the main challenges are: Limited enrolment, especially in Secondary school; Insufficient recruitment of teachers; Inadequate infrastructure; Inadequate qualification of teachers and instructional materials; The education system is not well-tailored to the labor market needs.

The 2050 perspective ensures access to quality education in the initial years of life through increased investments in early childhood development to achieve universal pre-primary enrolment rates by 2050 from 17.5% (2016). Access to quality primary education will be ensured too. All classes will reach middle-income standards for pupil- classroom and pupil-teacher ratios by 2035. Teachers will be empowered and equipped to deliver an education that provides all Rwandans with the capabilities to improve their skills and productivity continually.

NLUDMP is a spatial/land-use plan. Hence, its principal function is to identify land demands for the sector based on lessons from the current situation.

The crucial part of land and construction demands in education is in primary and secondary schools.

14.1   Primary schools

2,503,705 pupils attend the primary school system out of a population of 12,724,327 people, which is 19.7%. The percentage of the age group (six years 7-12) is only 14.3%, with a high enrolment rate of 98%. The difference is caused by the very high gross enrolment, which is 137.5%, meaning that 37.5% of the pupils stay in the primary school beyond six years, because of low achievements. This high volume fills up the classes to an average of 77 pupils. The number of classes per school is not more than two classes per year group. 2,909 Schools exist, but all of them are small, having 861 pupils each. The most problematic issue is the number of pupils per class, which is well known as the most harmful factor in learning and education. All the current data appear in Table 15-1.

The future size of the Primary system is spread in Table 15-2. It will be affected by population growth to 22.1M. The second factor is the gross enrolment ratio (GER), which should reduce to 100%, i.e. without pupils who stay with their age group for more than one year. Therefore, the number of pupils will be 14,3% of the population, resulting in 3,155,255 students.

District/ Province	Pop. 2018	schools	classrooms	Pupils	Classroom/ School	Pupils/ Classroom	Pupils/ School
Kigali city	1,370,550	239	3,020	203,680	13	67	852
South							
Gisagara	390,232	64	943	81,731	15	87	1277
Huye	397,362	99	966	66,590	10	69	673
Kamonyi	412,006	99	1,059	81,720	11	77	825
Muhanga	386,161	122	1,037	68,335	9	66	560
Nyamagabe	413,204	108	1,183	85,149	11	72	788
Nyanza	391,700	84	905	75,902	11	84	904
Nyaruguru	356,144	90	929	71,849	10	77	798
Ruhango	387,061	79	991	76,850	13	78	973
West							
Karongi	401,488	128	1,144	84,618	9	74	661
Ngororero	403,793	101	1,067	82,150	11	77	813
Nyabihu	356,635	92	941	71,916	10	76	782
Nyamasheke	461,983	139	1,258	94,303	9	75	678
Rubavu	488431	88	1,067	96,220	12	90	1093
Rusizi	485,038	121	1,227	94,763	10	77	783
Rutsiro	392,831	92	1,031	82,737	11	80	899
East							
Bugesera	437,916	102	,	95,475	12	80	936
Gatsibo	523,954	104	1,364	114,772	13	84	1104
Kayonza	416,430	89	1,053	88,598	12	84	995
Kirehe	411,845	65	1,065	102,947	16	97	1584
Ngoma	407,683	76	964	84,076	13	87	1106
Nyagatare	563,685	154	1,596	115,485	10	72	750
Rwamagana	379,288	74	995	82,035	13	82	1109
North							
Burera	407,264	93	1,162	85,578	12	74	920
Gakenke	409,263	118	1,061	73,187	9	69	620
Gicumbi	478,683	104	1,195	91,566	11	77	880
Musanze	445,603	95	1,238	87,456	13	71	921
Rulindo	348,094	90	890	64,017	10	72	711
Rwanda	12,724,327	2,909	32,548	2,503,705	11	77	861

Table 14-1 Primary Schools - Current situation

District	Pop 2050	schools	classrooms	GER 100%	Classrooms/School	Pupils/Classroom	Pupils/School
Kigali city	3,850,000	495	11,889	416,113	24	35	840
South							
Gisagara	450,000	82	1,958	68,545	24	35	840
Huye	750,000	109	2,612	91,407	24	35	840
Kamonyi	600,000	103	2,473	86,551	24	35	840
Muhanga	1,000,000	153	3,677	128,698	24	35	840
Nyamagabe	500,000	89	2,141	74,935	24	35	840
Nyanza	550,000	92	2,215	77,510	24	35	840
Nyaruguru	375,000	66	1,572	55,020	24	35	840
Ruhango	600,000	103	2,475	86,639	24	35	840
West					24		
Karongi	750,000	137	3,285	114,961	24	35	840
Ngororero	525,000	92	2,219	77,679	24	35	840
Nyabihu	600,000	105	2,514	87,993	24	35	840
Nyamasheke	550,000	97	2,333	81,651	24	35	840
Rubavu	550,000	94	2,251	78,799	24	35	840
Rusizi	47,000	80	1,928	67,492	24	35	840
Rutsiro	550,000	100	2,407	84,247	24	35	840
East							
Bugesera	1400,000	264	6,342	221,985	24	35	840
Gatsibo	750,000	142	3,414	119,482	24	35	840
Kayonza	900,000	166	3,979	139,259	24	35	840
Kirehe	525,000	114	2,727	95,441	24	35	840
Ngoma	550,000	98	2,357	82,492	24	35	840
Nyagatare	1,000,000	177	4,257	149,000	24	35	840
Rwamagana	1,350,000	253	6,067	212,354	24	0	840
North							
Burera	500,000	91	2,183	76,411	24	35	840
Gakenke	537,000	83	1,995	69,840	24	35	840
Gicumbi	587,000	97	2,333	81,662	24	35	840
Musanze	700,000	119	2,855	99,916	24	35	840
Rulindo	575,000	92	2,197	76,907	24	35	840
Rwanda	22,049,000	3,756	90,150	3,155,255	24	35	840

Table 14-2 Primary Schools - 2050

The number of schools and classes needed for this number is affected by two goals: one is the number of pupils per classroom which should not exceed 35. The second goal is the number of classes per school. A school of 24 classrooms is more efficient and economical. If these two parameters are achieved, then the size of the school in terms of the number of pupils will remain almost like today. The real situation will be much better, supporting better education and better achievement in the curriculum. The number of schools will be only 3,756, a 29% increase, while the population will increase by 73%. Hence, the significant change is not the number of schools but the number of classrooms which will triple, from 32,548 to 90,150. The land size needed for the entire system is 0.05 Ha per class, resulting in 90,150x0.05 = 4507 Hac. Net and 90 km² gross. The building area per classroom (with ennexed spaces) is 100 sq.m. and the total building volume in 2050 will be 90,150x100=9,015,000sq.m.

The service levels for Primary schools are summarized in Table 15-3.

2050 Hierarchy		District	Sector	Cell
22,049,000	24,801 km² of dry land			
Total 2050		30	416	2,148
Average Population		735,000	53,000	10,260
Elements / level		14 sectors	5.16 cells	1
Primary Schools-Average		120	08-Sep	2
Primary pupils-Average		105,000	7,500	1, 470

Table 14-3 The service levels for Primary schools

14.2 Secondary Schools

1,728 Secondary schools operated in 2018, containing 652,944 pupils. Enrolment was in 2018 39.3%, while admission is only 29.8%. The transition rate from lower to upper is 85.4%. However, still, the drop in recruitment from primary to secondary education is very high, as can be seen in Fg.16-1, especially at the age groups 16-18 years.

This fact is the reason for the depressing statistics showing that out of 12,724,327 people, only 658,285 pupils (5.2%) get an education in secondary school, a fact that indicates that the bridge for higher studies is so narrow. However, the physical conditions for those who enroll are better than in the primary system. This fact is caused by the relatively low numbers of pupils per class (37).
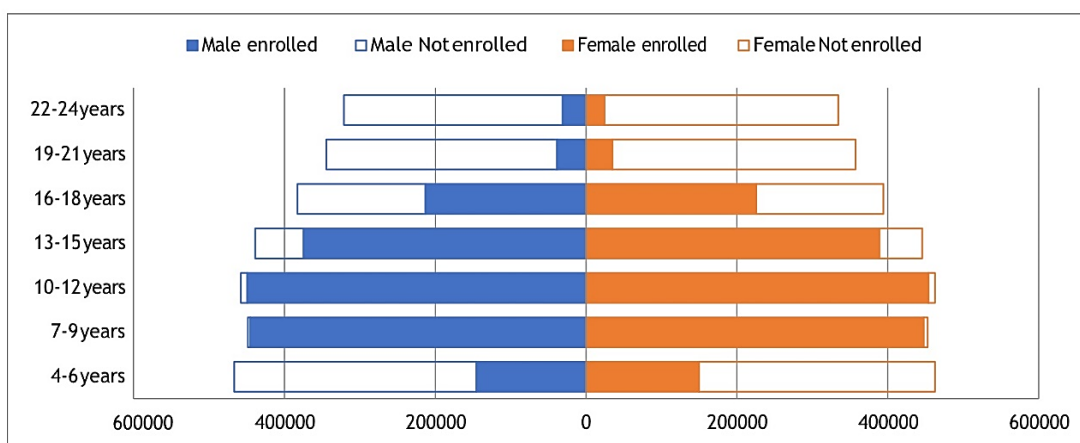
Figure 14-1 Enrollment Drop

All the current data of secondary schools appear in Table 16-4, and the future system is specified in Table 16-5.

District/Province	Population of 2018	schools	classrooms	Pupils	Classrooms /School	Pupils/ Classroom	Pupils/ School
Kigali city	1,370,550	143	1,613	60,997	11	38	427
South							
Gisagara	390,232	43	492	17,146	11	35	399
Huye	397,362	56	621	20,024	11	32	358
Kamonyi	412,006	59	585	23,100	10	39	392
Muhanga	38,6161	68	754	27,499	11	36	404
Nyamagabe	413,204	58	653	22,364	11	34	386
Nyanza	391,700	59	600	23,790	10	40	403
Nyaruguru	356,144	50	485	18,464	10	38	369
Ruhango	387,061	59	623	21,608	11	35	366
West							
Karongi	401,488	64	603	24,020	9	40	375
Ngororero	403,793	53	488	17,038	9	35	321
Nyabihu	356,635	44	503	18,689	11	37	425
Nyamasheke	461,983	64	675	28,185	11	42	440
Rubavu	488,431	64	653	24,905	10	38	389
Rusizi	485,038	69	707	26,514	10	38	384
Rutsiro	39,831	53	517	19,897	10	38	375
East							
Bugesera	437,916	50	579	18,918	12	33	378
Gatsibo	523,954	66	728	26,998	11	37	409
Kayonza	416,430	52	574	21,173	11	37	407
Kirehe	411,845	54	535	20,101	10	38	372
Ngoma	407,683	60	556	17,925	9	32	299
Nyagatare	563,685	58	643	25,368	11	39	437
Rwamagana	379,288	65	591	21,841	9	37	336
North							
Burera	407,264	45	547	18,976	12	35	422
Gakenke	409,263	59	592	17,813	10	30	302
Gicumbi	478,683	83	774	26,620	9	34	321
Musanze	445,603	57	676	26,813	12	40	470
Rulindo	348,094	73	605	21,499	8	36	295
Rwanda	12,724,327	1,728	17,972	658,285	10	37	381

Table 14-4 Secondary Schools - Current Situation

The main target for 2050 is to increase the net enrolment to 90% and increase the number of pupils from 658,285 to 3,835,162, or 17.4% of the future population. Based on the parameters of 24 classes per school and 35 people per class, the number of schools will be 2.6-fold, and the number of classrooms will grow to 6-fold. Therefore, infrastructure and construction in Secondary schools will be very challenging, indeed.

District/Province	Pop 2050	schools	classrooms	Pupils NER 0.9	Classrooms /School	Pupils/ Classroom	Pupils/ School
Kigali city	3,850,000	612	14,687	514,038	24	35	840
South							
Gisagara	450,000	71	1,695	5,9316	24	35	840
Huye	750,000	135	3,240	113,383	24	35	840
Kamonyi	600,000	120	2,883	100,921	24	35	840
Muhanga	1,000,000	254	6,104	213,634	24	35	840
Nyamagabe	500,000	97	2,320	81,185	24	35	840
Nyanza	550,000	119	2,863	100,213	24	35	840
Nyaruguru	375,000	69	1,666	58,325	24	35	840
Ruhango	600,000	120	2,871	100,487	24	35	840
West							
Karongi	750,000	160	3,846	134,612	24	35	840
Ngororero	525,000	79	1,899	66,457	24	35	840
Nyabihu	600,000	112	2,695	94,327	24	35	840
Nyamasheke	550,000	120	2,876	100,664	24	35	840
Rubavu	550,000	100	2,404	84,133	24	35	840
Rusizi	475,000	93	2,226	77,896	24	35	840
Rutsiro	550,000	99	2,388	83,573	24	35	840
East							
Bugesera	1,400,000	216	5,184	181,440	24	35	840
Gatsibo	750,000	138	3,312	115,937	24	35	840
Kayonza	900,000	163	3,922	137,279	24	35	840
Kirehe	525,000	92	2,196	76,871	24	35	840
Ngoma	550,000	86	2,073	72,547	24	35	840
Nyagatare	1,000,000	161	3,857	135,012	24	35	840
Rwamagana	1,350,000	278	6,663	233,216	24	35	840
North							
Burera	500,000	83	1,997	69,891	24	35	840
Gakenke	537,000	83	2,003	70,118	24	35	840
Gicumbi	587,000	117	2,798	97,931	24	35	840
Musanze	700,000	150	3,610	126,362	24	35	840
Rulindo	575,000	127	3,044	106,540	24	35	840
Rwanda	22,049,000	4,566	109,576	3,835,162	24	35	840

Table 14-5 Secondary Schools - 2050

The service levels for Secondary schools are summarized in Table 15-6.

2050 Hierarchy	District	Sector	Cell
22,049,000 people 24,801 km² of dry land			
Total 2050	30	416	2,148
Average Population	735,000	53,000	10,260
Elements / level	14 sectors	5.16 cells	1
Secondary Schools-Average	152	11	2
Secondary Schools pupils-Average	128,000	9,142	1770

Table 14-6 Service Levels for Secondary Schools

15. Health Services

Rwanda's health system has witnessed several transformations that have translated into a significant improvement in geographical and financial access to medical facilities in the country. Modern equipment has been availed for the proper diagnosis and treatment of diseases. Rwanda stands as the number one country on the continent as far as health insurance coverage is concerned - 90 percent of all Rwandans are currently insured. At the same time, life expectancy has increased from 49 years in 2000 to 66.7 years in 2017. Maternal Mortality Ratio dropped steadily from 476 per 100,000 live births in 2010 to 210 per 100,000 live births in 2015;

infant Mortality Rate also dropped from 50 to 32 per 1,000 live births in 2015, and over 90% of children are immunized in Rwanda. These and more achievements hinge on efficient health service delivery. The government has made it a top priority to reach out to the citizens with excellent, adequate health services when needed. This has been done through the establishment of structures and systems that facilitate easy accessibility and affordability and effectiveness of health services in the country. The number of hospitals increased from 34 in 1994, to 48, including 8 national referral hospitals, 4 provincial hospitals and 36 district hospitals.

The number of doctors deployed in the public health sector grew from 112 in 1996 to 709 by May 2015, including 174 medical specialists. A total of 8933 Nurses are working in the public sector, up from 949 in 1990 and 742 in 1996. Also, 692 Midwives are deployed in public health facilities, and this category of staff did not exist before the 1994 Genocide against the Tutsi. Under the current programs for the development of Human resources for health, priority is given to training specialized doctors and upgrading A2 nurses to A1 level. For Specialized Doctors, most of them are trained in Rwanda through an MoU signed with American Universities, and others are sent outside. Currently, over 250 doctors are being trained in clinical specialties (59 abroad, 191 in the country).

15.1 Health Facilities

Vision 2050 is offering a comprehensive health care system, including quality care for non-communicable diseases and commonplace screening for preventable forms of diseases. Health service delivery systems will further be devolved down to community levels, with patients receiving primary care near home and increasingly able to get specialized treatment at decentralized levels. ICT will broaden the range of specialty training for clinicians and foster the provision of quality care through leveraging ICT for improving medical research for reducing operating and administrative costs. Currently, Rwanda has the following infrastructures and facilities: 406 health posts, 499 health centers, **40 d**istrict hospitals, four referral hospitals.

In 2050, the service levels of health will be the following:

COUNTRY LEVEL:

10 Referral hospitals, each containing 720 beds on average.

The whole referral system **will have 10x720 = 7200 beds. The country rate per 1k population will be 7200/22,000k = 0.3 beds.**

PROVINCIAL and DISTRICT LEVELS:

Each provincial and district hospital will provide government-defined "Complementary package of activities" (CPA), which include C-section, and treatment of complicated cases, among others. They also provide care to patients referred by the primary health centers as well as carrying out planning activities for the province and district health and supervise district health personnel. Each district hospital will Cover an average catchment area of 735,000 people,

Program: 60 district hospitals and 8 provincial hospitals, each containing 1440 beds to achieve the rate of 2 beds per 1k population.   2 hospitals/district, 2 provincial level hospital per province, 720 beds per hospital.

SECTOR LEVEL:

At the sector level, Health Centers (HC) provide the government defined "Minimum Package of Activities at the peripheral level (MPA). This includes complete and integrated services such as curative, preventive, promotional, and rehabilitation services. H.C's also supervised health posts and community health workers (CHWs) operating in their catchment area.

Program: 2 Health centers (HC)for each one of the 416 sectors = 832 HC

CELL LEVEL:

The cell level will also be well covered with 3000 health posts (HP) for the future Imidugudu cells in the country.

HP will be established in areas that are far, enabling people with easy access. Services provided here are similar, albeit reduced from those by Health Centers. They will supply out-patient care, specific diagnostic tests, child immunization, growth monitoring for children under five years, antenatal consultation, family planning, and health education.

The whole services given today on the village level will be consolidated into the HP's.

45k Community health workers carry out community-based prevention, screening, treatment of malnutrition, Integrated Management of Child Illness, Provision of family planning, Maternal Newborn Health, DOT HIV, TB, and other chronic illnesses, as well as sensitization for behavior change. All these services will be conducted through HP's.

Program: 1 Health Post (HP) for each cell = 3000 HP's

15.2 Built Areas and Land Allocation

Table 16-1 below summarizes all components of the demand for health services for each service level. Rows 5 and 6 represent the spatial needs per element and as total. The total land demand for the next 30 years is 484 hectares.

1		2	3	4	5	6
2050 Health Facilities		Districts	Sectors	Cells/ Imidugudu	**Ha/Unit**	Total Ha
Component/level		30	416	3000		
22,049,000 people						
	2019	2050				
Average Population	424,144	735,000	53,000	10,260		
Health posts (HP)	406			3000	0.06	180
Health centers (HC)	499		416x2=832		0.2	166
District hospitals	40	735 X~2 beds =1440beds 1440/720 beds per hospital= 2 hospitals/district Total in country: 2x30=60 hospitals	720x40 sq.m/bed= 28,800 Sq.m/Hospital Provincial hospital optimal land size is 3Ha		2	120
Referral hospitals	4	4 Referral hospitals 4x720 beds per hospital =2880 beds	720X40 sq.m/bed= 28,800 sq.m		4	16
Total land Allocation						484

Table 15-1 Built Areas and Land requirement for health facilities

16. Environment and Natural Resources

<u>Summary of guidelines and measures for environmental management:</u>

Environment and Natural Resources (ENR) study calls for a review and updates of various policies and legal frameworks to be in tandem with the NLUDMP. Further to this, critical recommendations for planning priority for Environment Natural resources (ENR) in NLUDMP are based on anchoring them to the elements of; Green growth, Green Urbanization, Sustainable Agriculture, Ecotourism, Environmental and social safeguards, Resource Efficiency and Cleaner Production, Circular economy, and Zero waste economy.

These fundamental elements and tools will ensure the sustainable and harmonized development of the NLUDMP. The Environment and natural resources (ENR) sector contribute significantly to the economic growth of the country. However, the sector faces challenges due to the inefficient use of natural resources as a result of unsustainable investment trends and pressure by other sectors. This ENR report proposes the rational use of natural resources in order to optimize future land use management, which includes the following measures:

- Ensuring that all 1,389 km² of natural forests should be preserved entirely, and economically maintained and managed.
- Ensuring that all existing 3,873 km² of forest plantations will be protected, increase the current forest densities, and professionally and financially managed.
- Ensuring that all the bare slope above 55% totaling 1,554 km² of high hills are planted with trees to become part of the forest cover. Erosion control practices are required in unprotected areas or where the existing erosion control techniques are judged inadequate with regard to the type of risks found and existing land use. If economically maintained and managed, cash crops like tea plantations can be developed on those very high slopes.
- To ensure an effective stormwater management approach for any project, better site design techniques are to be used. Better site design involves techniques applied early in the planning and design process to preserve and convey runoff like volume control, peak control or flood, capture and re-use.
- Ensuring that there are no new plantations of forest in agriculture lands, except agroforestry.
- Ensuring the promotion of green energy use, particularly in cities to increase the protection of forests.
- Ensuring that erosion and sediment control for site alteration works must be performed in such manner that release of sediment into receiving waters is kept to an absolute minimum without sediment migration offsite.
- Ensuring that all the water bodies and their buffer zones and the protected wetlands and their buffer zones totaling to 4,242 Km² are protected. The buffer zones need to be used for their role in preserving the water bodies and wetlands.

- Opening of a conditional use for unprotected wetlands for agriculture, which adds 1,100 km² to the agricultural stock while allowing 183 Km2 to be left for other potential purposes.
- Allowing shrubland (436 km²) and wooded savannah (1040 km²) to be allocated for Agriculture, except their protected parts
- Opening of a conditional use of slopes between 30-50% for construction projects after fulfilling some studies and investment requirements.
- Ensuring that all existing urban, rurban, and rural settlements are consolidated in proposed sites, decongesting all other areas for agriculture and conservation.
- ENR sector should support its implementation through enhancement and adoption of green growth approaches and programs, ensuring a masterplan that will lead to environmental and natural resources sustainability.
- Undertaking a cost-benefit analysis for proposed mining activities versus the values of current land uses.

Rwanda's socio-economic development is dependent on the environment and natural resources such as land, water, air, minerals and biodiversity. The Environment and natural resources (ENR) sector contribute significantly to the economic growth of the country. However, the sector faces challenges due to the inefficient use of natural resources as a result of unsustainable investment trends and pressure by other sectors. This ENR report proposes the rational use of natural resources to optimize land use.

Rwanda is a natural resources-based economy, and therefore environment and climate change issues are a key priority and cross-cutting area that needs to be enhanced as stated in various medium and long-term national planning and strategic documents. Further to this and considering limited land, rapid population growth, increasing food demand, urbanizations, and other infrastructural development will continue adding to pressure on conservation and encroachment to natural resources. Based on this, the key to planning and implementing the NLUDMP is to ensure harmonization of land allocation for each sector while at the same time ensuring that they are targeted efforts to the conservation of natural resources and promotion of their sustainable use. Rwanda's natural environment has been assessed and categorized amongst others to include land, wetlands, forests, water, soil, and minerals.

The NLUDMP assessment grouped the environment into three key sectors, namely: Natural Resources, Biodiversity Protection, and Environmental Quality Sector. The evaluation gives guidance on critical aspects that need to be considered by various other sectors. It provides policy orientations that need to be undertaken under each of the environmental sub-sector going forward. Protected and conserved areas are fundamental for achieving many of the Sustainable Development Goals, the current land cover in 2019 includes land for conservation in the form of National parks, protected wetlands, water bodies and forests which makes up 10,818 Km2 (41.07%) of the total Rwandan area. Based on the proposed national balance sheet, which is based on a total country area of 26,338sq Km. The environment and natural resources sector have been allocated the second highest land use of 9,925 km² is representing 37.7% of the country.

Agriculture has the highest (12,433 km² or 47.2%) land use while the built-up areas have been allocated the least (3,980 km² or 15.1 %). The proposed land uses are majorly three: agriculture, conservation, and built-up areas, which are currently distributed and intended to be distributed as follows in 2050 (Table 17-1).

	2019		2050	
	Areas in sq. Km	% coverage	Areas in sq. Km	% coverage
Agriculture	10,949	41.57	12,433	47.2
Conservation	12,501	47.46	9,925	37.7
Built up areas	2,888	10.96	3,980	15.1
	26,338	100	26,338	100

Table 16-1 Distribution of Land in 2019 & 2050

The global coverage of protected areas is continually changing. The World Database on Protected Areas that tracks these changes shows that of December 2016, 14.8% of the terrestrial and inland water areas are covered by protected areas. Globally under the Convention of Biological Diversity, which developed the Aichi Biodiversity, Targets guided the global targets of conservation. Target 11 set out goals for protected and conserved areas in terrestrial, marine, and freshwater ecosystems. It had set to achieve 17 % of terrestrial and inland water areas and 10 % of coastal and marine areas as protected by 2020. The current and proposed situation is elaborated below, where it's noted that the land area that has been allocated to ENR protection is well above the set targets (Aichi Biodiversity Targets). Globally it has been recognized that implementation and achievement of the strategic plan for biodiversity 2011-2020 and the Aichi Biodiversity Targets contribute to the success of the Sustainable Development Goals (SDG's).

The proposed NLUDMP land use balance sheet 2050 has set 37.7 % of the country's surface to be set aside for conservation purposes, and this is expected to meet the global set targets of 27 % under the SDG's program. The proposed changes in the land use will be necessitated by the expected changes in population from the current estimated 12.5 Million to the expected 22 Million by 2050. It calls for attention and measures on population growth and catering for more land for agriculture and settlement, at the same time, conserving the environment and natural resources. It's a well-known fact that intense human pressure on areas set aside for preservation could be threatening biodiversity.

To mitigate and balance the expected needs for development and conservation needs, this calls for demarcation and protection of identified protected sites and environmentally sensitive areas, putting in place measures and implementing green cities and infrastructures and ensuring sustainable land management and resource efficiency. Utilizing the elements of spatial ecology where every spatial unit is occupied by various species in this case categorized as agriculture, conservation, and built areas. The proposed NLUDMP balance sheet achieves zero balance of 26,338 km2 of country surface and an economic equilibrium between them - Conservation (Forest, bare high slopes, water, wetlands, and their buffer zones) 37.68%), agriculture lands 47.21%, built areas 15% but for it to be fulfilled these conditions have to be met in the course of the implementation of vision 2050.In order to fulfill the aspiration of ENR protection and conservation, the following are proposed to be undertaken under each of the subsectors:

16.1   Forestry

Forest and forest land resources will be managed to play an integral role in supporting Rwanda's goals for sustainable, green, low-carbon, climate-resilient development to sustain and improve social security, livable environments, economic prospects, and the well-being of present and future populations. Forests are a vital component of the life-support system given both the products and ecological benefits (e.g., oxygen provision, capturing carbon dioxide) they provide. Besides, the forests also provide the foundation for Rwanda's tourism opportunities, forests also protect watersheds, downstream wetlands, and support agriculture. However, due to the dense and rapidly increasing population on a fragile land resource, forests have been threatened by deforestation and continuous degradation. The most recent data on forestry in Rwanda based on the 2019 Forest cover and soil cover mapping[2] report (Table 17-2), Rwanda total forest cover of 7,246 km² (30.4% of the dry country land), of which 53 % are plantations, 21% is wooded savannah in East, 19% are natural mountain rainforests, and 7% are shrubs. There are also small reserve forests of Busaga, Buhanga, Sanza, Iwata, Rubirizi, Makera[3]. There are improvements in total forest area cover with increases from 18% in 2014 to 29.6% in 2017 to the current 30.4 % of the 23,038 km² country drylands surface.

Forest Cover Type	Forest area (Ha) per density category (%)					
	High (>70%)	Low (10 - 40%)	Medium (40 - 70%)	Very low (0 - 10%)	Grand Total	%
Bamboo stand	410	39	149	15	613	0.1%
Forest plantation	169,971	48,816	156,625	11,978	387,389	53%
Natural forest	127,331	2,852	8,254	473	138,910	19%
Shrub land	2,493	13,206	24,386	2,230	42,315	6%
Very degraded shrub land	25	585	84	954	1,648	0.2%
Wooded savannah	8,175	83,462	50,813	11,336	153,785	21%
Grand Total	308,404	148,960	240,312	26,987	724,662	100%

Table 16-2 Rwanda Forest Cover Types, 2019

The significant drivers of deforestation and forest disturbance in Rwanda are high population densities in both rural and urban areas (with 82.6% living in rural areas and 18.4% in cities, 2019), leading to more significant land fragmentation. With the number of jobs in non- agricultural sectors highly limited and high poverty levels. There is greater exploitation of freely available natural resources that have a compounding effect on deforestation and forest disturbance. Pressures of this increased reliance on the collection of firewood and other forest products, illegal logging, charcoal production, bush fires, mining, and invasive liana, among others. Increasing pressures due to climate change contribute to disrupting the fragile balance of forest pests and the natural cycles that maintain these forests. Deforestation and utilization of the woods are driven using biomass energy, which still accounts for 79.9% (EICV5/NST1, 2017) of national energy consumption, followed by petroleum at 11% and electricity at 4%. Demand for forest products is increasing, and a look at the demand and supply for

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[2] Presentation by IUCN 07/10/2019
[3] Rwanda Third National Communication on Climate Change - 2018

wood shows that the demand/supply ratio is 2:1, and the shortage is projected to increase demand to 4.3 million tons (oven-dry weight) in 2017, which is expected to increase to 7.5 million tons by 2026 and 10 million by 2050.

Increased population and urbanization will lead to an increase in forest product demand. At the same time, there will be more requirements for land, which may lead to encroachment to more existing forest land. Currently, the projected Biomass (fuelwood, charcoal) imbalances pose an increasing threat to forest resources, which are further exacerbated as the population increases. At current population growth levels, it is difficult to foresee a time when the still rising demand for wood as fuel and charcoal can be met. The projections given in the Forest Policy 2017 show a growing deficit of 6,591 tons in 2026. Other recommendations to ensure maintenance enhancement of the current forest cover and tree resources include the following:

• Improving forest management for plantation, natural and degraded forest resources (Reforestation recommended for degraded forests). The areas especially to undertake the reforestation program need to be identified, delimited and worked on in collaboration with the relevant institutions
• As strategy to protect forests, the green energy has to be seriously promoted in the country, more particularly in cities.
• A majority of those marginal lands that are unsuitable for food crops need to be put under forest covers with large scale reforestation programs.
• Enhance and elaborate integrated plans of other sectors like landscape restoration, water resources management and agroforestry programs that involve afforestation, reforestation and forest rehabilitation
• Enhance the licensing of sustainable charcoal production techniques & promotion of Improved Cookstoves (ICS) for efficient and clean wood and charcoal consumption
• Elaborate on agroforestry programs in the country with a focus on species diversity, including both native and exotic species.

The summary of the forest cover in 2050 is shown in Table 17-3.

Forest plantation	3,873	53%
Natural forest	1,389	19%
Shrubland	443	7%
Wooded savannah	1,537	21%
Total	7,242	100%

Table 16-3 Rwanda Forest Cover Types, 2050

16.2   Slopes

Rwanda is majorly a mountainous country and has slopes that range from the following:

- 64.5 % is between 0 – 30 % slopes
- 22.9 % is between 30 and 55% slopes
- 12.6 % is above 55%

Sloppy areas suffer from erosion, sedimentation, Stormwater runoff, which all leads to a limitation to the use of the sloppy hills. Currently, there is a limitation on the construction of slopes above 30%. Based on the NLUDMP analytical work, the following is recommended:

- Slopes of 30 – 50 % can be used for Settlement, ensuring that there are no risks for earthquakes, landslides, and floods.
- As noted above, ensuring that the bare slope above 55% is planted with trees to become part of the forest cover. Where possible, they could be used for perennial/cash crops like upland tea. Wheat, pyrethrum, coffee, and other cash crops in those slopes.

16.3   Water and Wetlands

Water bodies occupy 6.2 % of the total area of the country that accounts for about 1537 km². Most of the lakes and rivers are fed by marshes, which in turn are fed by shallow groundwater and seasonal floods. One hundred one lakes are covering 149,487 ha, and 861 rivers are totaling to 6462 km in length in Rwanda. The central pressures on water resources result from the use of utilizing the natural resources to meet basic household needs as well as social-economic development, e.g., undertaking Agriculture. In the implementation of NLUDMP, the following are recommended:

- Ensuring that all the water bodies and their buffer zones and the protected wetlands and their buffer zones are fully protected totaling 4,242 Km², particularly prohibition of settlements in 50m from lakeshores, 10m for rivers and 20m buffer for wetland boundaries. Buffer zones are used for forestry, tourism and conservation efforts.
- Ensuring policies relating to water resources extraction and protection with a focus on enhancing saving and water conservation are aligned with NLUDMP.
- Putting in place a prudent water resource management plan driven by projected increases in water consumption/demand and climate change at all levels of administration and catchments areas
- Develop hydrological and hydraulic at district and catchment levels, supported by hydrological and hydraulic models, improved rainfall monitoring, river flow and groundwater monitoring and a better understanding of agro-meteorology and water quality testing.
- Enhance and improve the knowledge and operations of water users within districts, catchments area, irrigated and mining sites.
- Managing and protecting all the water catchments in Rwanda through catchment restoration and improvement programs to mitigate disasters and efficient stormwater management. Within each catchment planning process, defined based on the risks of land use change in relation to details of land use and site planning and potential for flooding within the catchments.
- Development and implementation of stormwater management practices in all the urban areas. It calls to predict the cumulative stormwater impacts of development and to integrate this information with other economic, physical planning of land use and sustainability objectives and

policies when considering land use change. It also calls for the use and conservation of urban wetlands as collection points and filters for stormwater, which can efficiently be utilized for agriculture and recreational.

- In cases of new development, adequate conveyance and reduction routes for major/minor storms shall be provided to meet the flood risk management plans. It calls to localities to adopt stormwater management in zoning requirements, subdivision regulations, site plan regulations, conditions to be imposed on project approvals;

- Enhancing rainwater harvesting practices in all the proposed housing infrastructures, expanding water storage and irrigation infrastructure through the development of dams, chance reservoirs, and ponds to enhance water conservation and water efficiency practices;

- Develop and implement flood zoning of highly vulnerable uses in high-flood-risk areas, and protect land reserves to provide flood storage or safeguard environmentally sensitive areas.

- In the development of Green street, a streetscapes should facilitate natural runoff infiltration wherever possible and therefore have less impervious surface such as concrete and asphalt.

- Develop dam's foundations to support irrigation agriculture leading to an impact on water resource utilization and also help in the control of flooding. It should be undertaken in the more drylands in Eastern Province, however other parts can be done where feasible;

- Enhance conservation of water resources in agriculture; This needs to be supported through water catchment allocation plans and delimitation, enhancing the protection, riverside buffers, with bamboo or any other appropriate shrubs.

- Wetlands constitute the backbone of Rwanda's green development as they provide various goods and services that millions of Rwandans depend on. Healthy, functioning wetlands are essential for a number of their livelihoods and are crucial for water, energy, and agriculture sectors, which are one of the main branches of the national economy. Wetlands also provide critical habitat for wildlife and play a pivotal role in the ecosystem, e.g., flood control and water storage.

There are 935 swamps under the order No 006/03 of 30/01/2017, drawing up a list of swamplands, their characteristics and boundaries, and determining modalities of their use, development, and management. They have a total of a recorded 276,477 ha where 74% of total wetlands are under conditional exploitation, 6% are under full exploitation, and 20% of the full wetlands are fully protected. Based on this distribution, the following is recommended:

Zoning enforcement and ensure limited and acquisition for wetland for other functions. Further zoning and rezoning of protected areas of wetlands. Wetlands that are designated/Zoned for agriculture and others for conservation and for the 2,068 km² of the existing wetlands their uses are recommended as follows:

- ❖ Protection in the totality of 480 Km² of the wetlands
- ❖ opening up for conditional use 1,100 km² of the unprotected wetlands for agriculture
- ❖ (following the laid down guidelines)
- ❖ Opening up and leaving 183 Km² of the wetlands to be used conditionally for other uses, e.g., Recreation, research, tourism, etc.
- ❖ Conservation of all the buffers zones for wetlands totaling 305 km² or have their use guided by the above uses
- ❖ Use and retention of urban wetlands as collection points and filters for stormwater from the urban areas, based on the fact that wetlands are part of the "green infrastructure" of healthy catchments and provide a multitude of ecosystem services especially in urban areas

- ❖ Systematic restoration of degraded wetlands in the country,
- ❖ Recovery or creation of urban wetlands goes together with the protection of river banks, is essential for the integrity of the water and wetlands resources.
- ❖ For the wetlands which are identified for conditional use, their proposed use(s) should be guided by undertaking Environmental Impact Assessment (EIA) to ensure their sustainable utilization
- ❖ Development of eco-tourism parks in the wetlands along with development areas for conservation, educational and recreational purposes. The enhancement and development of tourism and recreational activities on wetlands will enhance their conservation elements.

16.4 Islands Sub-sector

Assessment of the existing islands by REMA (2014) does show that they are 113 islands located in Rwanda: in Rusizi (7), Nyamasheke (36), Rutsiro (42), Karongi (27) and Rubavu (1). The role of Rwanda islands has been categorized into three a) Islands for Conservation, b) Islands for Tourism, and c) Islands for residential activities. Studies do show that 107 Islands are recommended to be registered as the public domain to protect the environment and the population in general and to conserve the biodiversity.

For the islands that are recommended for residential activities, Nkombo and Ishywa in RUSIZI Districts, Mushungo and Kirehe in NYAMASHEKE districts, and Bugarura in RUTSIRO District, they should respect all the requirements set under the Organic law N°48/2018 OF 13/08/2018 governing environmental Management in Rwanda.

16.5 Mining

Mining is an activity that involves the excavation of the surface and subsurface to exploit and process minerals. Therefore, mining activities, by its design, disturb and transform the natural environment. Such disturbance and transformation, in most instances, have a permanent and irreversible impact on ecosystem processes and functioning and the resulting stream of ecosystem goods and services flowing from the impacted site. There are 369 active mining sites, operated by 259 companies; 36 companies are dealing in mineral processing and exporting. There are over 250 registered mining and exploration companies in Rwanda, and they are categorized as either artisanal, small-scale, or large-scale operations. As mining will use and utilize land that is of value and meant for other land uses in addition to having environmental impacts, it is there very crucial that before allowing and giving a mining license and to give of ensuing sustainable mining the following needs to be ensured and undertaken going forward:

- • Undertaking a land-use analysis (cost-benefit analysis) for current land use versus the proposed mining activities and use the analysis results to understand the best land use.
- • Undertaking of a complete risks analysis to the natural and human environment before the licensing of the mining activities
- • Developing and Implement land-use masterplan concerning the proposed mining activities
- • Undertake and Enforce environmental and social assessment and monitoring (EIA, SIA, EMP)
- • Enforce the programs for orderly decommissioning, rehabilitation, restoration, and utilization of mining sites after an operation:
  - - Develop a mine drainage and leaching of contaminants plan associated with mining metals to avoid impacts on rivers, streams and water quality.

- Ensuring that erosion and sediment control for site alteration works must be performed in such manner that release of sediment into receiving waters is kept to an absolute minimum without sediment migration offsite.

16.6 Green Urban Development

The built areas will increase from 2,888 km^2 (10.96%) to 3,980km^2 (15.1%) in 2050.
To enhance environmental sustainability in urban and rural settlements development under the PUSH programs. The following key elements are recommended:

- All Population, Urbanization, Settlements, and Housing (Push) program must be streamlined and have in place use of green planning, and technology approaches use in the urban development programs, i.e., enhance the green city concepts in the developments;
- Urbanization approach where city's development takes into account environmental aspects, especially through land-use and spatial development planning to achieve low carbon growth overall and build resilience to climate change, i.e., ensuring that all urban development processes incorporate climate risk and low-emission strategies into on all the proposed activities;
- All urban development should promote climate-resilient human settlements as this will lead to halting the proliferation of informal settlements in urban areas.
- All the proposed investment in the proposed urban areas should have integrated, resilient, reliable and sustainable infrastructure which will enable the cities to adapt to climate change and function efficiently at the local level
- There should be mapping, delimiting, and greening of the transport systems. In all the new and proposed towns and cities, there is a need to have an improvement of the rural and urban transportation services and basic infrastructure, and this needs to be done in line with national green growth guidelines;
- All green infrastructure projects should be designed to complement gray infrastructure systems performing a combination of volume management, water quality improvement, and flood control;
- For all the urban developments, there should be identification and strengthening of the value of greenbelts and green spaces. The PUSH programs should have in place aspects that lead to the creation of urban green spaces in all urban and semi-urban areas, including satellite and secondary cities. The urban green spaces provide the linkage of the urban and rural areas. It is proposed that every city/urban development provide 20-25 % of green spaces.
- All urban development plans and programs must support urban agriculture areas and programs to enhance food security in urban areas.
- Have the operators in the Industrial parks that go for cleaner and greener production and support the Zero waste economy and circular economy in their production activities.
- Ensure that Industrial parks are well supported in green planning, green technology, and production practices. Further to this, there is a need to deliberately undertake the greening of the Special Economic Zone and the provincial industrial parks which is expected to lead the country realizing 'triple-win' opportunities: cost savings in production and operation, environmental benefits, and climate resilience
- Ensure that Strategic environmental assessment (SEA) is undertaken for all land-use master plans to ensure their sustainability.

16.7   Pollution control

The most pressing problems of pollution in Rwanda are those associated with air, water, and land degradation. This pollution is spreading in cities, mostly in Kigali City. The Industry's and households' hazardous wastes become a source of air, water, and soil pollution, disposed near recreational, agricultural land, residential locations, or water sources where they become a source of air, water, and soil pollution. The primary sources of pollution from agricultural and industrial activities and organic loads are sewage from settlements. An increase in population and Urbanization (PUSH) programs will lead to a rise in pollution in the country. In order to mitigate the impacts of pollution in the country, the following key recommendations are proposed to be implemented:

16.8   Solid Waste Management

NLUDMP recommends the following actions:

- Have a robust Solid Waste management system for all development that is based on reuse hierarchy but be focusing on zero waste generation
- Support for the circular economy programs in all the planned activities of NLUMDP so that there is a minimum generation of waste (total zero waste).
- Where they are waste treatment facilities ensure that they could be used for enhanced production of energy, fertilizer, or other production activities.

16.9   Waste Water Management

The following actions are proposed during the implementation of NLUDMP 2020-2050 to ensure that there are adequate sanitation and water control systems, and recycling programs. This would be achieved through the enforcement of the following:

- Enhanced development of liquid waste management systems in cities, towns, urban, and rural settlement areas. Since currently they are no centralized wastewater management systems and may be challenging to set up construction of semi-centralized sewerage systems in all planned and grouped settlements.
- Ensuring and having in place elaborated programs for the protection of waterways and systems where they exist
- Rehabilitation and upgrading of semi-centralized sewerage system in Kigali estates
- Promote sustainable agriculture to reduce environmental impacts

16.10 Climate Change

The Government of Rwanda recognizes the importance of climate change and its effects on both Rwanda and the international community. Based on the current data, it is projected that with the continued climate changes, the temperature may differ between the rise to 1.4°C – 2.3°C, and annual rainfall may increase by up to 5 - 10% rainfall by the 2050s.

Based on this, it is, therefore, critical and essential to put in place mitigation measures to ensure that there is a reduction of the expected climate impacts. The proposed mitigations measures are:

- Ensure improvement for cross-sectoral coordination to ensure smooth implementation of environmental policies and regulations, well-aligned with NLUDMP directives. as this would reduce land-use conflicts, assist in proper zoning and efficient land management;
- Ensure and elaborate mainstreaming climate change into medium-term planning, sectoral and district development plans since Land use planning has been identified as one of the most effective processes to facilitate local adaptation to climate change;
- Elaborating and increasing the adaptive capacity of natural systems and rural communities living in exposed areas to climate change through the Development and Implementation of a National Adaptation Plan into NLUDMP;
- Adoption of green and electric urban transport systems to reduce carbon emissions, lower barriers to access for transport, increasing the mobility of the population by setting up a bicycle and pedestrian walking lane and therefore offering opportunities for economic development especially on the Proposed Population, Urbanization, Settlements, and Housing (PUSH) programs;
- Elaborate and integrate Disaster risk reduction within crucial development sectors such as infrastructure, agriculture, environment, education, urbanization, information, communications, technology, and youth;
- Elaborate, incorporate a continued enhancement of disaster risk reduction into a district and local development plans aimed at preventing the creation of new risk, reducing existing risk and strengthening economic, social, health and environmental resilience;
- The NLUMDP needs to ensure that there is coherent mapping of the risk areas and delimiting them at National and local levels and based on this, ensuring that land uses assigned to them are in line with the risks that may occur in those areas;

In conclusion, the ENR study has proposed various activities. It suggests that it needs to be put in place to ensure that NLUDMP is environmentally sustainable in its implementation. It calls for a review and updates of various policies and legal frameworks to be in tandem with the NLUDMP. Further to this, critical recommendations for planning priority for Environment Natural resources (ENR) in NLUDMP are based on anchoring them to the elements of; Green growth, Green Urbanization, Sustainable Agriculture, Ecotourism, Environmental and social safeguards, Resource Efficient and Cleaner Production, Circular economy, and Zero waste economy. These fundamental elements and tools will ensure the sustainable and harmonized development of the NLUDMP. The Environment and natural resources (ENR) sector contribute significantly to the economic growth of the country. However, the sector faces challenges due to the inefficient use of natural resources as a result of unsustainable investment trends and pressure by other sectors. This ENR report proposes the rational use of natural resources to optimize land use.

17. National Land Use Balance Sheet

The size of Rwanda is 26,338 km², including water bodies and protected wetlands. Net land cover is **23,038 km²,** and this is the quantity on which land uses to compete. There is a consensus that natural forests and natural parks, should be out of the competition. The rest is the framework of competition between the ten primary land users. Secondary land uses are already included in the main land-uses of settlements.

Forestry and agriculture are the primary land consumers, each striving for maximum land. Forestry desires to add to already protected natural forests maximum conservation of the plantations, wooded savannah, shrublands, and even high slopes for future forestry. This list accumulates to 7320 km² at the same time, and agricultural studies raise the need for 14,500 km². Other requirements for cities, rural settlements, roads, and other built areas are for 3,980 km². If all dry land needs are accumulated, the expected deficit will be far beyond what Rwanda can supply geographically, only 24,138 km² of dry land.

17.1 Land Use Allocations and Deficit Resolving

In this given country size, there is no way to provide optimal land-use demands for each sector, unless a rational compromise is achieved. The rationale of the agreement using Land Use Categories (LUCA's) is as follows:

1. In **LUCA A,** there is an absolute preference for **Agricultural land.** No more expansion of forest plantations will be allowed and no more designations of natural forests. All wooded savannah and shrublands in LUCA A, which are not a part of a natural park, will be transformed into prime agricultural lands.
2. In **LUCA C,** there is an absolute preference for **forest lands.** All aspirations for expanding forest plantations can be supported in this category, either on high slopes or risk areas.
3. In **LUCA B,** a freezing strategy is suggested to stabilize the amounts of **both agricultural lands and forests.**
4. **Natural Forest** will be in full freeze in **LUCA A & B.**

The allocation process passed through land-use offsets. The Offsets are marked in blue for adding land and in red when the area was subtracted. The balance is zero.   Built up areas have received their demand by using unsuitable Agri lands. An integrative land-use balance sheet is presented in Table 18-1, followed by a map in Fig. 18-1, and its legend is in Fig. 18-2. The plan includes all prior land use categories based on agricultural suitability and forest intensity, roads & railways, cities by the size of the boundary, land cover of natural forests, forest plantations, and water bodies. The attributes and guidelines for each land use category have been described in this report

Current Situation 2019			Allocation 2050 Km²					
Land cover	%	Km²	Offsets	Water wetlands	Built Areas	Agricultural Lands		Protected
						Secondary	Prime	
Agriculture (net)	**41.6**	**10,949**						
Agriculture (Very Suitable)	31.9	8,414					8,414	
Agriculture (Not Suitable)	5.5	1,438	-1,092			346		
Grass Land (Livestock)	4.2	1,097				1,097		
Forests	**27.5**	**7,242**						
Natural Forest	5.3	1,389						1,389
Forest Plantation	14.7	3,873						3,873
Wooded savannah	5.8	1,537				1,040		497
Shrubland + Bamboo	1.7	443				436		7
Bare High Slopes ((>55%)	**5.9**	**1,554**						
Bare high slopes (>55%)	**5.9**	**1,554**						1,554
Built-up areas + Infrastructure	**11.0**	**2,888**						
Cities	3.9	1,025	452		1,477			
Rurban/emerging centres	0.1	38	269		307			
Rural Settlements	5.7	1,500	-259		1,241			
Industries	0.0	12	76		88			
Roads, railways & Airfields	1.2	313	554		867			
Water Bodies	**6.2**	**1,637**						
Lakes & Rivers	5.8	1,537		1,537				
Buffer zones-50m	0.4	100						100
Wetlands	**7.9**	**2,068**						
Wetlands (protected)	1.8	480		480				
Wetlands (Conditioned Agri.)	4.9	1,283		183			1,100	
Buffer zones-20m	1.2	305						305
Balance	**100**	**26,338**	**0**			2,919	9,514	
				2,200 (8.5%)	3980 (15.1)	12433 (51.5%)		7725 (32%)
						24,138		

Table 17-1 Land Use allocation and offsets for 2050

Land allocation to sectors has been established: The size of Rwanda is 26,338 km², including water bodies and 24,138km² of dryland surface: The following is the land allocated to sectors by 2050:

Agriculture 51.5% of the country dryland surface, Built- up areas and infrastructures 15.1%, Forest and Conservation 32% and Water and protected wetlands 8.5% of the country land surface.
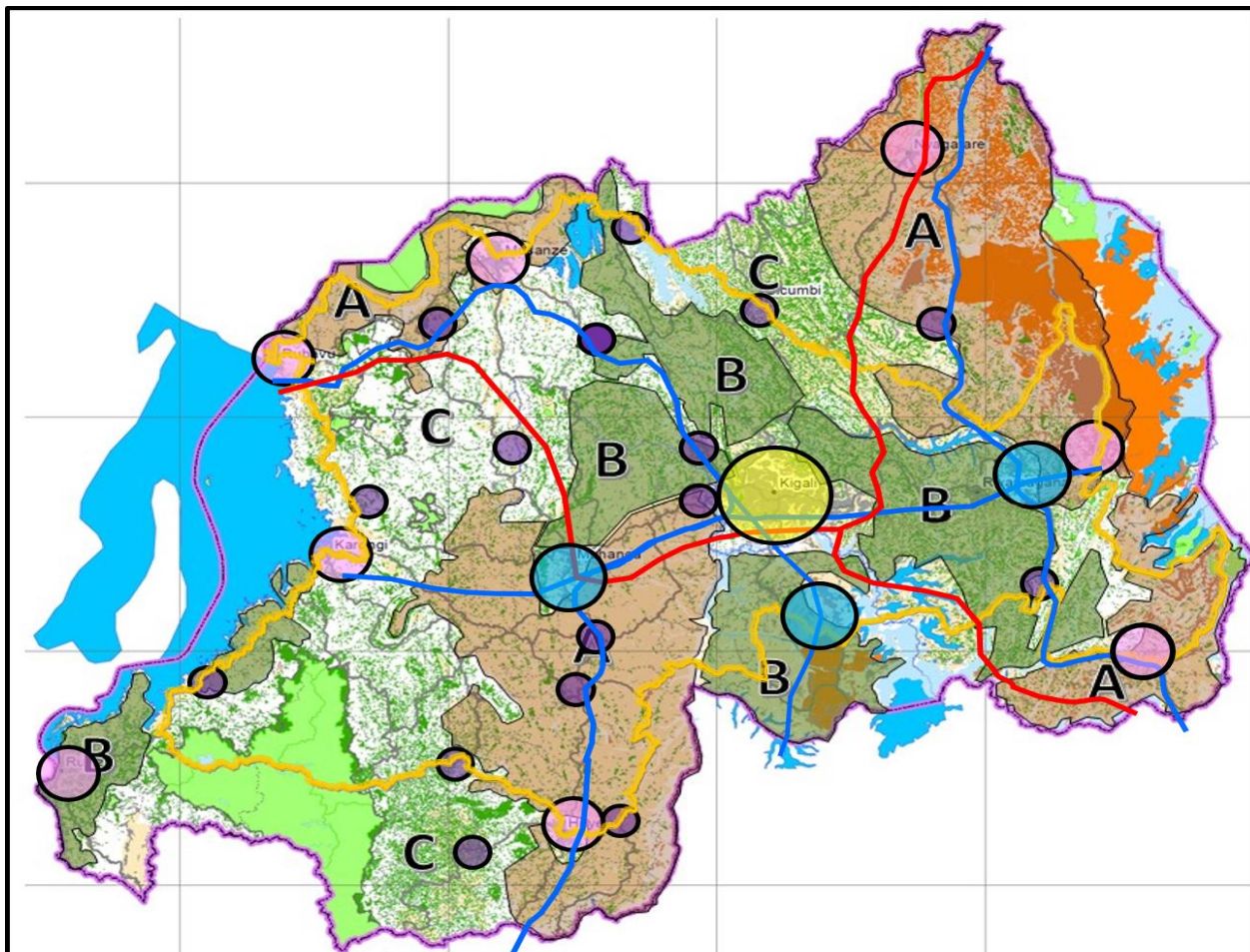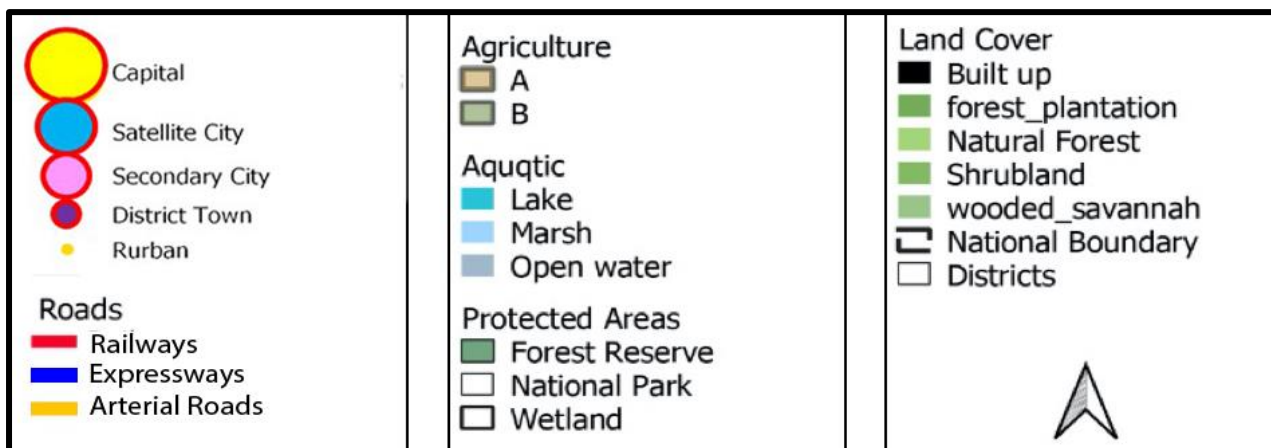

Figure 17-1 integrative land use map

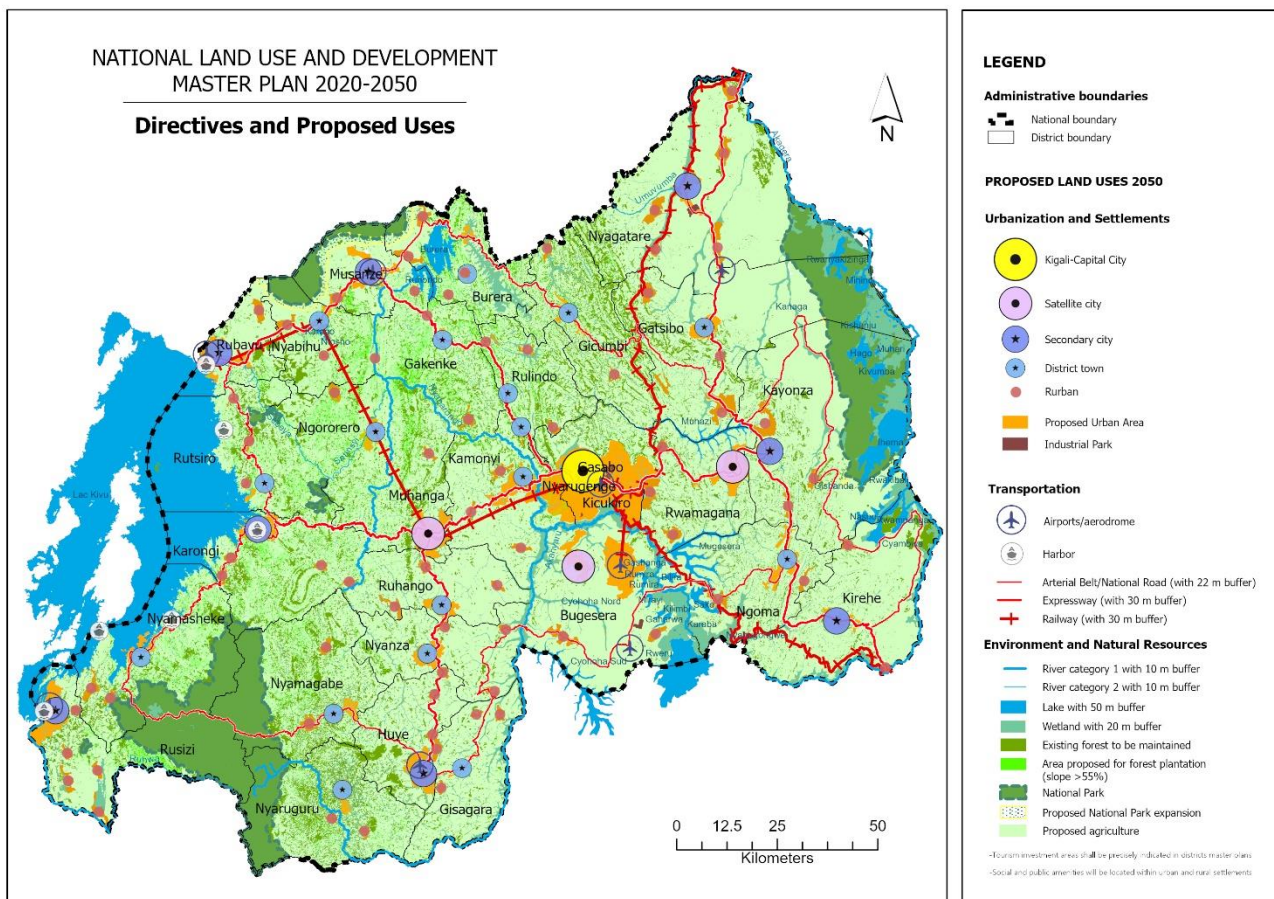Figure 17-2 Legend for the integrative land use map

Figure 17-3 NLUDMP 2020-2050 major land use zonings

17.2 Summary

1. This equilibrium in the national balance sheet of NLUDMP is a win-win solution in which every sector gets its reasonable allocation

2. 1484 km² of agricultural lands are added to the Agri stock by changing part of the savannah and shrublands lands into agriculture.

	SECONDARY Agriculture	PRIME Agriculture
1. Total Agriculture	2,919	8,414
2. Agriculture (Conditioned in Wetlands)		1,100
3. Grass Land (Livestock)	1,097	
4. Wooded savannah	1,040	
5. Shrubland	436	
6. Agriculture (not suitable)	346	

Table 17-2 Agricultural Land use

3. The three main groups of relocations are:

- The aggregate of Agriculture is the largest consumer with 12,433 km².
- The group of protected areas comes second in size – 7,320 km².
- All built-up areas and roads are third with the allocation of 3,980 km².

4. The natural conservation challenges have been reached optimally:

Natural forests	1,389
Forest Plantation	3,873
Wooded savannah	497
Shrubland	7
High Slopes (>55%)	1,554

Table 17-3 Natural conservation land use

5. The Built up areas challenges have also been reached according to the demands

1. Cities	1,477
2. Rurban Settlements	307
3. Rural Settlements (Gross)	1,241
4. Industry	88
5. Roads and Airfields	867

Table 17-4 Built-up areas of land use

18. Implementation, Compliance & Monitoring Strategy

18.1 Introduction

The purpose of this document is to provide through NLUDMP clear tools for spatial implementation in the country. Implementation, in general, provides the road-map of development on the ground for medium or short-term projects. The implementation of long-term plans is different. Its principal task is to advance the long-term guidelines and translate them into execution plans and provide to executive authorities the proper tools for controlling and enforcing compliance, legally supported.

The current legal structure does not provide sufficient tools for implementation. The deficiencies are:

- The Rwandan legal system for planning is incremental, with some existing coordination gaps that it can hardly support the land-use master planning and integrated planning.

- Under the current law system, each District Council is empowered to develop its land-use plan engineered by its economic development and poverty reduction strategy, but without any compliance control of the national Land Use and Development Master Plan.

- The law on land use planning, passed in 2012 remains silent on national co- ordination.

- Substantive rules govern each component of the spatial planning separately: the law governing modalities for protection, conservation, and promotion of environment, the law governing human habitation, urban planning law and its orders, special economic zone law, condominium law, Many other conflicting relevant laws and ministerial orders in different sectors, and national policies and directives that may affect the implementation of the National Land Use and Development Master Plan.

- There is no top-down legal hierarchy in the land-use master-planning process and regular review of the same. There is still a standalone planning, based on sector goals and plans, not an integrated perspective.

- The Government has identified the structural inadequacies that have led to un-coordinated land use planning and management. A new Land Law reform is underway to prevent the current highly decentralized Government structures of land use development.

This report will discuss NLUDMP implementation, compliance, and monitoring strategies.

NLUDMP 2011 has formulated the existing land use planning framework, as follows:

Figure 18-1 Current land use Planning Levels

The proposed sequencing of land use planning tools was not respected due to the following reasons:

- Low level of integrated planning at the national level.
- The coordination and enforcement gaps
- Limited planning capacity at the national and district level to be able to interpret NLUDMP
- Gaps in the NLUDMP 2011 to be able to guide lower-level plans
- Instead of orderly implementation, Districts adopted adhocism in their work.

18.2 New Structure of Planning Hierarchy

A new structure of planning levels is suggested, which shows the compulsory hierarchy of planning. The sequence starts in Vision 2050 through NLUDMP, District Land Use Plans, and detailed physical site planning until reaching the permitting for construction and development. The new structure is shown in Fig. 2-1 below.
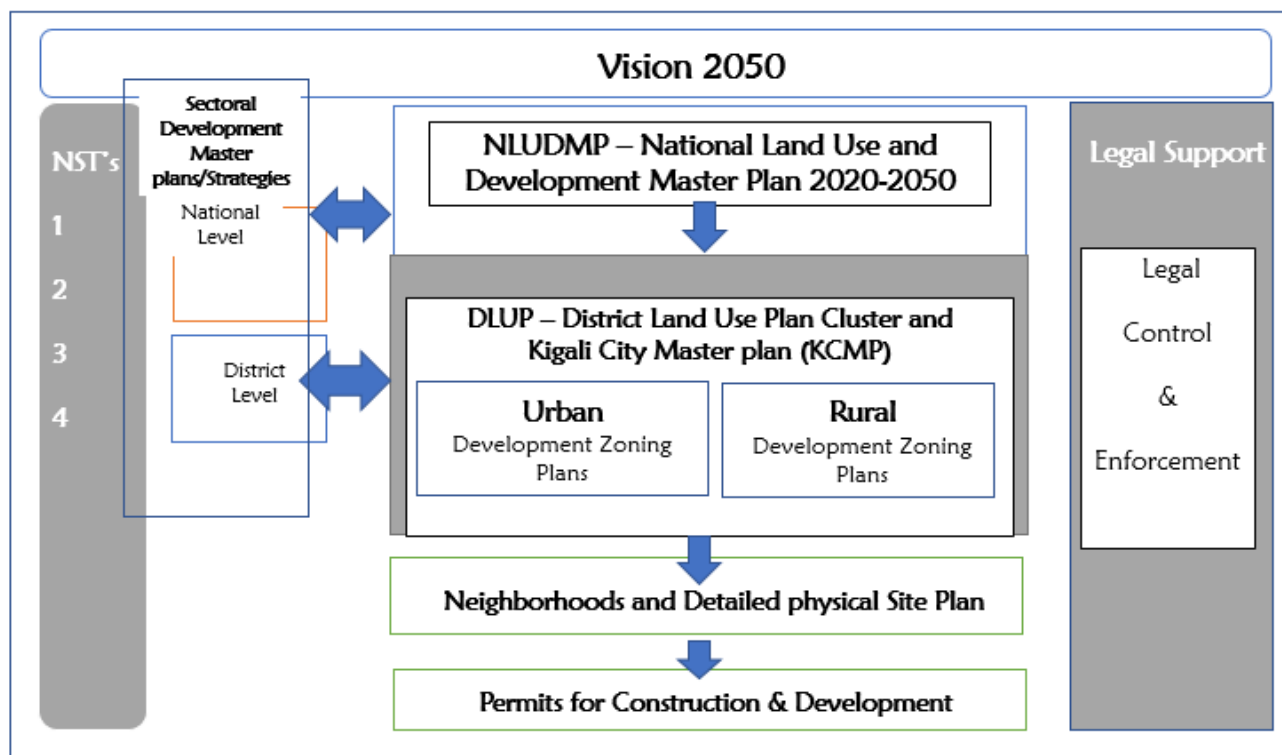
Figure 18-2 new planning framework 2020-2050

The functions of the planning levels and the dependencies between them are specified in the following section:

2.1 Rwanda Vision, 2050

Rwanda Government launched Rwanda Vision 2050, whose aspirations are to transform Rwanda from a predominantly low-income country to an upper-middle-income state within 30 years. The NLUDMP structure is aligned with that of Vision 2050.

2.2 NST, Annual Budget and MTEF

GOR annual budget and the NST's are increasingly harmonized, as planning and budgeting need to be aligned if the NST's are to be implemented. The budget is the primary tool by which the Government allocates resources to implement its plans and address emerging policy priorities. If NLUDMP's is integrated into NST's and Medium Term Expenditure Framework (MTEF) and annual budgeting, implementation will be almost automatic.

2.3 NLUDMP – National Land Use & Development Master Plan

The National Master Plan for Spatial Planning is a national spatial planning tool intended to guide the well-balanced, integrated and efficient use of land and development in the country during the implementation of Vision 2050. It is a tool for implementing Vision 2050 in spatial terms. It affects and guides all sectors of economic development towards inclusive and sustainable development.

NLUDMP 2020-2050 should be a living document. Its maintenance must include the tracking of feedbacks from lower-level planning procedures and lessons learned from the field along the way. Minor amendments to the plan can be approved continuously, but a comprehensive evaluation and the considering of a revision will be done in a cycle of 10 years i.e 2030. Rwanda Land Authority should establish a particular department, responsible for maintaining, enforcing compliance and revising the NLUDMP. Legal requirements and responsibilities for maintaining and correcting NLUDMP must be defined legally in the law.

A term of reference document for revision of NLUDMP will be prepared prior to the inception of the amendment. TOR will relate to the valid plan, chapter by chapter, and place-specific requirements to each, based on lessons from the monitoring process.

2.4 Sectoral Development master plans and Strategies

Each sector, which has a spatial dimension and requirement for land allocations for the sectoral activities, is recommended to update its master plan and strategies following NLUDMP guidelines. All land requirements are explicitly aligned with the national plan on the one hand and also based on quantitative programs for its operations. Sectoral Development Strategies will have two levels:

2.5 SDSN - Sectoral Development Strategies at National level.

These strategies will be prepared in parallel to NLUDMP and aligned with it completely. Two examples:

● National Agriculture Strategy is the most relevant and essential of all sectoral masterplans. This sector is the biggest land consumer and the one which guarantees food security. The primary purpose of this strategy is to show implementation strategies for increasing yields, sustain food market and preserve agricultural land where it is proper.

● National Land Transportation Strategy. Land, water and air Transportation schemes appear in the transportation chapter after aligning them with RTDA. The tasks of this strategy are first to finalize the criteria for the alignment of future national roads (expressways and arterial roads) and railways.

Seven other sectors strategies/master plans are optionally recommended to be assessed and probably updated as soon as NLUDMP becomes statutory:

1. Forestry and Natural Parks,
2. Water and Wetlands (+buffer zones),
3. Power and energy,
4. Mining and quarrying,
5. Human habitation (Urban, rurban and rural settlements)
6. Inlands
7. Tourism and Conservation
8. Agriculture and irrigation
9. Transportation
10. Etc.

2.6 SDSD - Sectoral Development Strategies at the District level.

These SDSD's will be prepared either in parallel to the national level strategies or in parallel to the preparation of the District Land Use Master Plan. Usually, the district level strategies can be more detailed to feed the district's land use plans with more informative data, relevant to their perspective and preferences.

2.7 DLUP - District land use Plans Cluster

A new concept of District land use Plans Cluster is highly recommended. This concept has the advantage of build-in compliance by simultaneous preparation of a package of plans at the district level and Kigali City Level.   The district land use plan cluster includes urban and rural zoning plans. It is detailing at the same time District level zones (DLUP) by integrating urban land use zoning (cities and rurban centres) and rural zoning which includes mainly the entire Imidugudu complex, agriculture zones, Forestry and infrastructures in the district. Kigali City master plan is part of this category and The District land use plan cluster should be done as Kigali City Master plan is done currently to capture the integration of the whole district.

The district land use plan cluster should comply to green principles and climate resilient strategies to become a District green land use plan. Whoever elaborates any master plan in the district should ensure the preparation of the <u>district land-use plans cluster and/or Kigali City Master Plan</u> to be developed as one package of urban and rural areas plans together to form integration at the district level and Kigali City level. The product will be <u>ONE DISTRICT DETAILED ZONING MAP and ONE KIGALI CITY ZONING MAP with zoning regulations,</u> useful for cadastral, construction permitting systems and for further local detailed physical planning. Any development of housing and infrastructure in the district should be regulated and authorized through the building permitting management information system (BPMIS) to ensure full control. With enforcement and smart permitting services, this type of planning will play a big role in eliminating the settlement sprawl, thus increases consolidation.

Statutory phasing of implementation in each land-use plan will be compulsory. **The leading idea in phasing is Tiling**, which prevents random or remoted locations of development. Each new phase must attach the previous stage geometrically. A five years' phase is recommended to be used by all district land use plans and Kigali City master plan.

The Authority in charge of land management should monitor the alignement and compliance with NLUDMP. After consolidating the 30 land use plans of 27 districts and City of Kigali, A DETAILED RWANDA LAND-USE ZONING PLAN (One Rwanda Map) will be available to guide the land use development of the country. The district land use plan can be fully revised every 10 years after evaluation.

It is therefore recommended that all new Districts Land Use Plans will be completed over a period of 4 years for all districts and Kigali City so that in the end of 2024 the entire country will be covered by Districts land use plans under the wings of NLUDMP and sectoral policies.

The district land use plan will have the following land use classification:

No.	Harmonized generic Land Use Classification for DLUPs	Harmonized land use details	Abbrev.
1	Residential	• High density • Medium density • Low density	R
2	Commercial	• Regional • City • Neighbourhood • General	C
3	Industrial	• Logistics, light industry , Warehouse, Business Park • General Industry • Mining/Quarry	I
4	Public Facility	• Education and Research facilities • Health facilities • Religious facilities • Cultural/ memorial sites • Cemetery/ Crematoria	PF
5	Public Administration	• Government offices/Police/Correctional and rehabilitation facilities/ Defence and security/ Courts/ Other •	PA
6	Forest and Open Spaces	• Recreational, Parks and open spaces/ Playground and pockets parks/ Sports and leisure facilities • Nature and Conservation areas/ Natural forest/ Afforestation/ Nature Reserves/ Steep Slopes	P
7	Agriculture	Crop farming / Agro-forestry/ Animal husbandry/ Livestock rearing/ Pisciculture/ Bee farming/ Aqua culture	A
8	Wetlands	Wetlands/ Swamps	W
9	Water Body	Lake/ Stream/ River/ Other waterbody	WB
10	Transportation	Road Reserve and Transport (Airports/ Airstrips, Bus terminal and depots, Ports, Roads and interchange, Railways and station etc, Other Transportation facilities (moto taxi park, charging stations, etc)	T
11	Public Utility	Power Plants & Stations /Treatment Plants / Sewerage Treatment Plants / Waste & Sanitation Sites and transfer stations / Fire & Emergency stations / ICT infrastructure	U

Table 18-1 Land use zoning categories

2.8 Detailed Physical plans for Local Planning Areas (LPA's)

Local Planning Areas include neighborhoods in towns, city centers, tourism sites, public facilities complexes, industrial and public utility sites, Transportation, specific area action plans, specific site project and more. It is of utmost importance to priotize the development of the detailed physical plans, land readjustments and sites servicing to ensure that the implementation is properly guided.

These physical plans are prerequisite plans for construction permits. The following land use categories should be used when preparing a Detailed Local plan for Local Planning Areas (LPA's). The specialty of these plans is in establishing new lots for construction and development.

1. Commercial LU and Lots
2. Light Industrial LU and Lots
3. General Industrial LU
4. Roads right of ways and Parking lots
5. Railways right of ways
6. Infrastructure facility Sites
7. Power lines right of ways
8. Infrastructure lines right of ways
9. Tourism LU and Lots
10. Open Space and Recreation LU
11. Agriculture LU
12. Forestry/Plantations LU
13. Natural Protection LU
14. Education LU and Lots
15. Local Public Administration LU and Lots,
16. Cultural and Art LU and Lots
17. Single Family Residential Lots
18. Low Rise Residential Lots
19. Medium Rise Residential Lots
20. High Rise Residential Lots
21. Mixed-Use areas and Lots
22. Expropriation areas for public services.

2.9 Land readjustments

Land readjustment of existing plots is also recommended to assure rational development. Where the plots are of different quality or value, area or value adjustments are made. The underlying principle is that every owner must be compensated for their land with the equivalent value or with the land of equivalent value, but organized community participatory approaches can work also in Rwanda.

The readjustment of the land transforms the irregularly shaped plots into regular and standard shape land with access to infrastructure and services, which contributes to an adequate and aesthetic implementation and thus increases the value of this land.

Landowners must be willing to participate, being provided by in-depth advice of planners and appraisal experts. A Readjustment map and appraisal documents must be approved together with the concerned detailed local plan as one unit.   Alternatively, simplified voluntary land exchange processes could be introduced. A readjustment is an essential tool for land consolidation and orderly development. However, this procedure must be included in the implementation orders of the new land and planning law.

18.3 Compliance and Monitoring

The compliance between the different planning levels is a must. As for now, compliance is missing, and many mistakes are made in the many plans, Policies, and Projects. An integration of economic and spatial planning is missing.

The purpose of this section is to set up administrative and planning tools, in which planning instructions transfer from level to level like in a relay race. Three common denominators characterize the team of runners: A common goal, they are in full compliance, and they collect feedbacks and plan their moves continuously. This metaphor should also guide the planning system: **CCP – Continuous Compliant Planning.** Adopting this principle will ensure the fulfillment of the chain of planning.

Under this concept, the following measures and procedures are required to achieve better compliance in the planning system:

1. Providing **a non-objection** to any land use plan and project by Rwanda Land Authority in charge of Land Use Management through the strong back up coordination force from MINECOFIN will be instrumental in resolving coordination and compliance issues. This will require to upgrade and strengthen technically and financially both institutions (Rwanda Land Authority/MoE and MINECOFIN) to become the high-level authorities responsible for tracking and controlling compliance of all land-use plans and projects and its spatial implications in urbanization and settlements, Infrastructure, Energy, Minerals, Oil and Gas, Transport, Education, health, Agriculture, Industry, Trade, Tourism, and Housing.

    NLUDMP dominance, ensuring that the projects and activities of all ministries & authorities comply with this plan, will be validated by a joint responsibility of the ministry in charge of Finance and Economic Planning and the Ministry in charge of Land through its institution in charge of land use management. **The national development planning and budgeting process (MINECOFIN) should ensure that sectors priorities and investments comply with the NLUDMP.**

    Strengthening the **legal and institutional framework is necessary** to support the effective implementation of NLUDMP. The new land law and its proper orders would be able to be a sole legal tool to govern the land use planning in Rwanda. All other conflicting laws and policies should be appealed. The institutional reform should strengthen the institution in charge of land use management to be able to do oversight for land use planning and management.

2. Delineate and enforce settlement boundaries. It is recommended that new boundaries will gain legal status only to supply developing needs for a period of 15 years (2020-2035). Designated land for far usage may harm rational development caused by speculative powers.   NLUDMP has proposed settlements numbers, their gross boundaries and sizes which should be improved more

accurately during district land use planning based on the NLUDMP guidelines but not exceeding 10% of the set size.   More improved boundaries would be approved by the institution in charge of land use management (currently RLMUA).

All master plans shall show implementation phases for midterm (2035) without overpassing this boundary. The areas of the development phases will be adjacent to each other to create a paving system for the efficient use of lands. The long-term boundary for 2050 will be protected for the next 15 years, allowing transitional land uses like agriculture or forest/agroforest plantation:

- New boundaries will gain legal status only to supply developing needs for a period of 15 years (2020-2035). Designated land for far usage may have a negative impact on rational development caused by speculative powers.
- Every settlement master plan has to show where implementation will focus every five years, after which evaluation would be conducted and approved before opening the next phase. The evaluation report will be accepted by a committee of institutions in charge of land management and urban planning (RLMUA & RHA) and relevant stakeholders.
- NLUDMP recommends a buffer of 4km around the urban boundary as a restricted zone for a new settlement set-up to limit urban sprawl around cities and rural settlements sites and then establish consolidated farms around them instead.
- Land readjustment of existing plots is also recommended to assure rational development. Where the plots are of different quality or value, area or value adjustments are made. The underlying principle is that every towner must be compensated for their land with the land of equivalent value or unconventional community approaches can be used for their parcels' readjustment. Statutory phasing in each land-use plan will be compulsory. The leading idea in phasing is **Tiling**, which prevents random or remoted locations of development. Each new phase must attach the previous stage geometrically.

3. **Consolidation principles in land use planning should be directed towards and applied to all levels and all sectors of land-use planning.**

- The approach of freezing and consolidation over the period 2020-2050 is strongly recommended to freeze existing establishments and impose consolidation in the proposed urban and rural settlement sites. All public and private investment programmes and initiatives should be directed in those proposed settlements boundaries.
- Agriculture land use consolidation is recommended and will be supported by progressive transformation of rural settlement system.
- Utilities and public facilities and services should be consolidated within proposed settlement sites and thus a community mobilization and facilitation programme would be established to guide the process.
- Given the limited land available, **the principle of intensification**, using small land at maximum benefit is to be adopted in tourism sector as well.

4. Discourage spontaneous individual construction and encourage professional real estate developers, housing cooperatives, and housing investment.

5. Legal requirements and responsibilities for maintaining and revising NLUDMP must be defined legally in the law.

6. Regular updating of spatial data and basemaps through large-scale mapping will greatly support the development of master plans and monitoring of land use.

7. Real-time monitoring technology like using accurate spatial data, integrated geo-information framework, Earth Observation tools, machine learning and Land Use Monitoring system is proposed. The monitoring system should be linked to an updated high-resolution ortho-imageries, upgraded Land Administration Information System, and Building Permitting Management Information system. All these systems will contribute to an interoperable environment capable of providing all necessary data for real-time analysis and warning to sectors and districts.

8. To improve the adequate performance of Building Permitting Management Information system (BPMIS) and its dissemination in all districts to serve the urban and rural construction and development permitting contrywide. BPMIS must be upgraded smartly to be interoperable with other systems enabling the remote inspection of field developments: connecting to LAIS spatial component, RRA, Land-use spatial data, and Earth observation tools.

9. Strong community outreach program and mindset change on land use in Rwanda should be organized continuously. The land use dimension of National planning should be placed in a more central role within Government policymaking. All levels of the Rwandan community from central, local leadership to a citizen have to be mobilized to understand the outstanding sense and issues of land use management and the current need for integrated efforts. It is also highly recommended to promote use of community based whistle blowers to report illegal constructions through incentives.

10. Annual Land Use and planning forums are encouraged to be organized annually for all stakeholders to discuss land use, planning, and implementation issues and take a collective decision. To develop the capacity, ownership and accountability of sectors and local government in land use development and management.

11. NLUDMP is a live organ. Its maintenance must include the monitoring of feedbacks from lower-level planning procedures and lessons learned from the field along the way. Regular data updating and minor amendments to the plan can be approved continuously, and comprehensive evaluation and update would be performed in a cycle of 7-10 years after assessment. Legal requirements and responsibilities for maintaining and revising NLUDMP must be defined legally in the law.

18.4 Settlement Boundaries

A settlement boundary delineation is a result of settlement definition before local circumstances are considered.

NLUDMP defines settlements as a combination of three parameters:

Population size + Density + Area, as summarized in Table 4-1.

Settlement Type	Population (thousands)	Density (Pop/Sq.km)	Boundary Area (Sq.km)
Kigali	<3,800	9000-10,000	<380
Satellite City	650-1,000	8,000-9,000	65-100
Secondary City	250-650	7,000-8,000	40-65
District Town	100-250	6,000-7,000	10-40
Rurban Settlement	20-100	<6,000	<10
Umudugudu	<2,200	<4000	<1

Table 18-2 Settlements Definitions

The definitions are as follows:

- A City and a town is defined as a built-up agglomeration that exceeds 20 sq.km and has than 100,000 - 3.8M permanent residents resulting in a population density of 6,000-10,000 persons/sq.km.
- A Rurban Settlement is defined as a built-up agglomeration that does not exceed 5 sq.km and has 25-100k permanent residents resulting in a population density of fewer than 6000 persons/sq.km.
- An Umudugudu is defined as a built-up agricultural agglomeration that does not exceed 0.5 sq.km and has not more than 2200 permanent residents resulting in a population density of fewer than 4000 persons/sq.km.
- Kigali, Satellite, and secondary cities are an urban area that holds authorities and institutions for central governance. District town is an Urban area that holds authorities and institutions for District governance; Rurban Settlement is an Urban area that holds authorities and institutions for Sector/local governance with emerging small scale trade, linked to agriculture produce;
- All settlements should be a gazetted area, which means that a land-use Master Plan has been approved to steer the development of the Settlement.
  - The settlement should be supplied with public services and utilities as regard to housing, education, health, recreation, transportation, commerce, industry, energy, water and sanitation, ICT, and local administration, tourism, urban forest and urban agriculture, etc.
  - The designation of boundaries is a critical implication of land use planning. A settlement boundary is a line that is drawn on a plan around a settlement, which reflects its built form. The settlement boundary is used as a policy tool reflecting the area where a set

of plans are to be applied. The settlement boundary has to cover the full extent of the Settlement according to its land-use plan. However, it should be noted that any land which has been included within the boundary has no automatic guarantee to get construction permission or planning approval

There are a few general advantages to having a settlement boundary which are:

- Certainty: with a 'blue line' being plotted on a plan, it is easy to identify the 'settlement' from 'open countryside.'
- Locally, settlement boundaries are an understood and accepted planning tool for guiding and controlling developments.
- It protects the countryside from unnecessary development and prevents ribbon development.
- Coordination and consistent approach provide a firm basis for planning applications.
- More certainty will be assured for developers or land owners within the boundary.
  NLUDMP sets five basic guidelines for delineating settlement boundaries:

1. It is recommended that new boundaries will gain legal status only to supply developing needs for a period of 15 years (2020-2035). Designated land for far usage may harm rational development caused by speculative powers. Districts will be responsible for delineating their settlement boundaries, based on the NLUDMP guidelines. Boundaries will be approved by the institution in charge of land use planning and management (currently RLMUA).

2. Settlement boundaries should be somewhat flexible, with the goal of not exceeding the size outlined in NLUDMP by more than 10%. All master plans shall show implementation phases for midterm (2035) without overpassing this boundary. The areas of the development phases will be adjacent to each other to create a paving system for the efficient use of lands. The long term boundary for 2050 will be protected for the next 15 years, allowing transitional land uses like agriculture or forest plantation. A settlement boundary delineation is a result of settlement definition before local circumstances are considered.

3. Districts will be responsible for delineating their own settlement boundaries, based on the NLUDMP proposed boundaries and parameters. Boundaries will be approved by RLMUA. Settlement boundaries should be somewhat flexible, with the goal of not exceeding the size set forth in the NLUDMP by more than 10%.

4. All master plans shall show implementation phases for midterm (2035) without overpassing this boundary. The areas of the development phases will be adjacent to each other to create a paving system for the efficient use of lands. The long term boundary for 2050 will be protected for the next 15 years, allowing transitional land uses like agriculture.

18.5 Phases of Development

Phasing of Development will be part of all land-use plans provisions below the NLUDMP, and elaborated based on the local context. The leading spatial principle in phasing is **Tiling**, which simply prevents random and remoted locations of development. A new development site must always have a common boundary with a previous one, as shown in Fig. 5-1
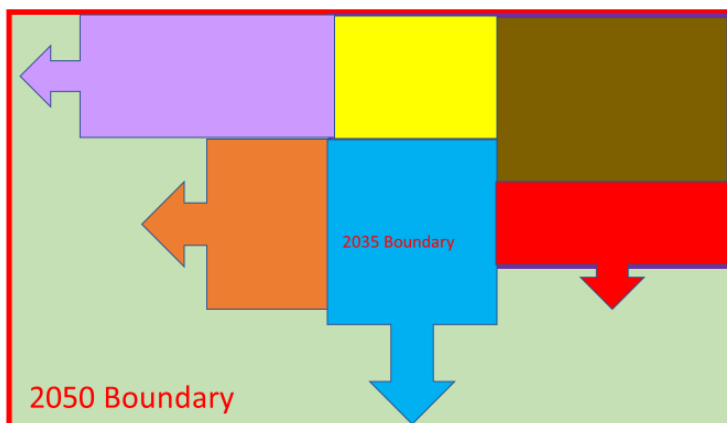
Figure 18-3 Phasing by the Tiling principle

Every settlement master plan has to show where implementation will focus every 5 years, after which evaluation would be conducted before opening the next phase. The evaluation report of each phase would be presented to institutions in charge of land management and urban planning (RLMUA & RHA) and relevant stakeholders to be a learning and decision-making tool before moving forward to implement other sites of the next phase.

18.6 Mandate and Responsibility

The institution in charge of land use management and National Spatial Planning (RLMUA) under the Ministry in charge of Environment (MoE) in a strong linkage and collaboration with a Ministry in charge of Finance and economic planning (MINECOFIN); both should be responsible and coordinate and approval the planning compliance of land use. The NLUDMP implementation is the role of other relevant technical sectors and local governments (Districts). An institution in charge of land management and National Spatial Planning (RLMUA) will be responsible for the monitoring of the compliance and implementation of NLUDMP through other lower-level land use plans. The real-time tracking using systems and ortho-imageries is recommended.

The land law provides for an organ in charge of land inspection to ensure that land allocated is put to the intended usage within the prescribed tenure. All other ministries should mostly follow and respect instructions from MINECOFIN and MoE in regard to land use management.

Continuous planning from the national to lower levels is required to actualize development programs and budgets to implement the NLUDMP.

The land use dimension of National planning should be placed in a more central role within Government policymaking. All levels of the Rwandan community from central, local leadership to a citizen have to be mobilized to understand the outstanding sense and issues of land use management and the current need for integrated efforts. Annual Land Use and planning forums are encouraged to be organized annually for all stakeholders to discuss land use, planning, and implementation issues and take a collective decision.

The vast demand for preparing plans will be supplied by planners that have not been involved in the process of this national plan. However, the spirit and approach should be preserved and guide the lower planning levels. The recommended way to achieve compliance with the national strategy in

terms of methodology and content is to initiate **Model Plans** for each plan level in the chain. These Model/Demo plans will demonstrate the required approach, methods, and deliverables in each planning level.

Rwanda Land Authority will initiate district land use demo plans to ensure the alignment with NLUDMP and capacity building to districts . The expected contributions are the following:

☒ Demonstration on how to use NLUDMP documents and GIS database for the relevant ministries & authorities,

☒ Support the political will, commitment, and sense of ownership of the Plan by ministries & authorities.

☒ Emphasize the need to have a well-coordinated and shared responsibility within Government and the private sector, development partners, civil society, and other non-Governmental organizations.

☒ The alignment of budgeting for national projects will be realized through ensuring the harmonization of the NLUDMP with the Projects.

☒ Establish advanced management of information for decision making.

☒ Clarify the roles and responsibilities of actors and effective partnerships with non-Governmental organizations.

☒ Increase human resource capacity and create a conducive working environment for Planning at all levels.

The following Distribution of Responsibilities is proposed:

- Strengthening the legal and institutional framework is necessary to support the effective implementation of NLUDMP. The new land law and its proper orders would be able to be a sole legal tool to govern the land administration and use in Rwanda. All other conflicting laws and policies should be appealed. The institutional reform should strengthen the institution in charge of land management to be able to do oversight for land use planning and management.

- NLUDMP proposal is to upgrade and strengthen technically and financially the institution in charge of land management (currently RLMUA). RLMUA will become the high-level authority responsible for tracking and compliance controlling of all land-use planning and its spatial implications in urbanization and settlements, Infrastructure, Energy, Minerals, Oil and Gas, Transport, Education, health, Agriculture, Industry, Trade, Tourism, and Housing. These operations in RLMUA will be established through Governmental regulations.

- NLUDMP influence and priority will be increased to ensure that activities of all ministries & authorities comply with this plan. This will be validated by a joint responsibility of the Ministry in charge of Finance and Economic Planning and the Ministry in charge of Land through its institution in charge of land use management (RLMUA) .

- NLUDMP proposal is to upgrade Institution in charge of Land use management and planning to become the high-level authority responsible for tracking and compliance controlling of all

land-use planning and its spatial implications in Infrastructure, Energy, Minerals, Oil and Gas, Transport, Education, health, Agriculture, Industry, Trade, Tourism, and Housing. These operations in Rwanda Land Management and Use Authority (RLMUA) will be established through Governmental regulations. Rwanda Land Authority/MoE is suggested to lead also NLUDMP dominance, ensuring that the projects and activities of all ministries & authorities comply with the national plan.

- The power of the Institution in charge of Land use management and planning will be in a statutory position to provide a Non-Objection to all land use plans in linkage with MINECOFIN.

Table 6-2 shows the **distribution of responsibilities** for operating the planning phases, and Table 6-1 is the legend for table 6-2. The table defines what an institution is responsible for preparing plans or strategies, what Central vs. Local Government institution is responsible for approving plans and what authority is behind controlling the whole process.

Plan Preparing	The act of preparing a Land Use Plan
Strategy Dev.	The act of developing a Strategy
Appr 1	Low-level statutory approval
Appr 2	High-level Final statutory approval.
Cab. Appr	Cabinet statutory approval
Full Control	The operation of fully controlling Compliance
Sampled Control	The operation of sampled controlling Compliance

Table 18-3 legend for Planning operations

Plan level		Cabinet	GOV. Sectors	RLMUA	District's Committee			Sector's Comitee
					District Executive Committee	City Council, City Executive Committee	RLMUA	
NLUDMP		Cab. Appr		Plan Preparing Appr 1				
Sectoral Strategy			Strategy Dev.	Full Control	Strategy Dev.			
District Plans Cluster	DLUP	Cab. Appr		Full Control	Plan Preparing Appr 1			
	Urban/ Rurban develop.plan	Cab. Appr		Full Control	Appr 2	Plan Preparing Appr 1		
	Rural develop. plan			Full Control	Appr 2			Plan Preparing Appr 1
Local/ Neighborhood plans				Sampled Control.	Full Control Appr 2	Design Appr 1		Design Appr 1
Permits					Sampled Control.	Appr 1		Appr 1

Table 18-4 Planning, Approval, and Control responsibilities.

18.7   Action against non-compliance

-   Ministry in charge of national planning will not approve the budget for the development project that is not aligned with NLUDMP. This can be done during the planning and budgeting process.
-   Rwanda Land Authority will not approve a different land use contrary to the NLUDMP. Rwanda Land Authority will be given the mandate to take Legal and administrative steps against any specific authority if it does not comply with NLUDMP, and its lower level plans or any kind of implementation conflicts with it.

18.8 Legal Support

The Government has identified the structural inadequacies that have led to un-coordinated land use planning. The new Land Law reform which holds the view to change legal procedures and prevent the current highly decentralized Government structures of land use master-plan.

The draft land law that is currently undergoing legislative process enshrines provisions for land-use planning and management. It creates a legally supported and structurally implementable land use master-planning, allowing an over-arching plan to guarantees optimal usage of the Rwandan land resources. The draft should be expedited, and the law promulgated to give legal credence to the land use master-planning and its on-going review/overhaul.

The draft land law provides for penal sanctions, which are aligned to penal code provisions.

There is a need for a review of all other relevant laws and regulations, including those that vest powers into institutions and organs to plan and manage land use. Such acts should be harmonized with the land law and other rules that are relevant for a nationally coordinated planning and management of land use across all sectors.

NLUDMP has evaluated the draft law and suggested some amendments and comments reach a proper alignment with the national plan.

Conclusions:

1. Legal requirements and responsibilities for maintaining and revising NLUDMP should be defined legally in the law and all other policies and regulatory frameworks should be harmonized with this national plan.
2. The approval procedure and responsibilities in the current legal instruments are not aligned with the specific recommendations in this report. An harmonization of laws is needed.
3. The law does not speak of the option that the central government can initiate District or local plans by itself or orders local governments to prepare them.
4. The proposed principle of District Plans Clusters should be anchored in the law.
5. Consolidation principles in land use planning are directed in the law towards agriculture only. It should be applied to the context of Urban and Rural settlement planning as well.

-   **END -**