National Strategy on Climate Change and Low Carbon Development for Rwanda

Baseline Report

PUBLISHING INFORMATION

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"The environment is our life-blood; indeed the real surprise is not that ministries of finance are now talking to ministries of environment – but that it has actually taken this long. Even when we look beyond agriculture, tourism, mineral wealth and fisheries, our economies depend critically on good environmental stewardship."

His Excellency Paul Kagame,
President of Rwanda 2009

THE SMITH SCHOOL VIEW

"Our climate is changing and we are causing it to change. While developed countries struggle to reach agreement, many leaders in the developing world are striding forward, meeting challenging goals in order to reduce the impact on their nations, while continuing development. Rwanda is one such country. Under the leadership of His Excellency Paul Kagame, Rwanda has made remarkable progress in economic development. With the assistance of the Climate & Development Knowledge Network and the Department for International Development, through the Smith School of Enterprise and the Environment, significant steps will be made towards sustainable and robust development strategies. This can only be possible through the in-depth and continuing support of the Government of Rwanda, whose efforts will ensure this project succeeds in its aims. This baseline report is the first stage in a unique opportunity to create a low-carbon, climate-resilient development plan, taking Rwanda into a sustainable, and above all a prosperous, mid-century as a middle income economy."

Professor Sir David King FRS
Oxford 2011

VIEW FROM RWANDA

“The elaboration of a Climate Change and Low Carbon Development Strategy marks a significant turning point in the development paradigm Rwanda is contemplating. Sustainable development will indeed be effective only if articulated by climate resilient and low carbon economic growth. The extensive appraisal reflected in this baseline report provides appropriate grounds to effect a new planning framework that will proactively take into account recurrent shocks relevant to the impacts of global climate change. ”

Honourable Minister Stanislas Kamanzi
Kigali 2011

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“The danger posed by war to all of humanity - and to our planet - is at least matched by the climate crisis and global warming. I believe that the world has reached a critical stage in its efforts to exercise responsible environmental stewardship.”

Ban Ki-moon
UN Secretary General

EXECUTIVE SUMMARY

This Baseline Report is the first step in the process of developing a National Strategy on Climate Change and Low Carbon Development for Rwanda. It provides a snapshot of the country today and the planned initiatives that will take it forward, placing it within the context of climate change. Though many opportunities are highlighted, the aim of the report is to provide the foundation for the next step where detailed analysis will take place and recommendations will be made.

Rwanda is a small, hilly, landlocked country in East Africa with the highest population density in Africa. It has strong leadership and good governance, which have enabled it to develop rapidly: it has experienced an average GDP growth rate of 8.5% in the past five years. Rwanda's collective vision for development is embodied in Vision 2020, which seeks to transform the country from a subsistence agriculture economy to a knowledge-based middle income economy by 2020. Export revenues are dominated by minerals, tea and coffee while services and agriculture contribute 81% of GDP. Tourism has recently become the largest foreign exchange earner. As the population grows and urbanisation and industrialisation increase, more and more pressure is placed on the natural resources in Rwanda, notably land, water and forests. Limited infrastructure, including the transport network, electricity grid and water pipelines, hinders trade and the provision of basic amenities.

Many initiatives are under way in Rwanda to address these challenges but there is a new challenge that needs to be addressed – that of climate change due to global warming. Rwanda is highly vulnerable to the impacts of climate change although lack of sufficient data means that regional climate change projections are uncertain. Agriculture, the source of employment for 80% of the population, is most at risk. Rwanda is currently dependent on hydropower for 50% of its electricity, making it vulnerable to changes in rainfall. Regional planning of hydropower plants has based maximum capacity on current river flows, which are likely to change. As temperatures rise, diseases will spread posing health risks to the predominantly poor population. Planning for the future in Rwanda needs to take all these changes into account to become climate-resilient.

The root cause of global warming, the burning of fossil fuels, needs to be addressed on a global scale. Rwanda, as a Least Developed Country (LDC), is not required to cut its greenhouse gas (GHG) emissions and currently is a net carbon sink thanks to forest sequestration. However, GHG emissions are expected to rise as the country's economy grows. Rwanda is currently dependent on oil imports for transport and 45% of electricity generation. Moving to a low carbon economy would reduce vulnerability to oil price spikes and improve energy security. As an LDC, Rwanda has priority access to international climate finance: developing a National Strategy on Climate Change and Low Carbon Development will facilitate that process.

This Baseline Report addresses various sectors of the economy individually for the specific purpose of gaining deeper insight. But sectoral integration is crucial in the development of a national strategy, and this will be a key component of the next stage. The project recognises the challenges of low capacity and funding. It aims to build local capacity, especially in the areas of climate finance and climate data collection and analysis, and will contribute to the establishment of a Climate Centre.

“We must use time wisely and forever realise that the time is always ripe to do right.”

Nelson Mandela

1. INTRODUCTION

Climate change poses the greatest global challenge of our day. It requires us to reduce our dependence on fossil fuels and to learn to adapt to new climate-related risks. For developing countries, poverty alleviation and human development have become an even greater challenge. Oil importers like Rwanda will be exposed to price shocks, threatening energy security and economic growth. Decoupling a developing economy from fossil fuels – low carbon development – and climate-proofing key economic sectors is a priority for stable growth. The Government of Rwanda has recognised this and is committed to addressing climate change with the same determination that it has shown towards socio-economic development. Rwanda's development vision is embodied in Vision 2020 which aims to transform the country from a Least Developed Country (LDC) to a middle-income economy, with an income of 900 USD per capita by 2020[1]. With real GDP growth rates of 8.5% in the past five years, Rwanda is on track to meet the Vision 2020 targets. However, this economic growth has implications for Rwanda's impact on the environment, and it is vulnerable to climate impacts and oil price shocks. In consequence, the Government of Rwanda (GoR) has commissioned the development of a National Climate Change and Low Carbon Development Strategy for Rwanda. The strategy aims to:

- Develop a roadmap for future climate resilient and low carbon economic growth in Rwanda
- Build on existing climate change initiatives and opportunities that are currently being undertaken in relative isolation in Rwanda
- Provide a framework around which detailed sectoral studies and implementation plans can be built
- Develop local capacity in sourcing, applying for and obtaining international climate funding
- Contribute to the implementation of a Climate Centre in Rwanda to improve climate data and models for the region

Many developing countries have produced climate change strategies or action plans, including Bangladesh, Kenya and Zambia. Low carbon development studies are less common, however, with early movers being Brazil, China, India, Indonesia, Mexico, Poland, South Africa, Guyana, Costa Rica and South Korea. The studies identify greenhouse gas (GHG) mitigation potential, assess the costs and benefits of lower carbon growth pathways, examine financing sources and mechanisms to address the additional costs, characterise appropriate policy support, and identify projects and programmes that contribute to growth and development goals while curbing GHG emissions[2]. Rwanda has the opportunity to join this group of early movers on low carbon development but would be the first LDC to do so. This will position the country well to be eligible for international climate finance for mitigation and adaptation. Key success factors in developing low carbon development strategies to date have been[2]:

- Senior government leadership
- Robust data and scientific and economic analysis
- Stakeholder engagement
- Consensus building around priority sectors

Rwanda has started the process well, with full support from His Excellency President Kagame and his Cabinet. Stakeholders in government, donor agencies, NGOs, academia and the private sector have been involved in the scoping phase of this project. This Baseline Report is a snapshot of Rwanda, taken during a three-week period in November and December 2010 by the Smith School of Enterprise and Environment (SSEE) research team, and aims to define the current and ongoing projects. It was reviewed by the SSEE team of expert advisors, the government steering committee, and the funders,

Figure 1.1: Major features of Rwanda and its locality[3]

CDKN and DFID. Owing to the rapid nature of development in Rwanda some of the information included in this study will already be out of date; this illustrates the challenge of producing a national framework in such a dynamic environment. The objectives of this report are twofold: to refresh and expand the research team's knowledge of Rwanda; and to provide the foundation for the second stage of the project. The second stage will involve detailed analysis of current and potential opportunities and is explained in more detail in the final chapter of this report.

Rwanda Today

Rwanda is a small, landlocked country in equatorial East Africa covering 26,338 km^2, bordering the Democratic Republic of Congo (DRC), Burundi, Uganda and Tanzania (figure 1.1). Rwanda is known as the "land of a thousand hills" as its terrain is characterised by steep slopes and green hills, upon which its predominantly rural population survive on subsistence agriculture. About 45% of land in Rwanda is arable, with an estimated 22% forested and 18% pastureland. Thanks to its altitude (950 to 4,500m ASL), Rwanda enjoys a temperate climate and has a bimodal rainy season with mean annual rainfall of 1,028mm. This drains into two major river basins, the Nile in the east and the Congo in the west. The geology of Rwanda is dominated by the Kibaran Belt, which also underlies parts of Tanzania, Uganda, Burundi, DRC and Angola and is known to be widely mineralised, hosting deposits of tin, tungsten, coltan, gold and semi-precious stones. With just over 10 million people, Rwanda has the highest population density in Africa at 370 people per square kilometre; the population is growing at 2.8% per year (the global average is 1.16%) and is expected to reach 13 million by 2020 (figure 1.2)[4]. This is mostly due to a high birth rate (5.41) but also to incoming refugees and the returning diaspora. The population is young, with over 41% under the age of 14, but life expectancy is low (50.1 years compared to a global average of 68.9 years)[5]. Only 20% of the population lives in urban areas, and 44% of those are in the capital city, Kigali. Rwanda was granted the United Nations Habitat Scroll of Honour Award in 2008 for its urban projects improving the local environment, access to amenities and quality of life in Kigali. It is one of the cleanest and safest cities in Africa.

Rwanda is a developing country with 56% of its population living below the poverty line. It has a Human Development Index (HDI) of 0.385, ranking 152nd out of 167 nations[6]. It has however achieved

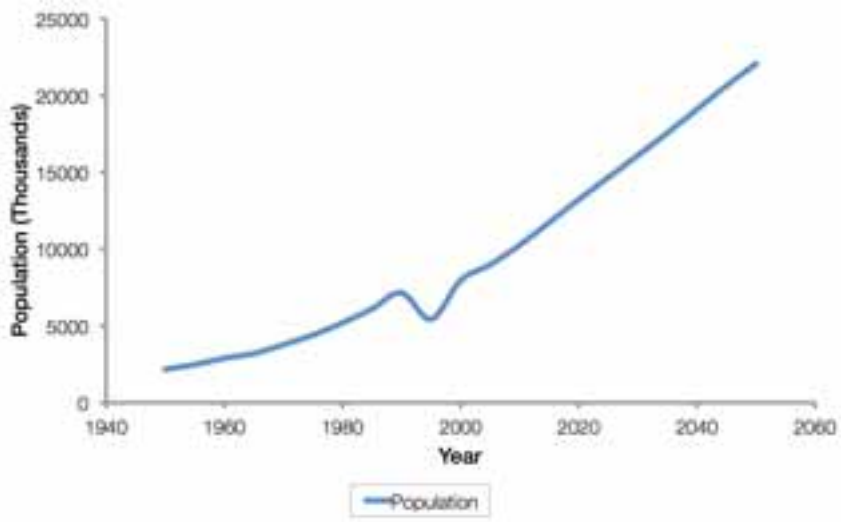


Figure 1.2: Rwandan Population[4]

significant economic growth in the past five years, and currently has a per capita income of 560 USD, up from 200 USD in 2000 when Vision 2020 was drafted. The vision is to transform Rwanda from a subsistence agriculture economy to a knowledge-based society, with high levels of savings and private investment, thereby reducing the country's dependence on external aid. The Economic Development and Poverty Reduction Strategy (EDPRS) is a framework for the implementation of Vision 2020 in the medium term[7], from 2008 to 2012. It aims to guide the actions of the GoR, mobilise resources from donors and involve the private sector and civil society. EDPRS addresses four cross-cutting issues, namely gender, social inclusion, HIV/Aids and the environment. Rwanda's commitment to its vision is shown by its parliament, more than half of whom are women. A new EDPRS II will be formulated in 2012.

Along with Kenya, Tanzania, Burundi and Uganda, Rwanda is part of the East African Community (EAC), which encourages the free movement of goods, services, labour and capital and will promote private sector development in Rwanda. Attention to the sensitivity of regional relationships, particularly concerning the exploitation of resources, is key in ensuring regional security. Water supply, transport systems and energy supply all have significant regional impacts and cross-border collaborations are in place to ensure the success of development strategies.

Climate and Meteorology

Rwanda is located astride two key climate regions, East Africa and Central Africa, with contrasting controls and drivers on climate. As a result the region is difficult to simulate in climate models, and climate projections are uncertain. Climate model scenarios show future increases in mean annual temperature of up to 3.25°C for the region by the end of the century. Changes in rainfall are more uncertain, though most of the models show that rainfall will increase. These projections are based on downscaling of global climate models to a single station in Rwanda (Kigali Airport); limited regional climate modelling has been carried out that captures Rwanda's unique regional setting and climatology. For example, El Niño and La Niña phenomena are associated with heavy rains and severe dry conditions respectively, with impacts varying considerably over space and time. The intensification and relaxation of synoptic systems determine the sources of moisture injection into the country, along with movement of the Inter Tropical Convergence Zone (ITCZ). Other factors

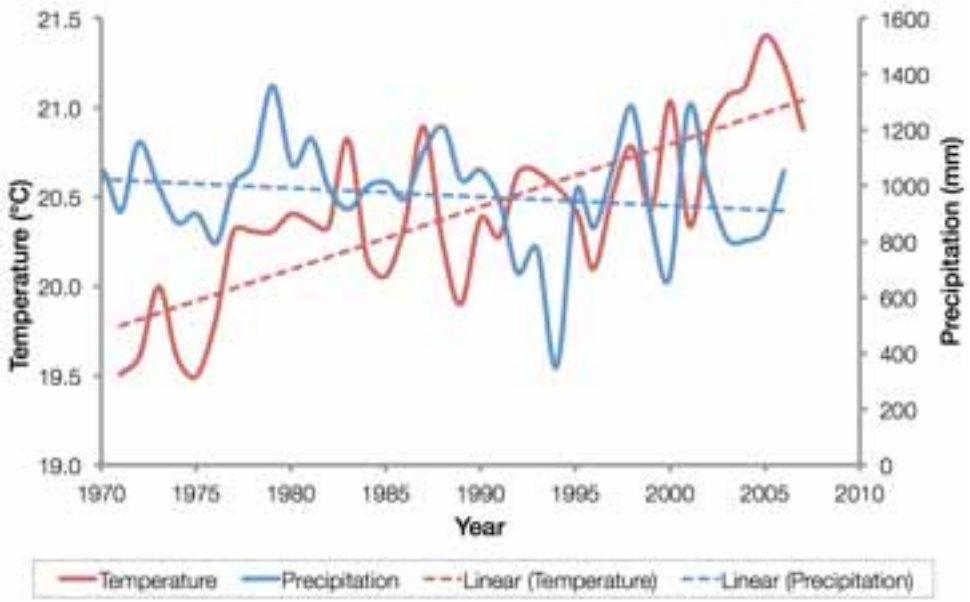


Figure 1.3: Variation of annual average temperature and rainfall at Kigali airport Station[8].

listed by the Rwandan Meteorological Service as influencing the country's rainfall are[8]:

- Subtropical anticyclones
- Congo air mass
- Inter-seasonal wave variation
- The Mascarene, Azores, St. Helena and Arabian high-pressure systems
- Regional topography, large water bodies (e.g. Lake Kivu), and large forests

Historical records show that there has been an overall rise in temperature and reductions in annual rainfall[8] (figure 1.3). A shift in the timing of rainfall seasons is being experienced in some regions, with significant impacts on rain-fed agriculture.

Climate Centre

Observed climate data is essential for climate model development, and - particularly given the small size and unique location of Rwanda - a sound observational network is vital for downscaling climate forecasts and climate change projections. This is required to integrate climate change into economic development planning. Prior to the 1994 conflict, over 100 stations provided regular meteorological observations, with some records going back to the 1900s. This historical data has yet to be added to Rwanda's digital data bank, and there is opportunity for liaison with the Belgian Technical Corporation (BTC) and Belgium Embassy to investigate colonial era data. Between 1994 and 2009 there are complete records only from the Kigali Airport station. Currently there are 13 synoptic stations and five automatic stations, which provide data at hourly intervals, along with 26 rainfall stations and 38 more planned for installation. In addition to these stations, the Ministry of Agriculture (MINAGRI) operates 88 rainfall stations for agro-meteorological purposes. For the last five years, there are good three-hourly, daily and monthly records of their observations.

Improved infrastructure and information are also important for the prevention and early warning systems (EWS) that Rwanda is developing. This will in turn inform adaptation and future investment planning, as well as address root causes of vulnerability. The establishment of a Climate Centre will be an important step in this process and will be a focus of the next

stage of this project. This will be supported by Meteo Rwanda's recent designation as an autonomous agency, no longer under the auspices of the Ministry of Infrastructure (MININFRA).

Adaptation

Findings from the Economics of Climate Change in Rwanda[9] study highlight the need for adaptation and disaster prevention. The study shows that existing climate variability has significant economic costs in Rwanda. Periodic floods and droughts already cause major socio-economic impacts and constitute an external shock that reduces economic growth. Major floods occurred in 1997, 2006, 2007, 2008, and 2009, when heavy rainfall resulted in infrastructure damage, fatalities and injuries, landslides, loss and damage to agricultural crops, soil erosion and environmental degradation. In some regions of the country, particularly in the east, periodic droughts (for example in 1999/2000 and 2005/6) have undermined agricultural production. Rwanda therefore has a current adaptation deficit, and is not adequately prepared for existing climate risks. To plan robustly for adaptation to future climate change, it will be critical to take this deficit into consideration, along with projected socioeconomic development and demographic change.

The physical impacts and economic costs of current climate variability and events in Rwanda are already very significant. The country has high land use pressures coupled with erosion from steep slopes, along with floods and rains, and in some eastern regions there are desertification trends due to droughts. Extreme events have had dramatic impacts across the key economic sectors of agriculture, infrastructure and health. Factors contributing to Rwanda's underlying vulnerability include:

- High levels of poverty and low adaptive capacity
- High population density and shrinking land availability
- Reliance on rain-fed and low input agriculture for 90% of households
- Reliance on biomass energy
- Severe land and resource degradation

The GoR has responded to the unplanned environmental degradation with a number of projects, including a national tree-planting scheme and wetland restoration, for which Rwanda won the Green Globe Award in 2010.

Table 1.1: Greenhouse gas emissions in 2005 [11]

Greenhouse Gas Sources	CO_2 (Gg)	CH_4 (Gg)	N_2O (Gg)	NOx (Gg)	CO (Gg)	NMVOCs (Gg)	SOx (Gg)	CO_2 eq (Gg)
Total National Emissions	**531**	**71**	**10**	**14**	**2,327**	**42**	**18**	**5010.4**
Energy (fuel combustion)	380	20	0	14	361	42	18	891.3
Energy Industries (petroleum)	45	-	0	0	0	0	0	-
Manufacturing industries and construction	28	-	0	0	0	0	1	-
Transport	274	-	0	7	17	3	0	-
Other (residential - biomass)	34	20	0	7	344	38	17	-
Industrial processes (cement and lime production)	151	-	-	0	0	0	0	150.5
Agriculture	-	49	10	0	9	0	0	3909.9
Land-use change and forestry (LULUCF)	0	0	0	0	1,957	0	0	10.9
Waste (disposal and handling)		3	-	0	0	0	0	47.25

Greenhouse Gas (GHG) Emissions

Rwanda has one of the lowest emissions per capita in the world, estimated at 0.65 tonnes CO_2/person (including land use change), compared to a global average of 4.63 tonnes CO_2/person. In January 2010 the GoR submitted its Second National Communication (SNC) to the UNFCCC with a GHG emissions inventory for the reference year, 2005 (Table 1.1). The majority of GHG emissions were CO_2 (87%) at 531Gg, dominated by transport (52%) and industrial processes (28.5%). Total CO_2 sequestration was 9,000Gg and land use change (conversion of forests and grasslands) was -545Gg making Rwanda a net carbon sink. CO_2 emissions from biomass and bunkers (aviation) were 7,228Gg and 17Gg respectively but are memo items only. The aggregate emissions or total CO_2 equivalent, used for measuring global warming potential, amounted to 5,010.4Gg in 2005, dominated by agriculture (78%) and energy (18%). Nitrous oxide (N_2O) and methane (CH_4) are the most potent greenhouse gases contributing 62% and 26% of aggregated emissions. Four key sources contribute 91% of aggregate emissions:

- N_2O from agricultural soils (57%)
- CH_4 from enteric fermentation in domestic livestock (19%)
- CH_4 from residential energy from fuel combustion (8%)
- CO_2 from road vehicles (5%)

The SNC recognises that there are uncertainties in the GHG emissions due to inadequate representation, lack of basic data and application of emissions factors for different conditions. The GoR has recognised the need for the National Institute for Statistics to include climate change and low carbon-related questions in the data collection process to improve confidence in the figures.

GHG emissions have shown an upward trend, from 2,896.34Gg in 2003 to 5,793.45Gg in 2006, and have continued to increase as Rwanda's economy has grown over recent years. In 2009 a Rapid Assessment of a National Energy and Low Carbon Path[11] reported emissions projections for key sectors, as shown in figure 1.3; these indicate that Rwanda's emissions will increase by 50% by 2020 and that it will become a nett emitter in 2012. Owing to the rapid development in the energy and other sectors in Rwanda, these projections need to be revisited.

Figure 1.3: GHG emissions and sinks of Rwanda[11]

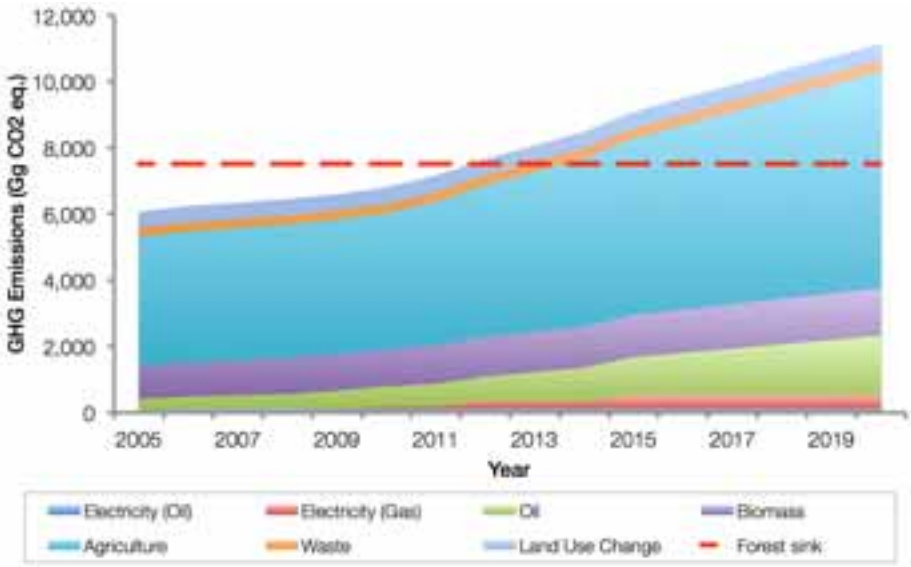


Figure 1.4: GHG emissions and sinks of Rwanda[12]

Oil Reliance

Rwanda imports all of its oil requirements for energy generation and transport, at a cost of 210 million USD (2009 dollars) which was 4.7% of GDP in 2008[12]. Rwanda's heavy reliance on imported oil puts it at risk from oil price spikes, which directly impact GDP. An example of this was the inflation spike from 5% to 20% in 2008 (figure 1.4). This was directly attributed to the increasing global oil price, with inflation reducing to 2007 levels once the oil price crashed. Further development reliant on fossil fuels will only make Rwanda's economy more susceptible to such price shocks. For a robust development strategy, Rwanda's economy must be decoupled from oil.

A country's vulnerability to oil prices is a function of the degree to which it relies on imported oil and its oil intensity, or the amount of oil consumed per unit of economic output. For example, using 2010 oil prices, a hypothetical oil price rise of 10% would result in GDP losses of approximately 1.5% in Rwanda, compared to 0.55% in the USA. Owen and King (2010) suggest the following key points[12]:

- The cumulative cost of oil (direct and indirect) to the Rwandan economy could be about 30% of GDP over the period form 2010 to 2030.
- Investment in alternative energy carriers, technologies, demand-side measures, industry etc. of a magnitude equivalent to potential losses associated with forecasted high oil prices is sufficient to reduce oil dependency to acceptable levels.
- Postponing investment in measures that decouple oil demand from economic growth will increase the challenge of doing so in the future.
- International Climate Financing Mechanisms

A wide-range of climate financing opportunities currently exists, or is under development, to address adaptation and mitigation in developing countries such as Rwanda. Mitigation financing through emissions trading schemes is the most advanced and well-known operational mechanism; in 2008 the global market was valued at over 119 billion USD. Compliance markets, represented by the Clean Development Mechanism (CDM) under the UNFCCC, consistently make up 99% of the total carbon market, with the non-compliance or Voluntary Carbon Market (VCM) remaining very small. CDM facilitates mitigation by developed countries that purchase carbon credits through projects in developing countries. Rwanda is currently facilitating development and registration of CDM and, to a lesser extent, VCM projects, focusing

on energy and forestry (afforestation and reforestation), with some (costly) potential for waste sectors. Adaptation financing is less straightforward owing to the challenges behind adaptation as a concept and the delayed nature of negotiations. A wide array of funds have emerged to help "fill the gap", with particular focus on developing countries, least developed countries (LDCs) and small island developing states (SIDS). Rwanda is receiving adaptation funding from a number of these sources (e.g. LDCF). The official UNFCCC Adaptation Fund (AF) released its first funds to Senegal in 2010. Rwanda applied to register its National Implementing Entity (NIE) in late 2010. Rwanda's climate change strategy may benefit from designating adaptation investment plans by key themes identified by the AF as a method of shaping priorities and efficiently advancing funding applications across key sectors and ministries.

In the follow-up to the Copenhagen Accord in 2009, the Cancun Agreement was concluded at the UNFCCC Conference of Parties (COP) in 2010. The Agreement set out the operationalisation of funding for adaptation and mitigation in developing countries. This presents an opportunity to address the financial barriers facing Rwanda's climate action. Outcomes of the Cancun Agreement that are particularly relevant for Rwanda are summarised in table 1.2. Rwanda's efforts in forest conservation and prevention of degradation from communities and agriculturalists would likely qualify for support under REDD+ financing. Developing countries have been requested to prepare strategies, develop reference levels and create monitoring systems for REDD+ and should form part of Rwanda's strategy development. It is important to note that the REDD+ currently omits non-forest sustainable land management such as agriculture and soil carbon conservation, which require a separate mechanism. This is highly relevant to Rwanda, given its dependence on agriculture, and has significant adaptation co-benefits. There are a number of key issues regarding this funding strategy which are important considerations for Rwanda:

- It is unclear where this money will come from, and whether promises of its delivery will be kept

Table 1.2: Key outcomes of the Cancun Agreement, December 2010, Cancun Mexico

Negotiation issue	Outcome
Shared Vision	To limit global average temperatures to a 2°C increase
Finance	30 billion USD is set out for developing countries in the 2010-2012 period, rising to 100 billion USD by 2020. Call for creation of a Green Climate Fund through which a significant part of the finance would be transferred
Mitigation	Countries to define own mitigation actions, and creation of registry for developing countries to list Nationally Appropriate Mitigation Actions (NAMAs)
Adaptation	Provisions establishing a Technology Mechanism for immediate facilitation of technology development and transfer for adaptation, as well as a Technology Centre and Network (CTCN)
Forestry	Provide countries with guidance on reducing emissions from deforestation and forest degradation, and other sustainable land management practices (REDD+), with need for further clarifications and negotiations
Monitoring, Reporting and Verifications (MRV)	Strengthening developing countries' reporting on mitigation actions and support of NAMAs.
Legal Form	The Cancun Agreement, like the Copenhagen Accord, does not cover the issue of the legal form of the post-2012 climate regime. This is postponed to COP-17 in Durban, South Africa

- How the money is to be distributed is contentious
- Ensuring the money is spent effectively will be both difficult and likely to intrude on the governments of recipient nations, and jeopardise democratic decision making
- The funding may not be made 'new and additional' to ODA

Despite the significant uncertainty, the international community is making progress towards climate finance for developing countries. By developing a national strategy on climate change and low carbon development, Rwanda will improve its eligibility for funding.

Education and Capacity

Education is essential for development and is therefore a key focus area for the Government of Rwanda. According to the Education Sector Strategic Plan 2010-2015, the mission of the Ministry of Education is to transform the Rwandan citizen into skilled human capital for socio-economic development of the country by ensuring equitable access to quality education focusing on combating illiteracy, promotion of science and technology, critical thinking and positive values. Education in Rwanda is organized into two different levels, basic education (pre-primary to lower secondary school) and post-basic. On completion of nine years of basic education, students can proceed to upper secondary education, technical secondary schools or to vocational training centres. Students who successfully complete their upper secondary education can either enroll at an integrated Polytechnic Regional Centre to obtain an A1 Diploma, or they can proceed to higher education to obtain an A1 Diploma in three years or a bachelor's degree after four or five years. Graduates can continue to the masters and PhD levels.

Rwanda has nearly achieved the second Millennium Development Goal of universal access to primary education, and strongly values university education. In order for the country to achieve its ambitious goals capacity still needs to be built across all levels. Technical and vocational training is essential for the implementation and maintenance of infrastructure developments, new technologies and young industries. New university degrees are also needed to develop new growing sectors in the economy such as mining, IT and tourism. The new challenge of climate change also calls for new skills in data collection, analysis and modelling. Some of these issues are being addressed by the GoR, with graduates sponsored to study overseas and experts brought in. But as Rwanda's economy grows, its human capacity needs to grow with it.

Table 1.3: Education in Rwanda (2010)

Education Level	Number of Institutions	Number of Students	% Female	Enrollment
Pre-primary School	1,369	96,934	51.7	6.10%
Primary School	2,510	2,299,326	50.7	95.40%
Lower Secondary (O-level)	1,399	298,799	51.8	22.60%
Upper Secondary School (A-level)		126,788	48.1	
Technical and Vocational Training	75	29,217	44.9	
University	29	62,546	44	

“All across the world, in every kind of environment and region known to man, increasingly dangerous weather patterns and devastating storms are abruptly putting an end to the long-running debate over whether or not climate change is real. Not only is it real, it's here, and its effects are giving rise to a frighteningly new global phenomenon: the man-made natural disaster.”

Barack Obama

2. CLIMATE POLICY

Rwanda's development and environment context creates a unique interplay between the risks posed and the opportunities provided by climate change. High levels of poverty and reliance on vulnerable agricultural systems, along with low levels of industrialisation and other carbon-intensive activities, underscore this dynamic. As climate risks increase, Rwanda's development path will largely determine the extent of its future vulnerability and resilience.

Rwanda has priority status for protection against negative impacts of climate change as a Least Developed Country (LDC) under the United Nations Framework Convention on Climate Change (UNFCCC) and Kyoto Protocol. Rwanda has adopted principles of sustainable growth, along with climate change adaptation and mitigation, as national priorities. Steps taken to address climate risks and low carbon development opportunities include national policy measures, awareness raising activities, institutional capacity building, and project-based activities[1, 2, 3].

National Policy Measures and Strategies

Rwanda has been engaged in climate issues since 1992 and has made good progress with national policy and environmental strategies. The following timeline summarises Rwanda's progress:

1992 - participation in the Rio Conventions

1998 - UNFCCC ratified

2003 - Kyoto Protocol ratified

2005 - Initial National Communication (INC) submitted to the UNFCCC[3]

2006 - National Adaptation Programme of Action (NAPA) completed[4]

2009 - Climate Change and International Obligations Unit (CCIOU) established within the Rwanda Environment Management Authority (REMA), overseeing its Designated National Authority (DNA) to coordinate carbon market activities[5]

2010 - Second National Communication (SNC) completed, including a stand-alone mitigation strategy, the Carbon Policy and an updated emissions inventory [6]

2010 - National Implementing Entity (NIE) application submitted to access international resources under the UNFCCC's Adaptation Fund[7]

Under the SNC, priority sectors for adaptation activities include water resource management, agriculture, forest management, and health. Recommended actions for the 2011 to 2015 period are complementary and, in many cases, identical to six broad priority adaptation options highlighted in the NAPA:

- Integrated Water Resource Management (IWRM)
- Early warning and agro-meteorological information systems with rapid response mechanisms
- Promotion of non-agricultural income generating activities
- Promotion of intensive agro-pastoral activities
- Introduction of drought-resistant species

From these options, seven projects were identified as urgent to address cross-cutting impacts to improve the adaptive capacity of populations, vulnerable sectors and ecosystems[6]. The Priority NAPA projects are[4]:

- Land conservation and protection of vulnerable regions
- Establish hydro-meteorological information and early warning systems
- Development of irrigated areas by gravity water systems in drought-vulnerable zones
- Support Districts of vulnerable regions in planning and implementation related to conservation, water harvesting, intense agriculture and new crop varieties
- Increase adaptive capacity of "Imudugudu" in vulnerable regions by

the improvement of drinking water, sanitation, alternative energy services and promotion of non-agricultural jobs
- Increase food security and modes of medicine distribution and sensitise to stocking and conservation of agriculture products
- Preparation and implementation of woody combustible substitution national strategy to combat deforestation and erosion

The SNC specifies that actions identified in the NAPA constitute primary policy guidance for informing Strategic Sector Plans (SSPs). In this context, the SNC also highlights the need for coverage of a number of cross-cutting issues amongst sectors:

- Technology transfer
- Research and systematic observation (hydrological, meteorological)
- Information on research programs (e.g. KIE, KHI, ISAR/NUR, KIST)
- Education (especially tertiary), training and public awareness
- Capacity building (government departments, universities, research institutions, etc.)
- Information and networking (especially in East African Community)

SNC and NAPA recommendations underscore Rwanda's overall implementation strategy of mainstreaming climate activities through sector development strategies and budgets. This approach has been actively promoted with technical support from the Rwanda Environment and Management Authority (REMA) under the Ministry of Lands and the Environment (MINELA). Consolidation of NAPA and SNC priorities and sectoral mainstreaming are illustrated in the five-year Environment Sub-Sector Strategic Plan, highlighting the need for spatial and thematic information, an institutional framework, capacity development and public-private partnerships to address climate change[8].

Rwanda's goal of climate mainstreaming across sectoral strategies aligns closely with stated development objectives of the Economic Development and Povery Reduction Strategy (EDPRS) 2008-2012 for optimal utilisation of natural resources, and commitments to protection of environmental resources under Vision 2020. Under the EDPRS, explicit measures to address climate include an incentive framework for implementation of the NAPA and to develop Clean Development Mechanism (CDM) project opportunities. In line with this, guidelines and recommended indicators are under development to institutionalise Strategic Environmental Assessments (SEAs) and Environmental Impact Assessments (EIAs) that consider sector-specific climate risks and resilience[7].

The GoR, in partnership with UNDP/UNEP, is in the process of operationalising a National Fund for the Environment, FONERWA. A scoping process is under way, strongly considering merging it with similar funds that are operational or in the pipeline, including the National Fund for Forestry and National Fund for Water, respectively. Joined with environment and climate change, FONERWA's revised scope would channel resources to four programmatic areas for accelerated sustainable development and environmental mainstreaming[9].

While the modalities and financing structure of FONERWA are in discussion, flexibility arrangements could allow the Fund to receive earmarked bilateral resources from development partners and international climate funds (including the Adaptation Fund and Green Fund), and to facilitate public-private partnerships. An example would be the promotion of special loan products for environmentally friendly technologies with microfinance institutions. Standardised eligibility criteria and centralisation of oversight and fiduciary risk within MINECOFIN – possibly under a representative board of trustees – would also create a strong institutional

framework for catalysing support for environmental mainstreaming.

Comprehensive analysis of the FONERWA framework is ongoing in work led by UNDP/UNEP and REMA to explore Environment and Fiscal Reforms (EFR) under the Poverty Environment Initiative (PEI)[9]. This process will be key not only to development of a National Climate Change and Low Carbon Growth Strategy, but to achieving more elaborate strategic outcomes planned for the revised EDPRS.

Human Capacity, Stakeholder Mapping and Engagement

As human development lies at the heart of sustainable economic growth, capacity building is recognised as central to Rwanda's national development objectives and will be a key element of a national climate strategy. Initial scoping work identified a wide range of stakeholders actively engaged in Rwanda's climate policy development. Stakeholders are broadly grouped into government, development partners, research institutions and private actors.

Other key ministries include MINICOFIN, MOH (Ministry of Health), MININTER (Ministry of Internal Security), and the National Land Centre (NLS) under MINELA, in addition to special units such as the DNA and NIE under REMA. The MINELA and REMA (highlighted in red) have led policy development, institutional capacity building, and demonstration pilots. Major initiatives, such as National Communications to the UNFCCC and the NAPA, involve close engagement of other key ministries, agencies, research institutions and development partners. This is in recognition of the cross-cutting nature of climate change and its importance as a development issue[18].

Although Rwanda has successfully initiated stakeholder-led efforts for climate policy formulation and sectoral guidance, significant coordination and implementation challenges have arisen in recent years, due in part to increasing international attention to climate change. There is an apparent lack of communication and awareness among stakeholders regarding their respective activities. This appears to be largely a result of poor communication between diverse and independently funded actors, designing and implementing initiatives without adequate background scoping of existing activities, often undertaken in parallel.

In the case of some stakeholder groups,

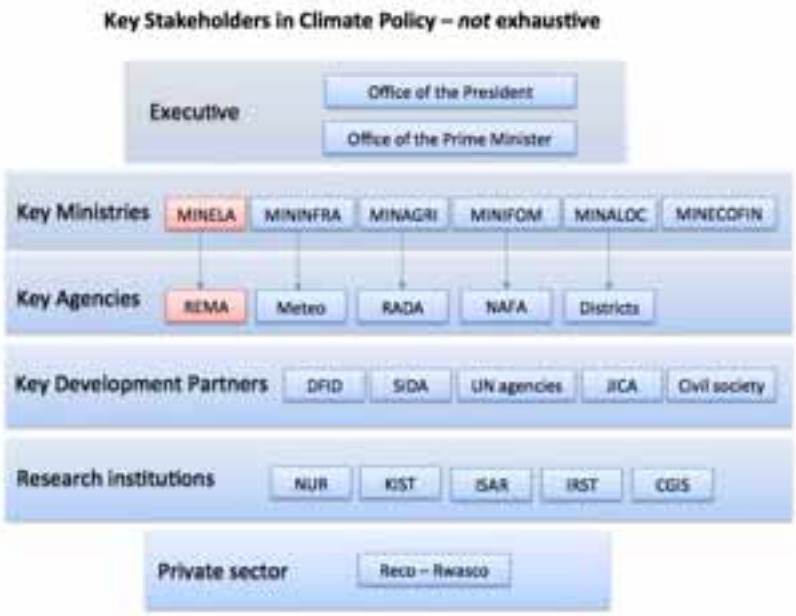


Table 2.1: Previous and ongoing climate change related activities

Issue	Activity
Awareness raising	Host of Climate Change and Human Rights conference (2008)
	Host of Climate for Development – 3rd Ministerial conference under Africa's Finance for Development initiative
	Regular radio and television programming, and print media coverage of climate issues
Projects/ research	Economics of Climate Change in Rwanda (SEI, 2009)
	Reducing vulnerability to climate change by establishing early warning and disaster preparedness systems, and support for integrated watershed management in flood-prone areas in the Gishwati ecosystem (UNEP/UNDP LDCF, 2010-2013)
	Approaches to climate change adaptation in Africa (AAP)– building a comprehensive national approach in Rwanda (UNDP/JICA, 2010-2011)
	Regional GEF/UNEP initiative to climate-proof energy sectors in Rwanda, ACCESA country study (IISD/ACTS/KIST)
	Decentralisation and Environmental Management Project (DEMP) (UNDP/REMA) Phase II (2008-2013), community-based district environmental management and planning
	Building Capacity for Sustainable Land Use and Management in Rwanda (GEF/ RADA/TerrAfrica)
	Kirehe Watershed Management Project (Eastern Province) under MINAGRI/ IFAD with adaptation component (soil and water conservation, irrigation and water harvesting)
	Project for Forest Management in Rwanda (PAFOR) for Gishwati area reforestation
	Nile Transboundary Environmental Action Project (NTEAP) to protect Nile Basin ecosystems through IWRM methods (GEF/International Waters/UNDP/World Bank, others)
	CC-DARE pilot projects on adaptation (Phases 1 & 2) with Nile Basin Discourse Forum (NBDF), NTEAP, & RENGOF with focus on ecosystem resilience
	Pilot adaptation activities in Nyabihu District, building capacity and raising awareness
	Land and Biodiversity Conservation Project in Gishwati area
	MINAGRI Gishwati area rehabilitation, revising Gishwati land-use master plan
	"Partners in Agriculture and Environment" Bigogwe Sector for LDCF implementation (SGP/GEF, 2009- 2011)
	Rehabilitation activities for Rugezi wetland and Rubaya District
	MINALOC climate proofing of Vision Umerenge Programme (VUP)
	Economics of adaptation in Rwanda's coffee sector (IIED/NUR/SEI/GCAP, 2010/11)
	Transboundary Agro-Ecosystem Management Project for the Kagera River Basin (FAO, TerrAfrica, GEF)
	Payment for Ecosystem Services (PES), Gishwati (WCS, REMA, 2010/11)
	Adaptation in Rwanda's coffee sector and gender issues (CARE, 2010/11)

the situation is gradually improving. For example, in September 2010, Rwanda's 31 development partners (DPs), excluding NGOs and private foundations, agreed to a division of labour with Sweden (SIDA), the FAO and UNDP leading on environment issues. In December 2010, further progress was made with the signing of a Sector-Wide Approach (SWAP) MOU between the GoR and development partners to improve coordination and support to the Environment and Natural Resource (ENR), in which climate change is identified as a key sub-sector[10].

Nevertheless, to date project origination, funding, and information sharing for climate initiatives has been relatively ad hoc and poorly coordinated. This highlights the importance of improved coordination and cooperation, particularly related to DPs, under the process of NCCLCG strategy development and joint implementation. The need for improved DP-GoR coordination has particular relevance to other stakeholder groups, including research institutions and civil society, which are active in policy formation and implementation, and largely supported by donor/public resources.

Scoping work also found the private sector to be the least engaged in climate policy formulation and initiatives. However, the electricity and water utility (Reco-Rwasco) is more actively engaging in ecosystem protection activities to ensure sustainable water regulation, while indirect engagement is increasing through private entry into renewable energy markets[19]. Facilitating enhanced private sector awareness of low carbon growth opportunities is the mandate of Rwanda's DNA under REMA, while the Rwanda Development Board (RDB) also plays a key role in informing potential investors. Nevertheless, analogous efforts in awareness raising and facilitation of private sector investment in adaptation activities are a clear gap area.

Lastly, there are very low levels of institutional and private capacity and low awareness of climate change issues and responses, particularly at sub-national (District and lower) levels.

Current Project Initiatives and Implementation

A wide array of adaptation and mitigation project initiatives are currently under way, or in the pipeline, in Rwanda (Table 2.1). In general, these activities have been designed and implemented exclusively for either adaptation or mitigation. Nevertheless, strong synergies or co-benefits between many adaptation and LCG activities are widely recognised, and integrated approaches of interest are being explored by stakeholders (e.g. FAO, REMA).

Predominant "win-win" activities for adaptation and low carbon growth relate to improved land management and more sustainable agriculture, including soil and water conservation, ecosystem protection and rehabilitation. These activities promote system resilience to climate shocks, and also conservation and/or sequestration of GHGs in soils, ground cover and forests, as well as reducing fossil fuel-based power through renewable generation. Despite such co-benefits, potential conflicts may arise between adaptation and LCG, for example, increased mineral fertiliser use on highly acidic soils, marshland reclamation and increased reliance on hydroelectric power under reduced rainfall regimes and increased water demand.

Adaptation Projects

Ongoing and planned adaptation project initiatives in Rwanda can be generally classified under capacity, financial, technical and research and development investments in a handful of integrated thematic areas linked to environmental policy and management. The various investment types, thematic areas, and special topics are highlighted in figure 2.1,

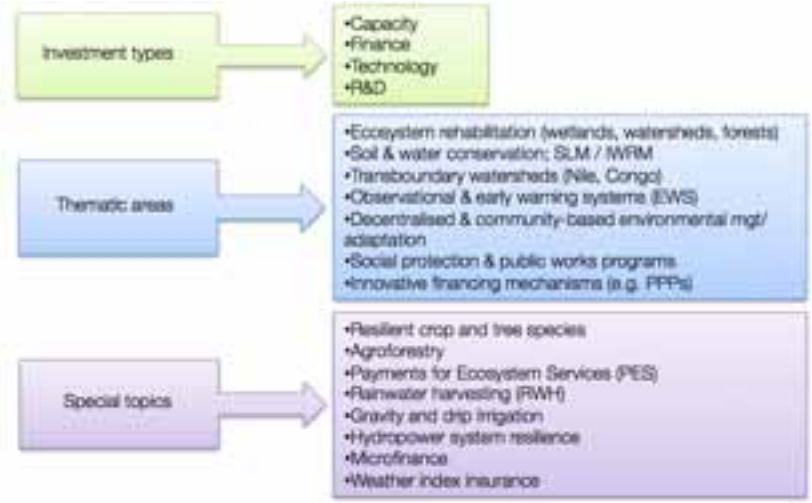


Figure 2.1: Example investment types, themes and special topics under current adaptation project initiatives

though not exhaustively. A vulnerability and DRR approach has largely been taken by project initiatives, analogous to the NAPA/ SNC methodology and recommendations. This affords priority focus to low-income and highly vulnerable groups in areas prone to extreme events and climate related hazards, namely floods, droughts and landslides. Across projects, different themes and topics are covered, with project scopes varying considerably by sector specific or economy-wide issues, or specific geographic areas of interest.

Ad hoc coordination to date has led to apparent duplication of efforts. Development of early warning and improved meteorological observational systems illustrates this as the FAO/ MINAGRI, World Bank, UNDP, and UK Hadley Centre, among other project originators, aim to improve the capacity or infrastructure of Meteo Rwanda, each under separate initiatives[11,12,13]. These parallel efforts are also notable given that a primary objective of the NCCLCG strategy is to establish a Climate Observatory in Rwanda.

Overall, activities overlap significantly across themes and investment categories. It is also evident that innovative sources of financing and trans-boundary issues are not widely covered in these major adaptation initiatives. In addition, in-depth analysis of synergies with mitigation activities, modelling energy system vulnerability, transport, the built environment and flooding, municipal water and sanitation, among other health-related risks (e.g. malaria, bilharzia, malnutrition, heat stress) and key sectors are not adequately covered under current project considerations. Finally, awareness raising, communication and information sharing need to be supported more as key thematic areas.

Two UN-led initiatives are particularly notable for their high levels of coordination, along with their comprehensive approaches to adaptation. This is due in part to the integrated institutional framework mandated by the "One UN" initiative. The Approaches to climate change Adaptation in Africa Programme (AAP) in particular has strong linkages with NCCLCG strategy work, as the overall objective is to build a comprehensive national approach to adaptation in Rwanda[14]. The project is funded by JIKA, and implemented through UNDP and REMA (2010-2011). The UNEP/UNDP project establishing an early warning and disaster preparedness system, and integrated watershed management in flood-prone areas in the Gishwati ecosystem, will link with AAP as a pilot initiative. This work is a follow-on project based on top NAPA

Table 2.2: Vulnerability areas across geographic priorities

	Bugesera	Gisagara	Huye	Karongi-Rutisiro	Ngororero	Nyabihu	Nyanza	Nyaruguru-Nyamagabe	Ruhango-Muhanga-Kamonyi
Food Security	√			√	√	√		√	√
Poverty		√		√	√		√	√	
Nutrition		√			√			√	
Drought risk	√	√	√				√		

*Food security: Together, these strata account for 36% of the population and 65% of all the food insecure. Poverty: These account for 25% of the population and 45% of all households with a poor food consumption score (FCS). Nutrition: Including wasting and stunting (Rubavu included). Drought risk: Areas most frequently reported (noting Nyagatare-Gatsibo-Kayonza should be monitored).

recommendations, and is supported by the Least Developed Country Fund (LDCF) [12].

The AAP and LDCF projects present excellent opportunities to inform and complement recently initiated discussions to 'climate proof' Rwanda's Vision 2020 Umurenge Programme (VUP), a flagship programme of the EDPRS. VUP has three components underpinned by sensitisation and training [11]:

- Direct support - cash transfers to the poorest households that cannot work
- Public works - employment to the poorest households who can work
- Financial services - a savings and credit infrastructure that will reach the poor

The goal of a revised VUP would be to ensure that accelerated reduction of extreme poverty and achievement of MDGs in targeted Imirenge is carried out in a climate-resilient way. This highlights that accelerated sustainable development is of primary importance for reducing vulnerability, mainstreaming environment at sub-national levels, and promoting climate-resilient development.

Further Vulnerability-Based Intervention Areas

High levels of socioeconomic vulnerability coupled with climate risk exposure lead to low adaptive capacity to existing climate variability and future climate change. The National Institute of Statistics of Rwanda (NISR) and its partners have completed a 2009 Comprehensive Food Security and Vulnerability Analysis (CFSVA) and Nutrition Survey[15]. These data establish a baseline of poverty, overall vulnerability and nutrition insecurity, analysing key trends over time and across geographic regions. This is critical for identifying priority intervention areas where increased climate risks will lead to greater exposure of already vulnerable populations and groups. Four priorities were explored in analysing geographic priorities: food security; poverty; malnutrition; and risk of drought. These are highlighted in table 2.2 according to key regions, each with different vulnerability characteristics that need to be taken into account when planning interventions.

Among surveyed communities, three livelihood profiles were identified as being especially vulnerable:

- Agriculturalists - low income (dependence on agriculture, low production diversity)
- Agro-labourers (manual and seasonal, paid in cash or kind, and agriculture)
- Marginal livelihoods (e.g. assistance, remittances, hunting/gathering, transport)

Significantly, the proportion of female-headed households is highest among the marginal livelihood group (19%), agriculturalists - low income (18%) and

agro-labourers (17%).

In 2006, the previous CFSVA and Nutrition Survey period, 7% of households were considered as having a poor Food Consumption Score, and 28% had a borderline FCS, compared to 4% and 17% in 2009, respectively. This improvement may reflect a general trend towards better food security. However, poor production in late 2010 may undermine this progress. The strata with the highest proportion of households reporting poor FCS are Nyabihu (9.5%), Ngororero (9.5%) and Nyaruguru-Nyamagabe (8.4%), located along the Crete of the Nile line that runs from North to South in Rwanda.

Multivariate analysis of underlying causes of vulnerability and food insecurity included:

- Less than 0.1ha of agricultural land (36% of poor FCS)
- Female headed households (comprising 21% of poor FCS)
- Presence of a chronically ill person (22% of poor FCS)

Surveyed communities also frequently identified general poverty (37%), access to clean water (34%), education (29%), health infrastructures (22%) and other infrastructure needs including roads and markets (29%) as structural problems requiring infrastructure, social services, and job/employment opportunities. These represent key intervention areas for the priority geographic strata indicated above for reducing underlying vulnerability, food insecurity and low adaptive capacity to climate and commodity shocks. Such interventions have synergies with ongoing adaptation projects and programmes.

Mitigation Policy and Projects

In 2009, a Rapid Assessment of a National Energy and Low Carbon Path carried out by SEI found that total national emissions are currently very low in Rwanda and, thanks to forest sequestration, Rwanda is currently a net sink[16]. This finding is supported by results of the 2010 Second National Communication updated emissions inventory, discussed in background information in Chapter 1.

In order to address its growing emissions and harness benefits of low carbon development paths, Rwanda established a Designated National Authority (DNA). Under the DNA, institutional arrangements include an operational DNA Steering Committee, specially nominated Technical Committees to review each new project, and a National Secretariat to coordinate project approval and international engagement. Priority is generally given to facilitation and oversight of Clean Development Mechanism (CDM) projects, with regulated markets preferred to unregulated Voluntary Carbon Market (VCM) activities[17].

Three primary areas have been identified and prioritised by Technical Committees as offering the most opportunity for carbon market development in Rwanda:

- Energy efficiency and renewable energy
- Agriculture, forestry and livestock
- Waste management

There are currently 25 projects in the pipeline for development in Rwanda, and these are mainly in the energy and forestry sectors. There is one registered CDM project, the RECO Compact Fluorescent Lamp (CFL) distribution project. Ongoing projects are:

Ongoing projects with carbon credit buyers:

- D-light rural lighting program
- Clinton Foundation forestry project
- K-Light project
- Nuru Design Lighting Programme
- Rwanda National Biogas Programme
- Rwanda 19.95MW Small and Micro Hydro Project Bundle
- Water treatment systems for rural Rwanda (Mugonero Esepan, Rwaesero, Nyagasambu)
- Water treatment systems for rural Rwanda (Shyira and Fawe)
- Reco Compact Fluorescent Lamp

(CFL) – Only registered CDM project

Ongoing project idea notes without carbon credit buyers:

- Contour Global Lake Kivu methane gas project with MININFRA
- 27.5 MW Nyabarongo Hydro Power Project
- KCC Solar Public Lighting PIN

Additional high-potential projects within the energy sector include micro- and pico-hydropower, solar and thermal power, biogas recovery from domestic, institutional, and industrial waste, energy-efficient cookstoves, energy efficiency in buildings, and biofuel alternatives.

Forestry is another high-potential area for carbon credit development in Rwanda. Activities are currently under way by the Clinton Foundation, ICRAF, VI-Life and others, exploring the development of carbon credits through increasing soil carbon stores, agroforestry and other activities. The GoR has also established capacity in the newly formed Ministry of Forestry and Mining (MINIFOM) and the National Forestry Authority (NAFA) to begin assessing carbon credit opportunities in the forestry sector.

Although Rwanda has made progress in facilitating low-carbon development, it is clear that the country's highest-emitting sectors of agriculture and, increasingly, transport pose particular challenges. This warrants national debate as part of the NCCLCG strategy development process, as well as reaffirming internationally the need to include agriculture and land management under regulated carbon market offsets – which stand to benefit Africa greatly and have adaptation co-benefits.

Summary

Rwanda has a number of climate change initiatives under way. FONERWA is a highly promising framework for mainstreaming climate action in Rwanda. Public and development partner engagement and coordination in climate activities are improving and facilitation of private sector investment in carbon credit opportunities is increasing. There is limited effort on adaptation and very low levels of institutional and private capacity and awareness of climate change issues, particularly at sub-national levels. There are significant areas of overlap across adaptation project initiatives, particularly related to improved observational and early warning systems. This highlights the importance of accelerated sustainable development for reducing vulnerability, mainstreaming environment at sub-national levels, and promoting climate-resilient development. It is also important to identify priority intervention areas where increased climate risks will lead to greater exposure of already vulnerable populations and groups. Sustainable land and water management, ecosystem protection and rehabilitation afford significant co-benefits for objectives of both climate resilience and low carbon growth. Current carbon credit development initiatives are in very early stages under Rwanda's DNA, and afford limited coverage of agriculture and transport sector emissions.

“In order to ensure sustained progress, it is important to emphasise thorough planning and implementation so as to rapidly facilitate total socio-economic transformation as stated in the country’s Vision 2020.”

Hon. Vincent Karega
Minister of Infrastructure

3. ECONOMICS, TRADE AND INDUSTRY

Rwanda has made remarkable progress since the tragedy of the 1994 genocide. After a period of reconstruction from 1994 to 2000, the country articulated its long-term development path, Vision 2020. The vision sees Rwanda as a middle-income economy of 900 USD per capita and positioned to become a regional service hub by 2020. To realise this growth ambition, the GoR is committed to facilitating the emergence of a strong and modern private sector, which will drive growth, competitiveness, economic diversification and export promotion. So far, much progress has been made in establishing a stable, macroeconomic environment with an average real Gross Domestic Product (GDP) growth rate of 8.5% for the last five years. Reforms in justice and 'doing business' regulations have led Rwanda to emerge, for two successive years, as a top global reformer in the ease of doing business; and the country is on track to meet the MDG targets by 2012 in education, health and gender equality. But despite Rwanda's impressive growth rate and committed leadership, 56% of the population lives below the poverty line. Income inequality is very high and the Gini coefficient increased from 0.47 to 0.51 between the last two household surveys. The economy will need to grow by at least 8% per annum to significantly reduce poverty and attain the Vision 2020 targets.

Economic Profile

Growth

GDP at current prices was estimated at 2.992 billion RWF in 2009 and attained a real growth rate of 11.5% in 2008. The growth rates have however been very volatile, reflecting the country's vulnerability to changes in climate as well as international finance and trade (figure 3.1). The real GDP growth rate dropped from a high of 11.5% in 2008 to 6% in 2009 owing to the global financial crisis. After a bumper harvest in 2008, seasonal changes in weather conditions negatively affected crop harvests in 2009. A combination of the financial crisis and bad weather eventually led to a general decline in real GDP in 2009.

Rwanda's growth is largely driven by the services sector, which accounts for 44.6% of the GDP (table 3.1). The leading services include wholesale and retail trade (12.9%), real estate and business (9.6%) and transport communication and

Figure 3.1: Growth trends 2005-2010 (Source: National Institute of Statistics)

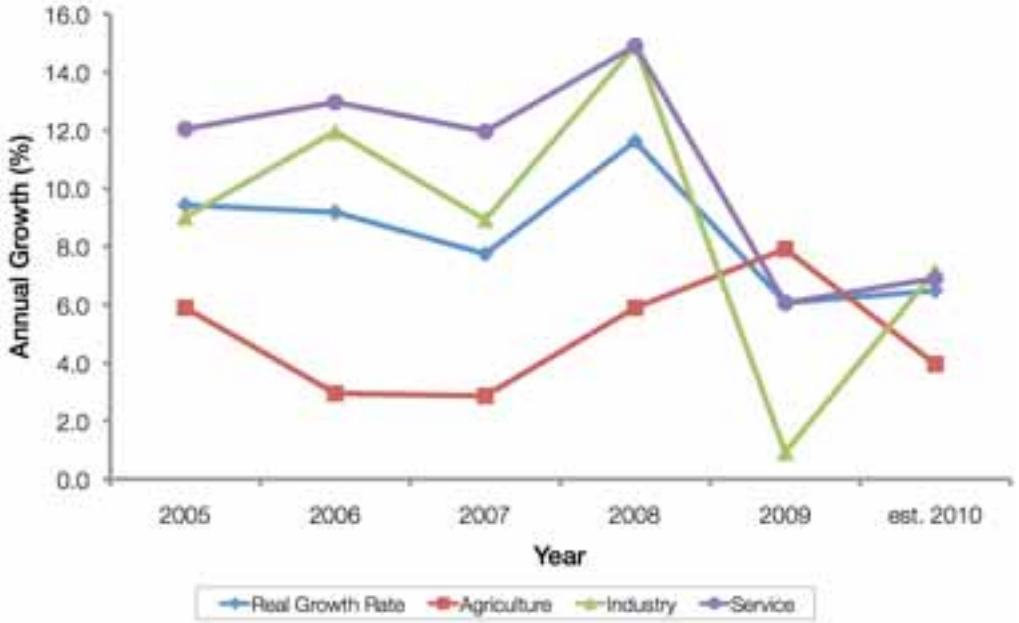


Table 3.1: The structure of the economy: growth and share of GDP (Source: National Institute of Statistics)

	Average Annual % Growth		% Share of GDP	
	2000-2006	2006-2009	2000-2006	2006-2009
GDP	6.4	8.4	100	100
Agriculture	4.8	5.6	36.4	35.1
Industry	6.4	8.5	14.2	14.2
Services	8.1	11	38.0	44.6

business (7.5%). The agricultural sector is the second most important sector and contributes approximately 36.4% to the total GDP, 27.8% of which is food production. The sector is a principal source of employment for nearly 80% of the population. There is limited diversification into manufacturing. Industry contributes only 14.2% to GDP of which 7.3% comes from the construction sector. The export base is narrow with tea, coffee and minerals contributing two thirds of the total export revenue. Evidence shows that over the last ten years there has been limited structural transformation (table 3.1). These structural constraints mean that Rwanda is very vulnerable to global commodity prices, climate change and the external debt crisis. The economy is heavily biased towards climate-sensitive activities and could hinder economic growth if no disaster risk reduction strategies are incorporated into the current national plans. The heavy dependence on agriculture, and in particular food production, is of concern as this sector is highly sensitive to climate change shocks. The increasing share of the construction sector in the national economy is also a concern because of the potential vulnerability to extreme events.

Government Finance

Rwanda is still an aid-dependent economy. In 2010, the country financed its budget from its domestic revenue sources by 12.5% of GDP and the revenue-to-GDP ratio has remained fairly elastic (12%-13%) for the last four years. The tax base is still narrow with only 42,538 registered taxpayers (as at end June 2010). The main source of domestic tax revenue is PAYE and VAT with a combined contribution of 11% of GDP. Taxes on international trade contributed only 1% and non-tax revenue 0.5%. Rwanda's capacity to mobilise its domestic revenue is constrained by the extent to which its economy is not monetised - 80% of the population is engaged in informal subsistence agriculture - and also by its entrance to the COMESA and East African Community (EAC) free trade area, which has the permanent impact of reducing revenue collection from international trade taxes. The medium term fiscal policy objective is to increase revenue collection from the current rate of 12.5% in 2010 to 14.3% of GDP in 2012. The current total spending and net lending is 25.8% of GDP. The donors' contribution is 13.2% of GDP and the remaining 0.1% was borrowed from both external and domestic sources. The Rwandan authorities recognise the country's vulnerabilities to low government revenue, narrow export base and severe bottlenecks in infrastructure – and have embarked on a programme of scaling up investments in projects that enhance productivity in agriculture (the Crop Intensification Programme) and mobilising private investments in the service sector and industry. In the short to medium term, however, the country will continue to seek for aid to finance its development agenda.

Clean Energy Technology and Tax Policy

Energy-related imports - which include

energy saving lamps, solar and water heaters, wind energy systems, LPG equipment, equipment for biogas, kerosene for domestic use, premium and gasoil - are exempted from VAT and import duty, in order to encourage the conservation of energy and promote the use of clean technology and thus protect the environment. The current levy on gasoil is a specific tax of 283 RWF per litre and 250 RWF for premium with this tax policy. Companies engaged in projects that promote clean technology are offered tax incentives.

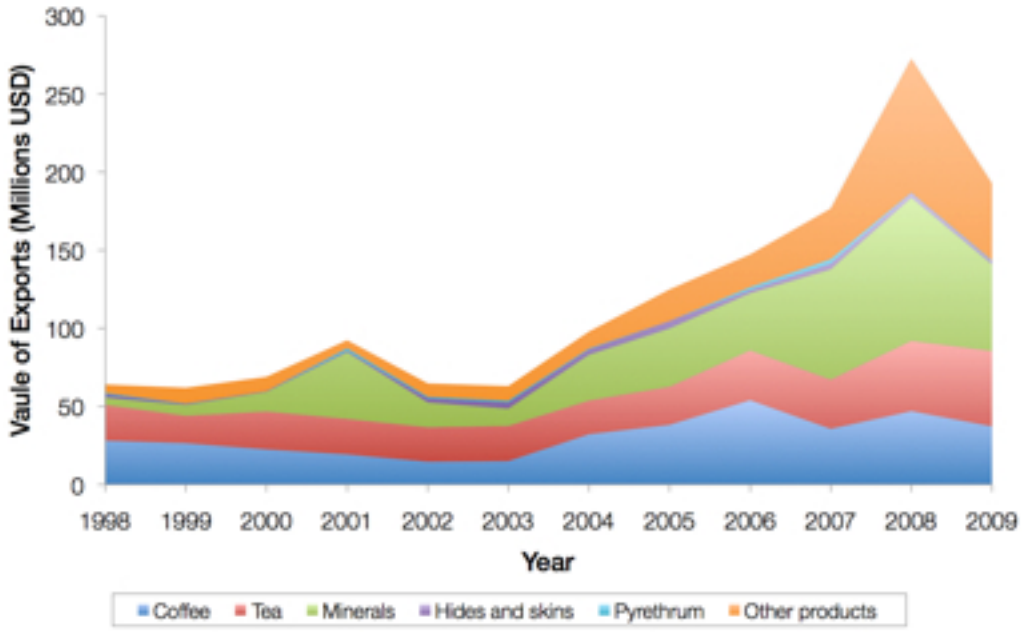
The Balance of Payments

Rwanda currently has an unfavourable balance of payments (BOP). The current account deficit, including official grants, is 7.9% of GDP. The main export products are minerals, coffee and tea (figure 3.2) which account for 74% of the total export earnings (estimated at 240 million USD in 2010). Tourism has emerged as the leading service export and in 2009 the sector earned 175 million USD more than tea, coffee and minerals combined together (141 million USD). The earnings from these products are subject to frequent fluctuations arising from unfavourable weather conditions and shifts in international markets. Year-on-year export growth is not keeping pace with import growth. The total import receipts for 2009 (1,025 million USD) and projected imports for 2010 (1,146 million USD) are four times larger than 2009 exports (193 million USD) and projected exports for 2010 (240 million USD) respectively. Energy products contribute significantly to the import bill (16%); other important imports are capital goods (30%), consumer goods and intermediate products. Fossil fuels (mainly gasoil and lubricating oils) account for 95% of energy imports, estimated at 203 million USD in 2010. Rwanda will continue to experience deterioration in the balance of trade if it does not reduce its reliance on fossil fuels for its domestic energy requirements.

Trade, Commerce and Industry

Trade, commerce and industry fall under the private sector development cluster. The Ministry of Trade and Industry (MINICOM) and the Rwanda Development Board (RDB) are the two lead government agencies responsible for implementing policies and programmes for private sector development. The key objectives of private

Figure 3.2: Value of Rwandan Exports



sector development are to grow exports by 15% of GDP in 2012 and reduce the BOP deficit, and to enhance the business climate.

Export Promotion and Diversification

A key priority of the government is to exploit opportunities for higher export revenues. The Rwandan Development Board (RDB) has completed a comprehensive export strategy and action plan to improve export growth and reduce dependence on coffee, tea and minerals. The export strategy aims for a target of 889 million USD by 2015. The focus of the strategy is to increase the value added to the existing export sectors and to develop new products and services centred around six clusters: dairy processing, horticulture, business outsourcing (using IT as an enabling tool), home décor and fashion, specialised tourism and hides and skins. The strategy also seeks to address bottlenecks to make local products more competitive, both locally and for export.

Current Status of Export Priorities

The constituents and value of Rwandan exports are illustrated in figure 3.2. As well as the exports covered in the relevant sectoral sections the following areas are also important areas of the Rwandan economy.

Tourism

Tourism is extremely important to the Rwandan economy and is quickly emerging as a top foreign exchange earner. The latest figures in 2009 indicate that tourism revenue (174 million USD) was greater than combined earnings for all the traditional exports for coffee, tea and minerals (141 million USD). Rwanda aims to be a premier ecotourism destination on the African continent, offering products in gorilla trekking, bird watching, canopy walks, national parks and cultural tourism. So far a number of projects are being implemented to support the growth of the sector and enhance product diversification. These include the Kigali convention complex (a five star hotel and a convention centre, intended to develop business tourism), a canopy walk launched in Nyungwe national park in October 2010, expansion of Rwanda Air, involving acquisition of more planes to serve a rising number of tourists, and a number of other private sector led eco-tourism projects. The tourism sector is vulnerable to climate change as it relies on attractive ecosystems.

ICT Sector

The ICT sector is considered as a flagship for the country's economic prosperity and a tool for transforming the Rwandan economy into a knowledge-based economy. The National Information and Communications Infrastructure (NICI) plan is meant to deliver this vision by 2020. The NICI plan aims to create a core infrastructure for a high speed broadband by building high capacity fibre optic lines by May 2011 (the Fibre backbone project), providing broadband wireless technology to up to 100,000 users by mid 2010 (the Wibrowimax project) and connecting Rwanda to undersea fibre optic cables by 2013. These projects will increase broadband access and reduce purchase costs by 90%. The national backbone project is on track and will make Rwanda one of the most connected countries in Africa.

Special Economic Zones

The special economic zone (SEZ) has been established in Gasabo district on a 277 ha piece of land to link Rwanda to the rest of the World in trade, manufacturing and logistics. This has involved the expropriation and relocation of companies from Gikondo industrial park to the new site at Masoro in Gasabo. The new site for the SEZ has a developed infrastructure for cleaner industrial production with a central sewage system for managing the toxic waste and a planned green belt for mitigating against adverse environment effects. The SEZ is therefore an integral

part of Rwanda's drive to attract investors by guaranteeing land that has a well developed road, energy and water infrastructure.

Challenges and Opportunities

The access and cost of energy is a big impediment to the competitiveness of Rwandan firms. The cost of electricity is 0.21USD/kWh, which is the highest in the region (and double that of Kenya at 0.12USD/kWh). Because Rwanda is landlocked, transport costs are also high: the average cost per tonne/km is 165 USD compared to 95 USD for the region. There is a significant skills gap in most areas of expertise, particularly for technicians and managers. Firms also cite access to finance as a major constraint to business development: private sector credit was estimated at 16.5% of GDP in 2010.

However, there are a number of opportunities that could be exploited to grow the trade and industry sector. The government is currently implementing six strategic investment projects which will alleviate the critical infrastructural constraints to increasing and diversifying exports of goods and services, thus helping Rwanda's progress towards a knowledge-based service economy. These are:

- Electricity Access Roll-out project
- Core ICT infrastructure
- Regional railway
- Bugesera Airport
- Rwanda Air expansion
- Kigali convention complex
- Enhanced Business Climate

The country has implemented a range of policy reforms and institutional changes that have greatly improved the business environment. Such reforms are particularly important for making Rwanda the preferred destination for investors. The recent reforms were recognised by the International Finance Corporation (IFC) when it upgraded its assessment of Rwanda in the ease of doing business to a position of 58 out of 183 countries and the second most consistent reformer of business regulations in the world. The achievements in doing business were particularly in simplifying business registration, getting credit, registering property, enforcing contracts, trading across borders, protecting investors, paying taxes and dealing with construction permits indicators. Other reforms in governance are helping to improve perceptions of Rwanda as a country with low levels of corruption. Transparency International's Corruption Perception Index (CPI) in 2010 places Rwanda at 66th out of 178 countries in the world. The political will to fight corruption and the ease of doing business are important ingredients for attracting foreign direct investment.

“Energy is a basic requirement for all Rwandans, whether for cooking, lighting or other services and devices. MININFRA is committed to exploring modern and sustainable sources of energy, thus increasing access to energy and ensuring the country follows a green development path... By working together, we can make sure Rwanda promotes and maintains its reputation for being an environmentally friendly, innovative and sustainable developing country.”

Hon. Eng. Coletha U. RUHAMYA
Minister of State in charge of Energy and Water

4. ENERGY

Energy is a crucial ingredient for economic growth and development and is an enabler for achieving the Millennium Development Goals. The Government of Rwanda (GoR) aims to strike a balance between energy for economic growth and energy to further social objectives and poverty reduction. Currently only 10.5% of the population has access to electricity, with the majority relying on woodfuel[1]. Rapid population growth has put pressure on resources, increasing prices of energy. From the 1950s Rwanda relied solely on hydropower for electricity generation, but low dam levels in 2004 forced the GoR to rent diesel power plants. Today Rwanda has 95MW of electricity generating capacity, 50% from hydropower and 45% from oil-fuelled power[1]. This oil dependence makes Rwanda vulnerable to oil price shocks and places significant demands on foreign exchange reserves. Reliance on hydropower makes Rwanda vulnerable to changes in rainfall. Since 2004 the GoR has invested in alternative energy sources (natural gas, solar PV, micro-hydropower, geothermal, peat) to improve energy security and energy access. Oil exploration is under way and there are plans to build a gas-to-liquids plant which will allow Rwanda to reduce its dependency on imported oil. The GoR has ambitious energy targets (table 4.1) and aims to reduce its energy costs to attract foreign investment[2]. The key challenges are funding, lack of local skills and insufficient regulation. As climate change increases the vulnerability of developing countries, it is important that Rwanda develops low-cost, robust, renewable energy options to ensure its future development.

Table 4.1 Key targets for the Energy sector[2]

Goal	Current status	2012 target	2017 target
Electricity capacity	84.7MW	130MW	1,000MW
Electricity access	10.50%	16%	50%
Electricity connections	175,000	475,000	1,200,000
Biomass energy	86%		65%

Current Status

Rwanda's primary energy source is biomass, providing 86% of energy used, while petroleum products account for 11%, used mainly in transportation, and energy for electricity contributes a mere 3% of the energy balance[2] (figure 4.1). Rwanda has the second lowest electricity consumption per capita in East and Central Africa, at 44kWh per person per

Figure 4.1: Energy balance in Rwanda[2]

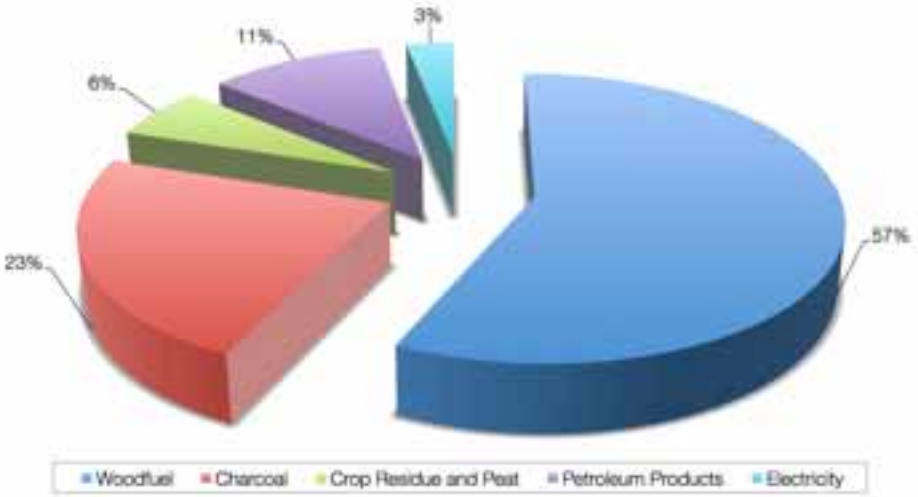


Table 4.2: Current and planned electricity generation capacity in Rwanda[1]

Source	Installed Capacity (MW)	Available Capacity (MW)	% Installed Capacity	Planned New Capacity (MW)
Domestic Hydro	26.25	22.9	31%	47.5
Regional Hydro	15.5	14.5	18.30%	164.97
Micro-hydro	0.7	0.7	0.80%	50
Domestic Thermal	27.8	27.8	32.80%	20
Rented Thermal	10	10	11.80%	-
Solar PV	0.25	0.25	0.30%	8
Methane	4.2	1.8	5%	300
Geothermal	-	-	-	310
Peat	-	-	-	100
TOTAL	84.7	77.95	100%	990.47

year[3]. Electricity generation (table 4.2) is dominated by large hydropower plants in the north-west and south-west and thermal (oil-fuelled) power plants near Kigali. In 2008 the sector expanded to include methane from Lake Kivu, solar photovoltaic (PV) and micro-hydropower. The national grid consists of 383km of high voltage lines and 4,900km of medium and low voltage lines, with a significant proportion in Kigali. Electricity access has improved from 4.0% in 2007 to 10.5% in 2010, mostly in urban areas. The current retail price for domestic consumers is 112RWF/kWh (0.21USD/kWh) while large commercial and industrial consumers pay 105RWF/kWh (0.19USD/kWh), despite GoR subsidies. An Electricity Tariff Study produced in January 2011 highlighted that Rwanda is one of the few countries that does not have multiple tariff categories and recommended four new consumer categories. The study suggests that operating costs could fall in 2011 and 2012 as hydropower replaces rented oil-fuelled plants, but would rise in 2013, so electricity prices are likely to remain the same. According to the Second National Communication, energy from fuel burning contributed 17% of GHG emissions in Rwanda in 2005 (table 1.1), but this includes transport and industry (cement and lime production)4. Oil-fuelled power plants emitted 8.5% of total CO2 while residential use of biomass produced 28% of methane emissions. As the energy sector has changed in the last five years, these figures do not reflect the current energy sector and need to be updated.

Power demand is expected to increase to 600MW in 2017, by when the GoR plans to have increased the capacity to 1,000MW through geothermal, methane, hydropower and peat, and by extending the national grid by 2,100km (700km of high voltage and 1,400km of medium voltage)1. The total cost of expanding the generation and distribution capacity is 5 billion USD. Table 4.1 shows the current and future electricity generation for Rwanda and figure 4.2 maps out the current national grid and power source locations.

Woodfuel and Charcoal

The most common source of energy in Rwanda is woodfuel, produced on plantations ranging from small household woodlots to large-scale state and private plantations. Many Rwandans depend on the sale of accessible and affordable woodfuel and charcoal for their livelihoods. To address concerns regarding deforestation, the Ministry of Infrastructure

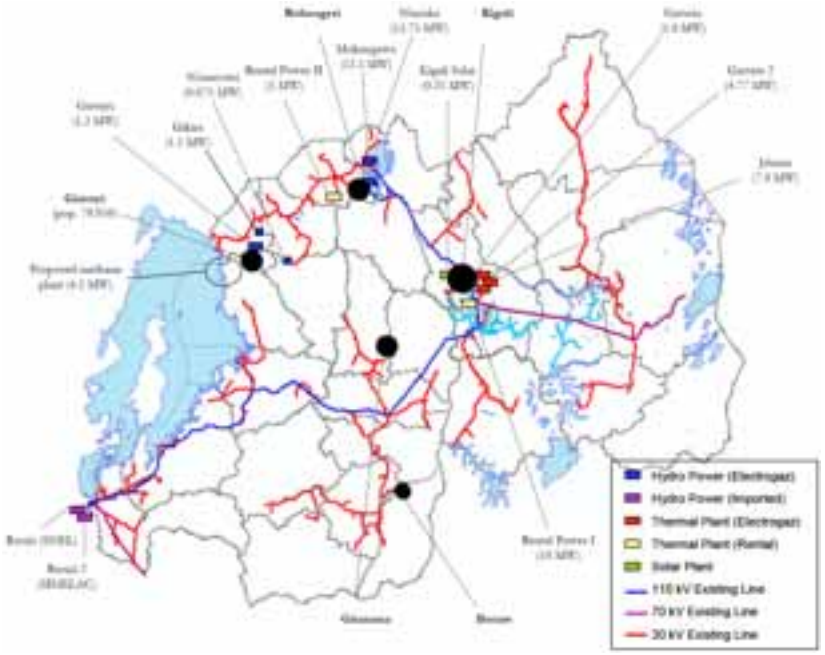


Figure 4.2: National grid and power sources[2]

(MININFRA) developed the Biomass Energy Strategy (BEST) in 2008. The main impact of burning biomass on climate is through land use change though it also causes air pollution and therefore health problems.

Hydropower

Hydropower is currently produced in four domestic plants in the north-west, two regional plants in the south-east and five micro-hydro plants. The GoR aims to create 300MW capacity hydropower by 2017 through two new domestic plants, three regional plants shared with Burundi, Tanzania and DRC, and micro-hydro power1. A Hydropower Atlas published by MININFRA in 2007 identified 293 potential sites with a combined capacity of 96MW. Over 50 potential sites for micro-hydropower (100kW-5MW) were identified, with 17 sites under construction. There are at least 172 pico-hydro (<50kW) potential sites and 21 existing sites, though the sub-sector has not been developed yet. It is ideal for remote communities who can use it to recharge batteries or mobile phones. Rwanda is a member of the East African Power Pool and the Nile Basin Initiative, and therefore has the option to import hydro-electricity from further afield. Hydropower is a clean source of energy but is vulnerable to changes in rainfall and regional politics. Four of the regional plants are located on the Rusizi River, the outlet for Lake Kivu, and together will utilise its full capacity by 2017. Projected changes in climate need to be taken into account before plans are finalised.

Oil-fuelled Power Plants

Since 2004 Rwanda has used rented or domestic oil-fuelled power plants to supplement hydropower, and has now become dependent on them - and hence is exposed to oil price shocks. The largest oil-fuelled power plant is the Jabana Heavy Fuel Oil (HFO) power plant which replaced rented AGGREKO generators in April 2009 and supplies 20MW to the national grid. Other plants include the Jabana diesel power plant (7.8MW) and the rented Gikondo power plant (10MW) which uses light fuel oil (LFO). An additional 20MW of oil-fuelled power generation is required to meet the immediate power needs and provide back-up in the future. These plants use

high carbon fuels and account for most of the GHG emissions in the energy sector.

Current Initiatives

Methane Gas

Lake Kivu contains 250 billion m^3 of CO2 and 55 billion m^3 of methane gas, continuously generated from volcanic activity and organic decomposition. It is estimated that 700MW can be continuously produced from methane for at least 55 years[5]. The resource is equally shared between DRC and Rwanda. Kibuye Power Plant in Rubavu supplies up to 3.6MW to the national grid, with plans to upgrade to 50MW (figure 4.3). The Rwanda Energy Company has a 50MW concession and is currently operating a 1.3MW pilot plant. ContourGlobal's KivuWatt plant will supply 25MW from early 2012 and upgrade to 100MW in 2013. A joint venture between the DRC and Rwanda for a 200MW plant is being discussed. The Industrial Development Group will build a gas-to-liquid plant to process 100 million m^3 of methane per year, producing 5,000 barrels per day of jet fuel, kerosene and diesel. A feasibility study has shown the potential for using methane to manufacture 400 tonnes of fertiliser per day[2]. Methane is a medium carbon energy source but if released into the atmosphere is a potent greenhouse gas. Currently, the CO_2 extracted with the methane is returned to Lake Kivu; however, it could be used to produce supercritical CO_2, which is used as a solvent in the chemical and pharmaceutical industries, for example for decaffeinating coffee.

Figure 4.3: Kibuye methane platform

Liquid Petroleum Gas

The GoR is promoting the use of LPG as a substitute for biomass to reduce deforestation and air pollution. Recently the GoR passed a new law to waive the import duty and VAT for LPG, making it affordable in urban areas. The GoR is developing LPG guidelines and standards, aiming to increase consumption from 360 tonnes to 3,500 tonnes per year by 20171.

Solar

With daily average of 8 hours of sunshine, Rwanda has the potential to produce 4.8-5.5kWh/m^2 of solar-generated power per day[6]. Rwanda already houses the largest solar plant in Africa, Kigali Solaire (figure 4.4), with a capacity of 250kW, which feeds the national grid. It is owned by Stadtwerke Mainz, which plans to expand the installation to 1MW. The company donated 50 small-scale solar plants of 1kW each for remote off-grid health centres and schools. The GoR has an off-grid solar PV programme for all public buildings more than 5km from the national grid, aiming for 1MW solar PV capacity by 2012. MININFRA and KIST are developing Solar Kiosks where consumers can charge batteries using solar power at kiosks in their village[7]. The GoR plans to install solar water heating in at least 70,000 households, hotels, health centres, schools, and hospitals by 2012. The GoR recently secured funds that will form a

Figure 4.4: Kigali Solaire

grant and credit programme for electricity consumers to buy solar systems. Solar energy is clean and in effect renewable, is well-suited to remote areas and is a common source of carbon credits in developing countries. GoR targets could be more ambitious though the manufacture of solar panels needs to be factored into a low carbon analysis.

Waste to energy

Biogas digesters (figure 4.5) provide a simple renewable source of energy for rural households and institutions, which use it for cooking and lighting. The National Domestic Biogas Programme (NDBP) was initiated in 2007 with a total production target of 15,000 units by 2012. Although the GoR subsidises the installation, uptake has been slow as the investment costs are high and only households with two cows or more are viable for biogas. The GoR plans to install 220 biogas digesters in public buildings. MININFRA is investigating the potential for landfill methane production or other gasification techniques yielding methane. This will be integrated into the overall solid waste management strategy. It is estimated that at least 30MW can be obtained from waste to energy.

Peat

Rwanda hosts over 48,000ha of peat with the potential to produce 155 million tonnes of dry peat of varying quality[2]. Peat is used as a fuel in community stoves, brick making, the production of charcoal and briquettes and in the cement factory, Cimerwa, where peat has replaced 60% of HFO used8. Peat is currently being mined at Gishoma, Rwabusoro and Nyirabironde. The GoR aims to produce 100MW of power from peat by 2017: this would require about 1,500ha of peat, depending on the thickness and quality[1]. The composition of peat determines its GHG emissions when it is burnt but it is a high carbon energy source. It also has land use change implications.

Biofuels

Rwandan dependence on imported petroleum products has led to research on biofuels. The Institute of Scientific and Technological Research (IRST) published a draft biofuel policy in July 2008 and established a biofuel laboratory in Kigali

Figure 4.5: Biogas Digesters at Rulindo High School

which can produce 2,000 litres of biodiesel daily. In March 2010 IRST successfully tested a 100% biodiesel bus, the Rwanda Biodiesel Express, which emits 48% less carbon monoxide than a conventional diesel-engined bus9. The German Biomass Research Centre produced a biofuel potential study in January 2010. As a result, Eco Positive and Eco Fuels Global plan to operate a large jatropha plantation on 10,000ha of marginal land and degraded hilltops near Akagera National Park that will aim to produce 20 million litres of biofuel annually. In February 2011, the German Institute for Development (GIZ) produced a study on the potential of sustainable liquid biofuel production in Rwanda which was less optimistic[10].

Oil Exploration

Oil exploration has been ongoing since 2007 by Vanoil Energy Ltd, which holds exploration rights to the 1,631km^2 oil and gas concession in north-western Rwanda, known as the East Kivu Graben. The Kivu Graben may be linked to Uganda's Albertine Graben which has an indicated oil reservoir of 1 billion barrels. Vanoil identified a 400km^2 sedimentary basin under Lake Kivu which may have oil potential. An oil supply would improve Rwanda's energy security and could provide a new export revenue stream; however it is a high carbon energy source. A petroleum exploration policy and act has been drafted by MININFRA and is awaiting revision and validation.

Geothermal

Rwanda hosts two prospective areas for geothermal energy exploitation, the Volcanoes National Park and the faults associated with the East African Rift near Lake Kivu. Rwanda aims to produce 310MW of power from geothermal energy by 2017 with the possibility of an increase to 700MW. MININFRA plans to drill exploration wells and build a 10MW pilot plant in 2011 followed by a 75MW power plant by 201311. There is potential for off-grid geothermal energy that could include heating greenhouses (e.g. Oserian flower farm in Kenya[12]), agricultural processes (steam-to-bake, e.g. tea) and cooking. Geothermal exploration is very expensive and funding needs to be secured to develop the resource, though operating

costs are relatively low. A geothermal exploration law is being drafted by the GoR to aid private sector participation, and MININFRA is working with the local university to raise awareness of the future skills and technology requirements for geothermal energy.

Wind

A Wind Atlas and wind potential study was produced in December 201013. The results show that there is weak wind power potential in Rwanda, with average wind speeds ranging from 2.4m/s to 4.3m/s and capacity factors of less than 13%. Wind power is a clean renewable energy source, but as remote off-grid hybrid wind/diesel installations are the only likely economically viable option, it becomes high carbon.

Energy Efficiency

Energy efficiency has two obvious benefits of reducing the cost of energy and reducing the energy demand, which increases net supply and therefore energy security. It also reduces carbon emissions. The use of energy efficient electrical appliances is actively promoted by the GoR while electricity for heating is discouraged. The GoR is considering introducing energy labelling and energy efficiency standards for imported electrical appliances and is distributing over 800,000 compact fluorescent lights (CFLs). Energy efficient strategies include the efficient use of petroleum products and electricity in agriculture, energy audits for industrial users, upgrading or replacing energy inefficient equipment and technology, a National Electricity Network audit to identify measures for network strengthening, and the inclusion of energy efficient requirements in building regulations. The GoR plans to raise awareness through regular programmes and continuous dissemination of information[2]. As the biggest source of energy is biomass, there could be a larger focus on efficiency of cooking stoves. Energy usage data collection is also crucial to implementing and monitoring energy efficiency.

Potential Opportunities

East Africa Power Master Plan

In March 2005, the East African Community (EAC) produced an East Africa Power Master Plan (EAPMP) which covered the planning, economic analysis and required investment for expansion of the generation and transmission system for the region. A key outcome of the study was the formation of the Eastern Africa Power Pool (EAPP) in November 2006 as a specialised institution of COMESA for electrical power for Eastern Africa. The EAC and EAPP are in the process of developing a Regional Power Master Plan and Interconnection Code which will expand on the EAPMP to include Rwanda and Burundi (not part of the EAC in 2005) and update key planning criteria. The regional plan will map out low cost power development through generation and transmission projects to cater for the region's power needs for the 25-year horizon from 2013 to 2038. The partnership with the EAPP will enable the EAC to identify sources of cheap electricity from ten east African countries to complement local resources[14].

Low Carbon Planning

Rwanda's strategy of energy diversification is important for energy security but it could also facilitate low carbon development. It is important to consider the climate impacts for each energy source and the possible funding sources available for mitigation. The Netherlands Development Organisation (SNV) is in the process of obtaining voluntary credits for Rwanda from the NDBP but other sources of carbon credits are hydro, solar, wind, methane and geothermal energy. The energy source for electricity consumed by the various industries in Rwanda will largely determine their emissions and hence be their primary focus for mitigation. These factors need to be taken into

account alongside the political, economic, social, technological and environmental aspects of the energy sector. Key criteria that contribute to the feasibility of exploiting each energy source are listed below:

- Capital cost
- Operating cost
- Time to delivery
- Ease of use
- Reliability/availability
- Land use impact
- GHG emissions
- Water resource impact
- Regional context

ESMAP and the World Bank are developing a comprehensive toolkit that aids low carbon electricity sector planning using a 'learning-by-doing' approach. It is being piloted in Nigeria and Morocco from 2010 to 2012 and could be used in other countries from 2013. The approach will support the development of objectives and supply-demand forecasts and the identification of options for low carbon development. The toolkit will document the approaches, methodologies and available tools to aid low carbon power sector policy and regulation development, investment decisions and low carbon technology choices[15].

Climate Change Impacts

With current growth, GHG emissions from energy generation will rise though the emissions intensity should decrease as hydropower, methane and renewable energy expand and replace rented high carbon oil-fuelled power. With the range of energy options available, the GoR can prioritise projects that will result in a low carbon development pathway.

The direct impacts of climate change will affect the energy sector in terms of supply, demand, costs and reliability. The most important impacts would be extreme weather such as storms, floods and droughts which could increase or decrease hydropower supply and may damage infrastructure and woodfuel plantations, reducing electricity and biomass supply. As it develops, Rwanda has the opportunity to build a climate-robust energy system. It is already doing this partly by investing in a diverse range of energy supply sources, especially renewable energy, and by expanding linkages with the East Africa region. Other methods of increasing resilience are technical adaptation (reinforcing infrastructure and equipment and appropriate siting of equipment) and operational adaptation (disaster preparedness planning, managing energy demand and investing in energy efficiency) 16. These approaches can be included in GoR policies to ensure that they are implemented. It is important that Rwanda quantifies the predicted impact of climate change so that it can incorporate adaptation into its energy planning process. Training of engineers, technology transfer from more advanced nations, research and development programmes, and raising public awareness are also crucial to ensuring that Rwanda's development is not hindered by climate change.

Government Policy and Targets

In 2008 the GoR produced a National Energy Policy, which is an update of its 2004 Energy Statement. It specifically covers the long term development of the electricity sector, household energy requirements, gender sensitivity, and Rwanda's commitment to private sector participation. The policy is complemented by the National Energy Strategy which covers the period to 2020. MININFRA is in the process of implementing a detailed strategy for the period 2008-2012 - the Energy Sector Strategic Plan - and an Energy Strategic Plan for 2011 to 2017 has been drafted. An Electricity Master Plan was produced in December 2010. The policy objectives are:

- To ensure the availability of reliable and affordable energy supplies for all Rwandans
- To encourage the rational and efficient use of energy
- To establish environmentally sound and sustainable systems of energy production, procurement, transportation, distribution and end-use

The strategy shows that high rates of GDP growth are only going to be possible for Rwanda if based on activities with low energy intensity, locally produced electricity and an oil price below 100 USD per barrel

- Under the EDPRS17 there are four energy sub-programmes each with its own target for 2012. These are:
- Increased access to electricity
- Reduced cost of service and introduction of cost reflective tariffs
- Energy diversification and security
- Strengthening the governance framework and institutional capacity

Stakeholder Mapping

The key stakeholders for the Energy sub-sector are the Ministry of Infrastructure (MININFRA), the national utility the Rwanda Electricity Corporation (RECO), previously known as ELECTROGAZ, and the Rwanda Utilities Regulatory Agency (RURA). RECO is responsible for transmission and distribution but off-grid schemes and independent power producers are encouraged. The introduction of competition within the electricity industry is a long-term policy goal. RURA was created in September 2001 to regulate the public utilities and in May 2008 an Electricity Directorate and a Gas Directorate were formed[18]. In 2009 the National Energy Development Agency (NEDA) was created and an Energy, Water and Sanitation Authority (EWSA) was approved in December 2010. An Energy Development Directorate will be set up in EWSA which will take over the responsibility of implementing energy policy from MININFRA. MININFRA works closely with many other government ministries as well as RDB, OGMR and REMA.

Active development partners are the World Bank, African Development Bank, Belgian government, Netherlands government, European Union, French Development Agency, Japan International Cooperation Agency (JICA), Opec Fund for International Development, Arab Bank for Economic Development in Africa and DFID. NGOs such as SNV and CARE work in the biogas and biomass sub-sector and ARED, a local association that represents renewable energy companies, is working on implementation. Involvement from the private sector is encouraged and RECO is outsourcing work on the distribution network to local private sector companies. All of these stakeholders form an Energy Sector Working Group, a quarterly coordination and decision making forum co-chaired by the GoR and the World Bank.

Summary

Rwanda's current reliance on hydropower and oil-fuelled power makes it vulnerable to climate change and oil price shocks. Current GHG emissions are low, contributing 15% of national CO_2 emissions and 28% of national methane emissions in 2005. Rwanda has an impressive programme to expand and diversify its energy sector which will improve its energy security and aid poverty alleviation. The GoR is investing in a large range of energy sources that vary in carbon emissions from clean renewables like solar to high carbon options like oil. The majority of the large energy resources are in the west of the country and have land use or regional impacts. For the country to follow a low carbon development pathway, these options need to be thoroughly assessed for economic, social and environmental costs and benefits.

5. MINING

The mining industry in Rwanda is in a state of transition, recently privatised and moving from a regional trading industry to a local extraction and exporting industry. As the largest export earner, it plays a significant role in the economy and is a key focus area for the Government of Rwanda (GoR). It provides employment to over 35,000 people and earned almost 60m USD, 30% of export revenue, in 2009. The main exports are cassiterite (tin ore), wolframite (tungsten ore) and coltan (tantalum ore) with small amounts of gold and sapphires. The industry is dominated by small-scale and artisanal miners (ASMs) while the larger companies trade more than they mine, including ores from eastern DRC. The current focus is on exploration and the GoR aims to triple production and increase revenue by 10% by 2015[1]. The key challenges are lack of ore reserve knowledge and of local technical and business skills. The mining industry is vulnerable to global price shocks and storms and floods, exacerbated by climate change. Opportunities for product diversification and mining services are therefore very important for the stability and growth of the industry. Rwanda could position itself as a regional mining services hub and contribute to achieving Vision 2020. The only record of GHG emissions are estimates of cement and lime production in 2005[2] (table 1.1). As the industry grows, it has the opportunity to develop in a low carbon way. This is largely dependent on the type of energy used in mining and processing, but water use and energy efficient technologies and methods also play an important role.

Current Status

The first geological map of Rwanda was published in 1926, and mining began in 1930[1]. After independence, the GoR created a public mining company, SOMIRWA, by combining all existing mining companies to strengthen the industry. In 1985 SOMIRWA went bankrupt and in 1989 another public company, REDEMI, was established to continue mining and exploration. There was slow growth from 1994 but intensive privatisation of state-owned mines from 2006 increased productivity while high commodity prices boosted the sector. Rwanda is underlain by the Kibaran Belt which extends into Tanzania, Uganda, Burundi, DRC and Angola and is known to be widely mineralised. Rwanda is currently mining cassiterite (tin ore), coltan (tantalum ore), wolframite (tungsten ore), gold and sapphires (figure 5.1). In 2008 Rwanda produced about 5% of the world's tantalum and 4% of global tungsten[3].

Figure 5.1: Mineral deposits and potential target areas[4]

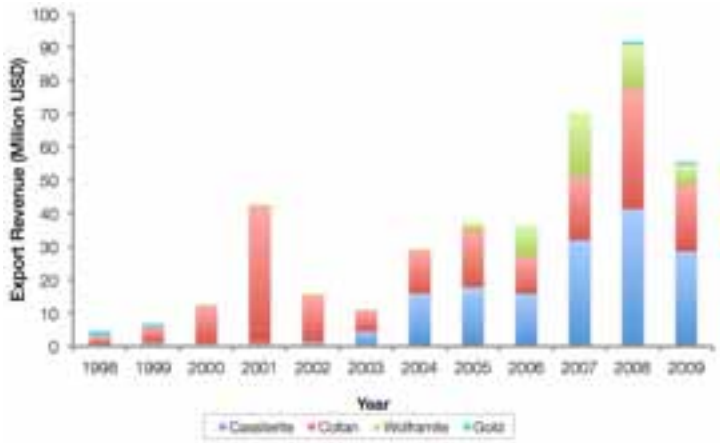


Figure 5.2: Mineral Exports in USD, 1998 to 2009 (Source: RDB, 2010)

Mining

Mining is the largest export earner in Rwanda, bringing in up to 94 million USD annually (figure 5.2) and is a key focus area for the GoR[4]. Export revenues are highly dependent on global commodity prices, which increased over the past five years (dropping only during the global financial crisis). There has been a similar pattern with domestic production and export volumes. Exports are dominated by cassiterite, contributing 6,477 tonnes of the total 8,401t exported in 2010[5], while local production is dominated by wolframite (Figure 5.1). There are nine companies - predominantly owned by foreigners - with processing operations in Rwanda, having a processing capacity of 2,735 tonnes of concentrate per month[4]. Two smelters exist, one in Kigali and one in Rubavu, but they are not operational due to the high cost of electricity in Rwanda. GHG emissions are not measured or recorded for the industry but the largest sources of emissions are likely to be CO_2 from mineral processing and transport.

There are four types of mining permits – a two-year prospecting licence, a four-year exploration licence, a five-year mining licence and a thirty-year concession. There are 323 prospecting, exploration and mining licenses and 161 permit holders in Rwanda[5]. Twenty government concessions have been privatised and are now owned by ten companies, with one concession in the process of being privatised. There are two large long-term private concessions mining wolframite. Land use conflicts are dealt with at district level.

Quarrying

Quarries in Rwanda extract aggregates, silicon sands, dimension stone and clay and are used to produce cement, tiling and concrete. They are classified into three categories[1]:

- Small quarries (<1ha) - managed by districts
- Quarries > 1ha - managed by MINIFOM and exploited for industrial use only
- Government-owned quarries - permits to manage these quarries are issued for a specific period via MININFRA when there is an activity of public interest e.g. construction of roads

The quarrying industry is relatively undeveloped, with aggregate quarrying being dominated by large international construction firms. The majority of value-added construction materials are imported. Rwanda has three cement factories, the largest of which is Cimerwa, which produces 100,000 tonnes per year but plans to expand by 600,000 tonnes per year to meet domestic demand. A

large granite manufacturing plant is due to start operating from May 2011. The only reported GHG emissions for the mining industry are estimates for 2005 of energy used in cement and lime production. Together they are thought to have produced 151Gg of CO_2, 28% of the national total[2]. Construction materials in Rwanda that can be used in their primary state or processed include amphibolite, granite, quartzite, volcanics, dolomites, clay, kaolin, sand and gravel.

Regional Resources

The countries bordering Rwanda are rich in minerals and gemstones[6]. They host metal deposits of gold, copper, cobalt, tin, tungsten, coltan, silver, iron ore, lead and gemstones including ruby, sapphire, tsavorite, aquamarine, cordierite, emerald, tourmaline, tanzanite, diamond, amethyst, garnet, spinel, beryl and citrine. They also have quarries for limestone, sand, stones, clays, granite, soda ash and marble for construction materials. There is very limited processing of ore, with some copper and cobalt smelting and minor production of steel and lead. Mineral resources have significant regional development implications and should be part of ongoing initiatives in regional integration.

Current initiatives

Exploration

The lack of detailed ore reserve information has led to a focus on exploration. Recent geophysical work[7,8] identified 21 potential target areas (PTAs) shown in Figure 5.1. Four have been chosen for detailed survey and mapping, and the GoR is hoping to develop the areas through public private partnerships. Five large companies are exploring for gold while other metals identified by OGMR for exploration include chrome, uranium, zinc, lead, copper, thorium and lithium. Gemstones identified for exploration are tourmaline, opal, amethyst, topaz, corundum, chiastorite and agate.

Certification

A Trading Chain Certification Process is under way in partnership with the Germany Institute of Geosciences and Natural Resources[9]. The requirements for certification include transparent declaration of production and trading, fair remuneration and safe working conditions for all employees, contribution to social, economic and institutional development and continual improvement of environmental performance. There is an opportunity to include low carbon development in the environmental performance part of this process. Because of the conflict in the DRC, the United States has recently issued a law requiring certification of mineral exports from the region. In response OGMR has started tagging mineral exports.

Opportunities

As the mining industry is under-developed there are many opportunities not only in increased production but also in downstream processing, diversification, import substitution and mining services. With significant investment there could be a fourfold increase in production and export revenues within the next ten years, reaching 16,000 tonnes and 240 million USD annually[10]. High fixed investment costs, limited knowledge of reserves, high energy costs and lack of certified personnel are barriers to foreign investment in the sector. Before these opportunities are taken forward, low carbon pathways should be mapped out. Mining can not only be a driver of development, but of climate-resilient low carbon development.

Downstream Processing

The limited capacity for mineral processing in the region provides an opportunity for economic growth in Rwanda. The GoR plans to develop a mineral processing centre, encourage gemstone cutting and polishing enterprises, revive tin smelting operations and support smelters and

Table 5.1: Potential mining and manufacturing diversification

Mined Product	Estimated Resource	Manufactured Product
Sand	6.5 million tonnes	Glass Manufacturing
Fine Clays	4.5 million tonnes	Bricks, Roof Tiles, Ceramics (e.g. Insulators, Porcelain, Paint)
Limestone, Kaolin, Gypsum	2.9 million tonnes	Lime, Chalk, Fertiliser, Concrete
Talc	Unknown	Cosmetics
Dimension Stones - Granites, Marble, Amphibolites, Schist, Siltstone	Abundant	Tiles (stone cutting and polishing)
Gemstones - Emerald, Tourmaline, Beryllium, Topaz, Sapphire, Chiastolite, Amethyst, Opal, Agate, Flint	Unknown	Jewellery

modern concentration plants. With proper ore production supply and infrastructure, smelting activities could increase annual revenues by up to 5 million USD, reaching 10 million USD by 2020. Recent large investments of 57 million USD have been made in granite cutting and polishing, sapphire processing and a ceramic plant. Mineral processing, especially smelting, is the highest user of energy in the global mining industry. Rwanda, with its many renewable energy options, could ensure that even if energy use increases, GHG emissions do not.

Diversification

To reduce vulnerability to global commodity price fluctuations, the industry could diversify its construction materials and gemstones. MINIFOM and OGMR have identified a number of opportunities shown in Table 5.1 above. The benefit would come not only from the new products that could be sold domestically or exported, but also from the creation of a service industry.

Import Substitution

Rwanda has seen a rapid rise in exports and imports over the last few years. Of specific interest for the mining industry are imports of construction materials and fertilisers, worth some 150 million USD in 2008. This presents a significant opportunity for import substitution, as Rwanda possesses many of the necessary raw materials. Cement, tiles and bricks are already manufactured in Rwanda, but production could be increased. This would however increase domestic GHG emissions as cement production and lime production are carbon-intensive processes.

Mining Services

The mining services market generated 19 million USD in 2010. Rwandan companies provide basic services such as mineral analysis, logistics and site surveys while international providers specialise in highly technical services including mining engineering, validation and training[10]. With investment, the services market could increase to 53 million USD by 2020, with 29 million USD going to local service providers, and could become a regional hub. The GoR plans to build the Kigali Mineral Campus in 2014; this will include a Kigali Gem Cutting and Design Centre, cooperative treatment stations, private processors and refineries, training centres, financing facilities, investment promotion and business incubation. Local expertise in geology, mine engineering, and metallurgy is currently extremely limited, however, with only 40 scientists in the country. The industry will need 80 scientists and 300 technicians over the next five years. The GoR plans to send Rwandans overseas for training, develop local degrees in geology, mining and metallurgy and set up mining related technical training courses. The services

Figure 5.3: Five strategic pillars of the 2009 Revised Mining Policy

provided could be expanded to include technical and financial advice on climate resilience and low carbon development.

On-site power generation

Mining operations are often in remote areas away from the national grid. This limits their ability to mine and process ore and the level of technology and mechanisation they can employ. Micro-generation of renewable energy (e.g. solar PV, micro-hydro) on site could boost production while reducing GHG emissions. The GoR could consider incentives to promote this as it would reduce energy demand and emissions.

Biofuels

A large expense and contributor to GHG emissions in the mining industry is transport. In Rwanda, the majority of transport is of ore to processing plants or for export. Second and third generation biofuels could in time replace conventional diesel to reduce the industry's emissions.

Climate Change

The GHG emissions of the mining sector are currently unknown though it is likely that the largest sources are CO_2 from mineral processing and transport. As the industry grows, more energy intensive methods are likely to be used for drilling, blasting, loading, hauling and processing. Emissions will depend on the energy sources used and the level of energy efficiency employed. Electricity from the national grid is expected to be a mix of energy from fossil fuels and renewable energy. Water demand will increase as the sector grows: the principles of reduce-reuse-recycle need to be embedded early on.

Climate change will affect the mining sector in terms of costs, efficiency and disrupted production. The most important direct impact will be floods and storms which can halt mine production, damage infrastructure, cut electricity supply and hinder transport.

Government Policy and Targets

A Mineral Policy was written in 2004 but, with the rapid development of the industry, a revised Mining Policy was adopted in February 2010. A Mining Law[11] was published in April 2009 using international standards, and provides the framework to create a competitive industry. This was followed by four ministerial orders[12] gazetted in October 2010. Royalties are charged for mining companies - but not for small scale miners - at the rate of 2% for rare and base metals, 3% for gold and precious metals and 8% for precious stones. The Mining Policy proposes the creation of a mining development fund, which will receive a share of royalty payments to finance strategic public investments in the mining sector.

There are two EDPRS targets for the mining sector[13]:

- Increase mineral exports by 250% from 38 million USD in 2005 to 106 million USD by 2012

- Increase employment from 25,000 to 37,000 by 2012, of which 20-30% should be women

The strategy for achieving these targets is to promote private sector participation, increase mineral mapping and exploration and improve the capacity of small miners. More recently, MINIFOM has set targets of tripling production and increasing revenue by 10% by 2015. The Mining Policy has five strategic pillars with associated targets for 2020, shown in figure 5.3. The GoR is encouraging investors through import tax exemptions, accelerated depreciation of assets and access to services. While the industry is still young and starting to implement new legislation there is a window of opportunity to embed principles of climate-resilience and low carbon development. Regular measuring and reporting of energy use, GHG emissions and water use is required and monitoring and evaluation of the impact of the industry should be put in place. The GoR could include consideration of energy and water efficiency in the requirements for mining licences and concessions. The GoR is enforcing Environmental Mitigation Plans for the industry and these should include climate change mitigation.

Stakeholder Mapping

The two key government stakeholders are the Ministry of Forestry and Mining (MINIFOM), which has responsibility for setting policy and preparing legislation, and the Office of Geology and Mines in Rwanda (OGMR) which is responsible for implementing policy and regulation but also provides technical supervision, promotes sector growth and coordinates activities[14].

The private sector is diverse, ranging from large international firms to individual artisanal miners, with different levels of investment, production, performance and social commitment. In March 2011, 311 mining permits and 12 quarrying permits were operational, owned by 161 different companies or individuals[4]. As most domestic large scale mining projects are in the exploration stage, trading operations are larger than mining activities. Artisanal miners are encouraged to form cooperatives to improve capital, production, governance and technology. The Federation of Mining Cooperatives (FECOMIRWA) was established in December 2009 to support cooperatives in management, training, health and safety, promotion to investors and buyers and environmental conservation[15]. It comprises four unions - UCOMIMU, UCOMIGABU, UCOMIRU and RUMICU - each of which is made up of several cooperatives that operate in specific districts. A total of 22 cooperatives mine coltan, cassiterite and wolframite from over 90 mines. The Rwanda Investment and Export Promotion Agency (RIEPA) facilitates the strengthening of the supporting industry institutions of the mining sector. The Private Sector Federation (PSF) represents the interests of the private sector, including mining, and is discussing setting up a Mining Roundtable. A Minerals Investors Forum operates in Kigali.

Summary

The mining sector in Rwanda is in a process of transformation after recent privatisation and a focus on increasing domestic production. The industry is a driver of economic growth as it provides thousands of jobs and brings in about 30% of Rwanda's export revenues. The GoR sees it as a focus area and aims to triple production and increase revenue by 10% by 2015. Rwanda could become a regional hub for mining services, contributing towards Vision 2020. The GoR has the opportunity to establish climate resilient and low carbon principles into the industry from an early stage. Renewable energy sources and energy and water efficiency are key to minimising impact. GHG emissions, energy use and water use should be measured and reported.

6. TRANSPORT

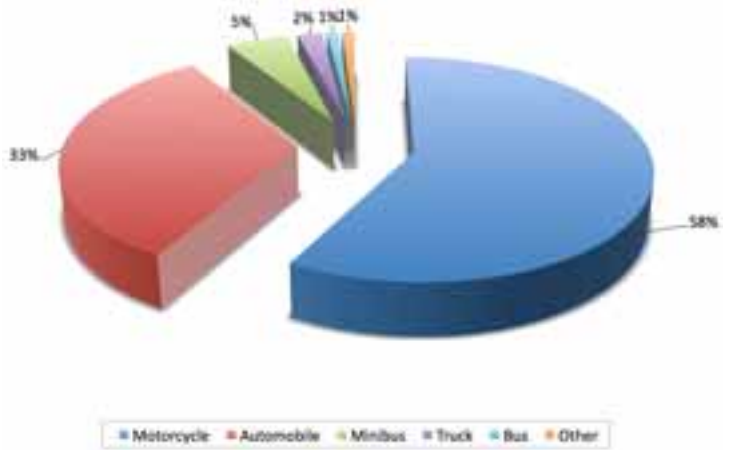
Mobility is an essential component of human civilisation. Efficient multi-modal transport systems promote the growth of cities, of global trade and of the economy in general. Usually reliant on petroleum products, transport can be carbon intensive. The average US citizen, a member of the most mobile nation on earth, generates 5.2 tonnes of CO_2 per year through transport alone[1]. Rwanda, with its landlocked position in the African continent, mountainous terrain and rapidly expanding population and economy, is susceptible to a carbon-intensive expansion, and is reliant on foreign sources for its energy supply. However, because its road fleet is small, Rwanda is not locked into a transport system and thus has the opportunity to choose systems that will meet future demands.

Current Status

Transport in Rwanda is currently dominated by internal combustion engined (ICE) road transportation, both for passengers and cargo. National and international transportation are dominated by the road sector; a limited volume of people and materials are moved by water and air. This has a significant effect on prices in Rwanda, as lack of modal competition and demand for imported fuel keep transport costs high. Currently over 40% of the cost of goods is attributed to transportation, keeping prices high and reducing the competitiveness of Rwandan exports. Whilst not separately accounted for, GHG emissions from transport are approximately 13% of Rwanda's total emissions. Local pollution is a concern due to the age and condition of the Rwandan fleet. Ozone levels exceed both US and Japanese environmental standards.

Rwanda is served by some 14,000km of roads, giving it one of the highest road densities in Africa, at 0.53km/km^2[2]. Approximately a third are classified roads (~4,700km), which fall under the jurisdiction of Ministry of Infrastructure (MININFRA); the remainder are unclassified roads. Classified roads are further separated into National Paved Roads (NPR) and National Unpaved Roads (NUR) (~2,900km), with the remaining classified roads (~1,800km) defined as District Roads (DR). Maintenance of the national road network falls under the remit of the Ministry of Infrastructure where as the district roads are the responsibility of the district[3]. The unclassified roads are gravel rural or feeder roads and urban roads, which fall under the jurisdiction of the various communes and city councils. The quality of the roads is highly variable. Nearly 75% of NPR are of good or passable condition, but only 20% of

Figure 6.1: Rwandan Road Fleet Mix 2008[4]



District Roads qualify for this grade. The Rwandan vehicle fleet consists of 13,305 vehicles (figure 6.1) - mainly motorcycles (58%), with two-axle vehicles (cars, jeeps and pick-ups) also a significant portion (33%)[4]. No rail currently operates in Rwanda; waterborne transport is limited to some irregular services on Lake Kivu. Air transport is mainly handled by Kigali International Airport, though Kamembe Airport in the southwest also has some regional flights. There are five other airports in Rwanda; these are unpaved, and handle either private or small civil flights. Kigali airport handles about 300,000 passengers a year (2008)[5] and is the main hub for RwandAir, the national carrier with a fleet of five small to medium-sized aircraft operating in the Eastern, Central and Southern African regions. Destinations served by direct flights include Brussels, Amsterdam and Dubai as well as regional centres such as Nairobi, Johannesburg and Dar-es-Salaam.

Current Initiatives

Land - Road

The main focus of the Rwandan Transport Development Agency (RTDA), the government agency in charge of transport in Rwanda, is the development of road infrastructure. As of 2011 there are forty-eight road maintenance and rehabilitation programmes ranging from widening and improvement of national roads to the relaying of urban and rural roads[6]. These projects are in varying states of implementation. The hilly terrain of Rwanda, and the levels of precipitation, make constructing and maintaining roads a major challenge, absorbing a significant portion of budget and aid finances.

In an aim to reduce road maintenance costs, RTDA is carrying out an axle load monitoring programme[7]. Excessive axle loading has a significant impact on the life of road infrastructure, leading to increased road maintenance and vehicle operating costs. Linked to this is a study on improving pavement durability through better selection of materials. Other studies include proposals to switch from left hand drive to right hand drive vehicles, as well as a number of regulation and road safety programmes such as vehicle inspection systems, construction guidelines, road signage and sensitivity to road safety campaigns.

There are also a number of ongoing rural road programs, both Government and NGO-based, as well as rural transport systems such as the coffee bike, a project to provide coffee farmers with long wheelbase bicycles that increase their productivity[8].

As a relatively low cost and readily accessible option, expansion of the road network offers an egalitarian transportation mode with low barriers to entry.

Land - Rail

Rwanda currently has no rail systems in operation though there is a project to link Rwanda to Dar-es-Salaam via Isaka[9]. This multi-national project, funded through the African Development Bank, will link the Rwandan capital Kigali and the Burundian city of Gitega with Isaka, Tanzania by a new line which will continue to Dar-es-Salaam by a standard gauge replacement of the current Tanzanian Railway Corporation metre (1,000mm) gauge line. This will result in approximately 1,500km of standard gauge line, which will be operated by diesel tractive power.

The route within Rwanda will also provide access to the planned airport at Bugesera. The 3.6 billion USD project is currently undergoing the tender process for the second design stage. As with road transport, the infrastructure requirements of rail are a challenge in Rwanda's terrain, as is the management of a multinational project. However a heavy rail system offers a method of transporting large volumes of goods, such as mining products,

efficiently, opening a possible opportunity for a significant export earner.

Air

To expand capacity of Rwanda's air services, and with the aim of operating an East African Hub in Rwanda, a new airport at Bugesera is being planned. It is expected that first phase construction will be completed in 2016 and full capacity of over 1 million passengers annually will be reached by 2025[10]. Plans are currently at the 90% design stage and investors are being sought for a public-private partnership model, which has recently gone to tender. To take full advantage of the opportunities available in the global market place, good air access is vital, facilitating the flow of knowledge and high value goods. However, air travel is expensive in economic and environmental terms, and has high barriers to access.

Water

A highly efficient mode of transport, waterborne services are limited by Rwanda's land-locked status. The two main possibilities for water navigation in Rwanda are the use of Lake Kivu and navigation on rivers[11,12].

Lake Kivu offers an opportunity to expand waterborne transport both within Rwanda and internationally with the DRC. Currently an ad hoc unscheduled passenger service runs between the three main ports, Cyanguou, Kibuye and Gisenyi, a distance of approximately 90km. Commerce is limited to fishing and some transportation by a local brewery (Bralirwa) between its plant in Gisenyi and warehouses in Kibuye and Cyanguou. A feasibility study was undertaken in 2009, and identified a market for 120 passengers and 15-20 tonnes of cargo daily, to be transported by two mixed-use vessels. Similar systems have previously been used both on Lake Kivu (1977-88) and on other great lakes.

A study is currently ongoing into the possibility of making the River Akagera navigable. The Akagera flows from Burundi to Lake Victoria. It expected that the system would be used primarily as international transport to the Lake Victoria area, and beyond through transportation systems in Kenya and Tanzania.

Potential Opportunities

There are a number of potential opportunities for low carbon transportation systems in Rwanda.

Labour-based Technology

There are still a high percentage of manually operated transport systems in Rwanda, with bicycles and walking being the transport modes of choice outside Kigali. These systems have few or no barriers to entry, and are widely available. One such system is the coffee bike, which provides coffee farmers with long-wheelbase bicycles to allow them to get their products to market sooner. They thus receive a higher price, resulting in economic benefits. There is a lack of beasts of burden: these could offer a significant increase in productivity in rural areas, with minimum infrastructural and environmental costs[8]. The cost of animals and the challenges of endemic disease (if any), as well as education on animal husbandry and management of waste products, would need to be addressed. One waste option is the use of Biogas digesters, which produces methane for heating and lighting. These are covered in more detail in the energy sector.

Infrastructure

The current road infrastructure varies from high speed, highly engineered asphalt surfaces to cleared dirt roads which suffer from wash outs and restrict both speed and vehicle type. While fully engineered roads are the best option from a transportation point of view, the cost is prohibitive, the recently completed Musanze to Gisenyi road cost 575,000 RWF (€715,000) per km[13]. A cheaper option is the application of labour-based technologies. Rwanda's labour based

Figure 6.2: Algal fuel bioreactor

intensive local development program (HIMO) was launched in 2003 with the aim of creating employment and generating revenue by utilising local resources. a 12.5km rural trial connecting three rural centres at a cost of approximately 5,000,000 RWF per km[1]. There are trade offs between access and levels of maintenance, with water ingress and run-off being of a particular but improved road surfaces improve transport efficiency and therefore reduce emissions and reliance on external energy supplies. Secondary infrastructure, such as street lights, signage and traffic flow improvements can also offer significant savings in fuel use and transport costs.

Pneumatic

Pneumatic or compressed air vehicles (CAV) utilise an onboard store of high pressure air to drive a pneumatic motor. In the developed world, CAV do not compete with gasoline or electric vehicles in terms of environmental and economic metrics, but could offer a lower cost answer to urban transport in Rwanda[14].

Hydrogen

Seen as a possible replacement for Internal Combustion Engines (ICEs) in developed nations, hydrogen fuel cells are unlikely to have any impact in Rwanda. The high initial cost of the devices and the high level of technology needed to maintain them, as well as the issue of hydrogen supply, means that fuel cell systems are generally unsuitable for developing countries[15].

Biofuel

A number of biofuel projects are under way, in Rwanda, covering first and second-generation biofuels, produced from food and non-food biomass respectively. The ability for biofuels to be 'dropped-in' to current technology, with little or no alteration, is an attractive opportunity, as is the energy security and the export potential. The widespread use of biofuels has a number of challenges, particularly land use pressures, water needs and fertiliser use. Third generation biofuels from algae biomass offer promise, but are currently at pilot plant scale (figure 6.2) and will require a meaningful scale-up to allow mass market penetration[16].

HEV/BEVs

The use of Hybrid Eclectic Vehicles (HEV) and Battery Electric Vehicles (BEV) is championed in the developed world as a low carbon transport solution. The drive for Rwanda to provide electricity generation from renewable resources makes these technologies an attractive proposition, offering low carbon transport and energy security. There are a number of problems with the use of HEV/BEV vehicles in the Rwandan context; electricity generation is currently supply constrained, and neither electrical nor road infrastructure is suitable[17].

Mass Transit

As Kigali accounts for 10% of Rwanda's population, and is growing rapidly, it is necessary to investigate the options for a reliable low-carbon mass transit system to prevent the city becoming like the smog-ridden and gridlocked cities, characterised by a car based development, that are seen in the US and elsewhere in Africa. There are a large number of options for mass transit, including biofuel and biogas fuelled buses as well as electrically powered systems such as trams and trolley buses[18].

Figure 6.3: Hybrid Lighter-than-air Vehicle (Source: Lockheed-Martin)

Biogas/Natural Gas

With significant reserves of methane in Lake Kivu and the possibility of a nationwide network of biogas digesters processing human and animal waste, there is an opportunity for large scale use of biogas power transport, as widely used in Sweden, Switzerland and Germany. Biogas sources would have to be scrubbed of various additives and the carbon emissions addressed[19].

Hybrid Lighter-Than-Air

Another option is the utilisation of hybrid lighter-than-air technology (figure 6.3). These combine airship and aircraft technologies to produce a low energy, low infrastructure transport system. Currently in the development stage, such craft should be available within five years, and will offer a low cost and low emission transport system which can operate from small clearings. Vehicles in the region of 20 tonnes are expected, and will be able to operate in the international context[20].

Behavioural Management

A number of policies, based both on command and control and on incentives, have been introduced to change in the behaviour of the public by encouraging the use of mass transit. Examples for opportunities in Rwanda include introducing emissions standards for vehicles, enforced by either bans or increased taxes, to induce users to purchase lower-emission vehicles. Similar methods can be used to control other transport characteristics, such as vehicle size, but there are issues to be overcome before such policies can be implemented. For example the road network in Rwanda currently requires large vehicles, which due to their size and weight have high fuel consumption. Efforts to reverse this through a combination of infrastructure improvements and education of consumers would offer significant gains in emissions in the long term, assuming a business as usual case where Rwanda followed developed country trends. Such methods are usually low cost compared to other, technology based options, but can still require significant investment[16].

Climate Change

As an infrastructure-based system, transport is particularly susceptible to climate change. Increased precipitation can lead to flooding, land slips and wash outs, which cause significant damage to infrastructure, with resulting heavy financial penalties in both lost productivity and repair and maintenance costs. Excessive temperature variation can cause damage to road surfaces and metallic structures,

with rail systems and bridges being particularly vulnerable. Climate change also adds a significant level of risk in the planning phase of projects. Past measures of unexpected climatic events have now become unreliable, leading to difficulties in designing future-proof transport systems. Designing transport systems to withstand greater climatic variations also leads to increased cost and complexity.

Operation of transport systems is also vulnerable to climate change. Variation in precipitation levels impacts on the safety of transport and can prevent operation in the case of aerial systems. Again systems and procedures to offset these challenges, such as education campaigns or improved air traffic control measures, are costly. Predicting the level of intervention required is also difficult, leading to a greater level of variability in the success of such climate change adaptation projects.

Indirect impacts of climate change could also have significant effects on transportation systems. Rapid changes in demand on transport networks could leave countries with inadequate transport systems for many years - as such systems have lead times in the decades - or with expensive white elephants, produced for demand that has reduced or disappeared and saddling governments with debt.

Government Policy and Targets

The current transport policy in Rwanda is framed by the 2008 document 'Transport Sector Policy'. It identifies the Government's vision for the transport sector as to gain 'cost effective and quality services with due regard to safety and environmental concerns'. A number of key issues within the transport sector are identified and it places the transport sector within the national, regional, socio-economic and socio-political contexts.

The excessive cost of transportation at national and international level is identified as a significant issue to be overcome, as are a number of constraints:

- Geographical and climate constraints
- Multitude of physical and non-physical barriers along international routes
- Over-dependence on a single mode (road) with little multi-mode competition
- Poor historical maintenance of transport infrastructure resulting in poor condition
- Low standards in vehicle condition
- International transport dominated by foreign transporters, which reduces competitiveness and security
- Lack of financial, institutional, design and implementation capacity
- The legal and regulatory framework is lacking in the present and future context

To overcome these issues and achieve the vision of a low-cost, high quality transport sector, five strategic axes have been identified for implementation:

- The private sector to play a more active role in development
- Support from the decentralised entities in the management of the sector
- Local community participation in management and maintenance of the sector
- A system that can react to the opportunities and the challenges of the regional context
- Reinforcement of the capacity, both institutional and human, that will build a viable transport sector
- The document also sets out a framework for achieving this within the current framework of political orientation and reform programmes initiated by the government.

A number of planning tools impact on transport, including Vision 2020, the Economic Development and Poverty Reduction Strategy (EDPRS), the National Investments Strategy (NIS), and the Medium Term Expenditure Framework. EDPRS and Vision 2020 frame the medium and long-term development goals

of Rwanda. Both documents identify the poor state of infrastructure, high cost and restricted access to services as key obstacles to achieving the objectives in development. The NIS proposed over 120 billion RWF to be invested by the public sector between 2002 and 2010 in rehabilitation of the transportation system.

Rwanda is a member of three regional bodies: the Common Market for Eastern and Southern African States (COMESA), the East African Community (EAC), and the Economic Commission of Central African States (ECCAS). The policies aligned with these organisations also impact on the transport sector in Rwanda.

The COMESA treaty charged member states to undertake co-ordinated and complementary transport policies and establish and expand links to further physical cohesion between member states. The aim of this is to increase inter-state mobility. The five main aims of the articles referring to transport revolve around improving transport infrastructure and service, but the most important statement is to 'grant special treatment to landlocked member states' of which Rwanda is one. The EAC and ECCAS follow similar veins on harmonisation of transport policy, improvement of infrastructure, cross border co-operation, security and service. Rwanda is also part of the Northern Corridor Transit Agreement (NCTA), which was set up in the late 1980's to facilitate trade through the port of Mombasa, safeguarding access to the sea.

There are also a number of programmes running within the eastern and southern states region which impact on Rwanda's transportation links with the region and on regional transport:

- COMESA Transport and Communications Strategy and Priority Investment Plan (TCS/PIP)
- SADC Infrastructure Master plan Development
- The Corridor based COMESA/EAC/SADC Joint Aid for Trade Programme
- The EAC Railway Development Master Plan
- The IGAD Transport, Energy and Water Programme under the (JAM Programme)

These programmes work on co-ordinating, developing, maintaining and standardising transport systems across the region, and impact either directly or indirectly on Rwandan transport systems.

Other references include the Millennium Development Goals (MDG) and the Sub-Saharan Africa Transport Policy (SSATP)

Millennium development goals are measurable goals and targets for combating poverty, hunger, disease, environmental degradation and discrimination against women. They were defined in 2000 at the United Nations Millennium Summit, and, while not directly mentioned, transport is a key sector in the achievement of these goals.

SSATP is a broad partnership of 35 countries, eight regional economic communities and fifteen public and private sector regional and sub-regional organisations. It promotes the development and implementation of sound transport sector policies and strategies, in support of sustainable economic growth and poverty reduction among its partner countries. SSATP is currently in its second development plan, focusing on policy development. This includes strengthening links between transport strategies and SGPRS, strengthening transport performance monitoring, assessing rural transport, sustaining reforms in road management and financing, improving urban mobility for the poor and facilitating transit transport.

Stakeholder Mapping

Public Sector

The Ministry of Infrastructure is responsible for the transport sector in Rwanda, with three organisations directly involved in

transportation. The main agency is the Rwanda Transport Development Agency (RTDA), established by act of parliament in January 2010, to oversee the transport sector. Other bodies are the Rwandan Civil Aviation Authority (RCAA) and ONATRACOM. ONATRACOM, a national bus service, runs a fleet of 205 buses on 172 routes, including regional and inter-regional routes. The majority of the fleet is operated in the rural areas. RCAA, the national aviation administrator, also provides the traffic management in Rwandan airspace. RwandAir is a joint venture between the Rwandan Government and Silverback Cargo Freighters and operates a five aircraft fleet.

Private Sector

The transportation sector is dominated by private companies, from design and construction to service providers. International companies dominate the design and construction of large infrastructure projects. The recent road construction projects have been designed and constructed by external companies: for example the rehabilitation of RN4 between Ruhengeri and Gisenyi was carried out by STRABAG Construction Company, and the current rehabilitation of the Kigali to Ruhengeri section is managed by China Henan International Corporation Group. Rwandan construction companies are limited to rural, non-engineered roads owing to their limited experience and capacity to manage large projects.

The service sector in transportation is split between Rwandan and foreign companies, particularly those from other east African countries such as Kenya and Tanzania. Whilst the Rwanda transport fleet has grown since deregulation in 1994, larger companies (+100 vehicles) from Kenya and Tanzania control the long-distance transportation industry. They have higher levels of utilisation and lower operational costs, so can out-compete the Rwandan companies, tend to be of a much smaller scale (<5 vehicles) and have specialised in specific goods, allowing them to capture a small but profitable niche. The main form of public transport in Rwanda is the various taxi services, including the 'moto' (motorcycle based transport), 'twegerane' or shared taxi (Toyota Hi-ace minibuses) that are both privately and publicly owned, and the car taxi.

Aid Agencies, NGOs and Funding Bodies

Many development organisations operate in Rwanda and a number of these have direct roles in the development of transport infrastructure. Recently the World Bank and EU have both funded large-scale rehabilitation of national roads in Rwanda, while aid agencies such as USAid have plans to develop rural routes as part of their rural development plans.

Summary

With a transport system largely dependent on road transportation and fossil fuels there are a huge number of opportunities to diversify the transport system in Rwanda. This offers Rwanda a number of opportunities: to improve its energy security; to reduce its susceptibility to economic shocks; and to become a regional if not global player in the application of advanced transport methodologies. There are a number of challenges facing transport in Rwanda: the terrain and climate, characterised by hills and intense bursts of precipitation, makes constructing and maintaining transport infrastructure an expensive proposition; to develop and implement huge nationwide transport systems quickly and effectively is difficult without appropriate institutional capacity and tools; and there is a risk of lock-in to inappropriate and inadequate systems with high social, economic and environmental costs. However with strong governance and a clear vision it is possible to achieve a transport system that accelerates economic development in an environmentally sound and climate-conscious process.

7. CITIES AND THE BUILT ENVIRONMENT

Housing is a basic human right. The Government of Rwanda (GoR) recognises that providing affordable shelter with access to basic facilities and services is key in improving the quality of life of its citizens. Urbanisation is itself a driving force for economic development, creating a market for services and products as well as centres for employment. The current practice in urban developments, or cities, is unsustainable. Cities depend on a multitude of sources for supplies, most being truly global in their reach when it comes to demands for raw materials and services. This leads to contemporary cities having an ecological footprint many times their own area, far beyond what is sustainable. It is possible to develop sustainable cities by minimising energy and resource use through strong governance and engagement with the public. This is a challenge faced by Rwanda with increasing pressure from returning refugees, population growth and increasing urbanisation.

Current Status

Urbanisation in Rwanda currently stands at 18% and is increasing at a rate of 4% per annum[1]. By 2020 is expected that over 50% of the population will be living in urban centres. Kigali, by far and away the largest city, representing 44% of the urban population, illustrates the challenges faced by cities and the built environment in Rwanda. Holding a central location in Rwanda, Kigali comprises of three districts (figure 7.1) built over, and constrained by, a number of hills. Kigali has grown, fuelled by the return of refugees, both from the 1994 genocide and previous out-bursts of violence, and this has led to large unplanned and under-served neighbourhoods. Secondary centres are unable to attract returnees, as they are unable to provide solid bases for employment or economic services[2]. Unplanned developments are estimated at 8,500 to 10,000 units annually in Kigali, representing 90% of buildings in the city[2].

Figure 7.1: Map of City of Kigali Districts

Figure 7.2: Unplanned settlement in Kigali

These unplanned areas, built using impermanent materials and populated by low-income and vulnerable groups, are seeing increases in both load factor and extent (figure 7.2). This increases pressure on already limited services, such as sanitation and waste management. Water supply is provided by Rwasco, and consists of treated river or groundwater, though connection to the network is limited. Sanitation is provided by septic tanks or pit latrines, though some independent sites have water treatment works[3]. Solid waste is collected by private haulers and is dumped at the rate of 120 to 200 tonnes a day at a landfill at Nyanza [4]. The site is unlined and does not have a leachate control system, which leads to pollution of the local environment. The hilly terrain of Rwanda also causes challenges as it constrains urban development, promoting urban spread (across hill tops and valley floors) increasing costs of transport and service provision. Efforts in rural areas have centred on the regrouping of the traditionally dispersed rural settlements[5]. The creation of these imidugudu was undertaken to allow for more efficient use of rural space for agriculture, increasing output and focusing development funds on to the highest population areas.

There is also a large disparity in the built environment across Rwanda. The poorest rural families use one-room huts with grass roofs, while modern glass-and-steel buildings are being built in central Kigali. Traditionally, impermanent materials such as wood, reeds, straw, clay soil and termite nest soil were used to construct Rwandan dwellings. Colonisers and missionaries introduced adobe, burnt brick, tiles and corrugated iron sheet, materials and technology that still provide the majority of Rwandans with their dwellings. Post independence, the built environment consisted of traditionally built dwellings in rural areas and colonial technology of low, medium and high status dwellings in urban areas.

Current Initiatives

A number of masterplans have been created for various urban environments. Two have been completed for Kigali, one a conceptual plan by Oz Architecture of Denver in 2007[6], the other a detailed district plan by Surbana of Singapore (2009) giving details of the future central business district (CBD) of Kigali, in Nyarugenge District[7]. The conceptual masterplan identifies growth areas to the north-east and south and suggests a graded approach to building density from

low-density suburban and semi-rural areas (40 people per hectare) to high density surrounding the CBD (250 people per hectare). It recommends that further urban growth of Kigali be defined by the natural features of the area. The use of a decentralised urban growth model, based around the transport nodes of a regional multi-mode transportation network, would allow for the preservation of slopes and wetlands, giving a green belt and urban farming opportunities, as well as flood protection. Where informal communities are located, they recommend upgrading rather than replacement, and the creation of clustered services producing walkable communities. The plan also recommends the development of a new city centre clustered around new university and information centres. Citywide infrastructure is recommended with high levels of connectivity to the electricity, water and sewerage system.

The detailed plan for Kigali CBD in Nyarugenge concentrates on producing a modern glass and steel based city, very similar in appearance to Singapore. The plan encircles Kigali City, in a multi-lane ring road and requires a sixteen-story minimum on developments. The plan follows the earlier conceptual masterplan and approaches the challenge with a holistic view. A multi-mode transport system is proposed, centred around a bus rapid transit system. Waste management is a mixture of environmental treatment zones, biogas digesters and solid waste disposal systems.

Secondary urban centres also have developed masterplans with Karongi, Rusizi, Rwamagana, Nyagatare, Gakenke, Nyamasheke, Kibeho, Rubavu, Musanze and Kayonza completed and Nyamata and Byanza still ongoing. MININFRA also has a number of building and rehabilitation projects covering public buildings.

UNDP, assisted by Fukuoka University, is investigating the possibility of utilising the Fukuoka method to process Kigali's waste [5]. This method utilises semi-aerobic decomposition and is suited to Kigali's waste thanks to the very high organic content (~70%) of the collected waste. It has a number of advantages over the current landfill method including collection of leachate, control of gas venting and a lower cost option to aerobic-type landfills. Other programmes include solar water-heating, subsidised by the Government, and rainwater harvesting on public buildings. Rural projects include Ecosan toilet systems to manage human waste, and low cost housing materials, based on banana stems composite systems bonded with organic adhesives, being developed by Kigali Institute of Science and Technology.

Potential Opportunities

Cities

Creating sustainable cities is a challenge. The very nature of cities, as concentrations of human settlement, creates demand for inputs and produces significant volumes of waste in a concentrated area. Both inputs - resources to feed and maintain the city structure - and the waste produced in the form of gases, solids and liquids must be transported and processed, with the associated costs in economic and environmental terms. To make a city truly sustainable, these processes must be minimised by efficient use and sourcing of inputs, therefore reducing, and where possible reusing waste.

Inputs to a city system can be classified as: goods, such as materials and agricultural products; energy, which can be in the form of electricity, fossil fuels or biomass; and water. There are other inputs such as population and finance, which also affect the sustainability of a city, but as neither population growth nor economic growth is to be curtailed, these can be discounted. The efficient use of these inputs can be managed in many ways, through efficient planning and technology and through education and behavioural management. Efficient building

practises, design and maintenance can ensure the minimum amount of building materials is used. High density urban planning and integrated transport systems can minimise energy used for transportation while energy efficiency programmes in building services, such as low energy lighting and efficient cook-stoves, reduce energy and material use.

While efficient use of inputs should result in the minimum amount of waste, this waste can be reused and recycled and turned into an input, again increasing the sustainability of a city. Liquid waste consists of grey (domestic waste water) and blackwater (effluent). Greywater, where separated from blackwater, can be simply recycled on-site for use for irrigation or in toilet systems reducing the demand on white water supplies which is energy intensive to create and supply. Blackwater, or water tainted by pathogens, must be heavily processed. One option for blackwater processing is the use of biogas digesters. This uses anaerobic digestion to produce methane gas and a liquid digestate, which is then used as fertiliser. There is a minimum feed level for effluent (~50kgs a day) to keep the process viable, which equates to approximately two cows. Higher technology options are also available such as membrane filtration, which can process much higher levels of throughflow, but with associated costs. Solid waste can be processed in a number of ways. Reuse and recycling of non-organic materials can be very efficient and can also help with employment, for example the methods used in Cairo. One of the worlds largest cities, Cairo reuses and recycles most of its solid waste. Processing is handled by the Zaballen, a 10,000 strong community of coptic christians, with support from the city authorities. Recycling and re-manufacturing activities provide a waste management program and an income stream for development programmes.

Organic waste can be processed to produced fertiliser and methane. Waste gases are difficult but not impossible to turn into useful inputs. Methane released from the decomposition of waste would normally be vented to the atmosphere. This can be captured and utilised in buildings as a heat and light source, a process already used in Rwanda.

Built Environment

Key to the sustainability of cities is the built environment. The efficient use of energy within structures goes a long way towards reducing the ecological footprint of a city. While close to the equator, Rwanda's altitude gives a temperate climate. Building design can take advantage of this in a number of ways, reducing the need for secondary services such as heating and air-conditioning:

- Passive solar design which takes advantage of seasonal variations in solar energy
- Thermally massive buildings which take advantage of the diurnal range
- Well insulated buildings that minimise temperature fluctuations
- External protrusions that shade walls, minimising energy gains

The choice of construction materials also has an impact on the environment in terms of the carbon cost of their manufacture. Concrete, glass and steel are energy-intensive materials and should be used carefully, minimising the carbon cost of the construction. Current housing stock could also be made more efficient, using solar water heating, good insulation, and rainwater harvesting, all of which help to reduce energy demand. Retrofitting is however often an expensive and difficult option.

Climate Change

Climate change impacts cities and the built environment significantly. The infrastructural elements are vulnerable to extreme climatic events, and will require careful design to withstand future climate risks; existing housing stock may become unsuitable; with retrofitting expensive and

difficult; and the demands on the services of a city may change, causing excessive pressure or resulting in expensive 'white elephants' that are a drain on resources.

Government Policy and Targets

There are a number of government policies in Rwanda relating to cities and the built environment.

The National Urban Housing Policy for Rwanda is guided by a number of principles, foremost of which is the basic right of Rwanda's citizens to housing and to access to potable water and adequate sanitation. Housing has to be inclusive to all income ranges, allowing access to basic infrastructure and services while remaining sustainable and with reduced environmental impact. Urbanisation is recognised as a driving force for economic development and having other socioeconomic benefits. The document identifies eight constraints on the housing sector:

- Lack of adequate land and basic infrastructure
- Lack of basic urban data
- Lack of housing standards and lack of town planning
- Small percentage of registered land owners
- Lack of financial resources for resettlement of expropriated people
- Lack of planning and management tools
- Lack of adequate financial resources for the local communities
- Lack of human and materials resources

To meet the sectoral aim of alleviating poverty and promoting economic development, the GoR intends to execute various policy actions in the areas of urban housing, urbanisation and in related areas such as standards in construction and materials, monitoring and works. Programmes to achieve this include a city planning project for secondary urban centres, collection of basic urban data, land management tools for the urban setting, promotion of grouped settlements, upgrading informal settlements, revision of standards and legal requirements, assisting local communities in developing financial resources and the building of technical capacity. To implement these programmes a national, provincial and district level institutional framework will be created. The implementation of these policies is dependent on increasing the funding available for the housing sector from tax revenue, government funds and the private sector. The creation of urban planning legislation is a priority to ensure a coherent and functional level of urban development.

In order to implement infrastructure projects MININFRA has developed a National Construction Industry Policy, which is aimed at developing the national construction industry so the private sector can take an active part in Rwanda's development. The construction industry has in important role to play in developing cities and the built environment in Rwanda. It also has a more general economic development by providing various levels of employment in the construction and maintenance of key infrastructural systems. The current construction industry is constrained by number of problems including:

- Insufficient project continuity due to inadequate affirmative public polices
- Insufficient access to finance and credit
- Inadequate human resources in the public and private sector
- Unfavourable conditions for accessing donor credit
- Lack of a database for performance indicators

To combat these issues a number of actions will be implemented including developing professional bodies and education courses to improve capacity, application of labour-based technology, providing access to equipment, credit and multi-year contracts to registered

contractors. It is expected that these measures will result in a national construction industry by 2020, supported by strong public bodies, regulated and competitive with international contractors.

Vision 2020 addresses cities and the built environment by aiming to have 30% of the population living in planned cities with access to basic infrastructure to ensure sustainable development. It also states that by 2010 all cities will have an Urban Master Plan and Land Use Master Plans. The construction industry also contributes to economic development.

EDPRS emphasises planning and development of urban and rural settlements in conformity with the criterion of environmental viability through the reorganisation of national space. The urban environment must be based on strategies that stimulate economic activity.

The Kigali Economic Development Strategy aligns Kigali's development with Vision 2020 and emphasises global competitiveness, promotion of business and industries and improved quality of life.

The National Investment Strategy places the emphasis on the support of the private sector for infrastructural investments. This will be aided by the development of Urban Master Plans and the provision of basic infrastructure on allotted sites, opening them up to investors.

Rwanda's Building Control Regulations are the standard reference for the regulation of building design and construction and cover the whole range of the building process, from planning approval to structural design, services and maintenance.

The National Human Settlement Policy (2004) identifies the challenges facing the housing sector which, following years of underinvestment, has been significant strain because of returning refugees. It identified seven major issues relating to high demand, lack of resources to provide housing and the lack of human capacity to implement the necessary projects. The National Human Settlement Policy implemented an institutional and a legal framework as the initial foundation for developing the settlements of Rwanda.

Stakeholder Mapping

A large variety of stakeholders are heavily involved across the sector. The key public body involved in cities and the built environment is MININFRA, through the Directorate of Planning and Urban Development and the Directorate of Housing, Planning and Urban Heritage of the State. The specific aim of these bodies is the organisation and improvement of the current system of human settlements for sustainable socioeconomic development. There are also regional and district planning bodies as well as city planning authorities such as Kigali City Council. Private sector bodies include consultants, architects, construction and maintenance companies and service providers. NGOs such as the World Bank, UN-HABITAT, GTZ and African Development Bank are also involved in a number of joint projects with the public sector. These include resettlement projects, waste management, and sanitation as well as policy formulation.

Summary

With so little in the way of existing housing stock that has access to basic amenities there is a great opportunity in Rwanda to create a system that produces sustainable buildings and cities in both rural and urban environments. Key to these will be the redevelopment of unplanned settlements, the design and application of energy efficient housing designs and standards and the creation of urban areas which minimise their ecological footprint. The challenge is to provide the volume of construction required, in a sustainable way. This is to be achieved against a backdrop limited funds and capacity to develop the sector.

8. AGRICULTURE

Agriculture is the foundation of Rwanda. Recognised as the engine for development, it contributes more than 36.7% of GDP (2010), employs more than 80% of the workforce and supplies 90% of the nation's food and nutritional needs. Efforts to improve rural livelihoods and alleviate poverty place agriculture at the centre of Rwanda's strong progress towards achieving Millennium Development Goal 1[1]. Ensuring the sector's resilience against existing and future climatic change, and external economic fluctuations, is a national concern for long-term development. The GoR's primary goal is to transform the sector from subsistence scale to mass production, 'making the most with the available resource'. Mitigation and emission reduction opportunities lie in; improved and sustainable production methods, crop selection, modernisation, land consolidation and protection, agroforestry, agro-ecological extension, improved land and animal husbandry and collaborative management. For horticulture, this has meant improving quality not quantity.

Direct improvements can be achieved by; improving rural infrastructure and feeder roads, enhancing soil fertility and yields, post harvest storage and handling, water harvesting and irrigation. Key exports are tea and coffee contributing over 80% of agricultural exports combined[1].

Rwanda exports approximately 46.6 million USD (27.680 million RWF), of which 57.9% is agricultural related goods and livestock to its four cross border neighbours, of which 80% is traded with DRC (table 8.1)[1].

Rwanda's agriculture is the most pressured, complex and vulnerable sector to climatic change. Causal impacts are variance in Rwanda's diverse climatic sub-regions, moderate bi-annual wet-dry seasons, uneven rainfall and increasing episodes of extreme drought and flood.

Table 8.1: Total exports to neighbouring countries May to April 2009/2010[1]

	Value of Export (USD million)	% Share of Total Exports
Bovine Cattle (live)	5.735	12.22
Goats (live)	4.715	10.05
Paraffin	4.454	9.49
Dried beans	2.292	4.89
Maize flour	2.067	4.41
Irish potatoes	1.884	4.02
Raw milk	1.702	3.63
Ground nuts	1.611	3.43
Beef meat	1.422	3.03
Dried fry of Tanzania	1.278	2.73

The scarcity of available land, a highly leached soil profile, and an extreme undulating topography are the key limitations to production. Rwanda has about 1.5 million ha of arable lands, 90% of which is steep hillside area susceptible to landslides. Up to 81% of arable lands is now sustainably managed with the remit for addressing arable land degradation vested with MINAGRI. The rich volcanic soils of the North-West and numerous marshland regions across the country offer the best yields. Fertiliser use is currently limited due to socio-economic blockages – knowledge, though access and use is growing. Modern practice and mechanisation is low for similar reasons. Intensification, urbanisation, settlement, investment, improved environmental conservation of wetlands and sensitive areas have reduced the availability of productive lands.

Low carbon growth options have not yet gained traction though many opportunities exist. To ensure Rwanda's future and growth potential, it is necessary to create low carbon agricultural development, in harmony with a national vision that secures Rwanda's biodiversity, economy,

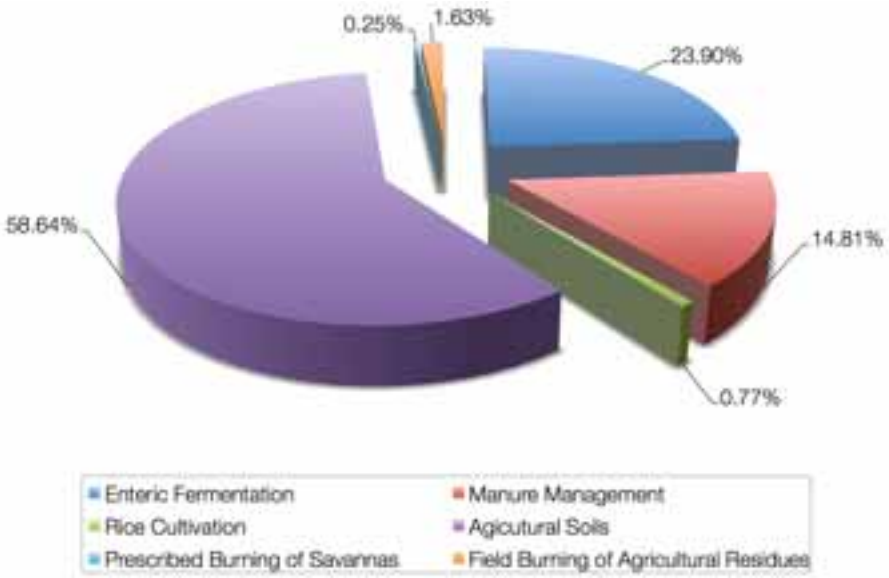


Figure 8.1: GHG emissions from Agricultural sector

investment and export potential, and the improved livelihood of its population.

Current status

Agriculture contributes 40.25% of Rwanda's total GHG emissions from a number of sources (figure 8.1). Soil erosion costs the country 1.4 million tonnes of fertile soils per year. Agricultural intensification demands high inorganic fertiliser inputs and expansion of organic input methods. The increased application of mineral fertilisers will have an impact on water pollution, nutrient loading, and potential emissions of nitrogen (N) compounds. Emissions from cattle are expected to be offset by sequestration resulting from crop intensification practices. GHG emissions from inland water bodies and the impact of radical terracing require analysis and investigation. Agriculture data is reliable to the extent of the capacity to accurately record quantities and movements of product. As such there is a recognised weakness in the available figures reported across recent reports[2].

Tea and Coffee

Following minerals, coffee and highland tea are the leading export commodities for Rwanda. However, these commodities are highly volatile, both in supply volumes and value. Both coffee and tea production declined 18% and 6% respectively and coffee prices fell 4% in the previous year. It is expected that revenue from tea will reach 68 million USD for the current year. In turn, coffee estimates have been revised down to 50 million USD (from 68 million USD) due to production challenges in the unusually long dry season in key districts in 2010[3]. In an effort to increase the value of exports, more than 10% of Rwanda's coffee is now fully washed adding value and raising international demand from gourmet roasters and retailers such as Starbucks™.

Livestock

Beef production requires substantial land for grazing and contributes to erosion, soil degradation and adverse impacts on water supply. The bulk of dairy production in milkshed areas is via commercial cut-and-carry systems. Animal and land husbandry methods need to be advanced and sufficiently controlled to preserve limited grazing lands. Annual animal production in 2008 was estimated at 97,981 tonnes of milk, 39,126 tonnes of meat, 2,432 tonnes of eggs, 7,612 tonnes of fish and 1,499 tonnes of hides and skins[4]. However, these rates do not meet

Figure 8.2: Tea plantations in the West Province

the needs of the population. Consumption in Rwanda is 13 litres of milk per person per year and 75% of that is consumed in rural areas. Meat consumption is 4.8 kg per person per year[4]. Beyond dominant investments in the dairy sub-sector, further policy formulation and analytical work is required to develop the emerging livestock and animal husbandry related sub-sectors namely meat production, leather materials, fisheries and beekeeping.

Dairy

Acknowledged as a young and fast growing industry, Rwanda currently produces approximately 160 million litres of fresh milk. About 62 million litres are consumed on the farm and up to 35% of raw milk product is spoiled before reaching market or processing centres[5]. Of the bulk of raw diary milk production, 48% is produced in the Eastern districts via traditional and extensive grazing and 52% produced elsewhere throughout the country. The two major milk basins are the Gishwati in the West and Umutara in the East. Critically, information on water resources in both basins is limited. Production falls by as much as 60% in the dry season attributed to decreases in available fodder and imported concentrate, highlighting the sub-sectors vulnerability to water availability. Poor rural infrastructure and roads has a major impact with predominant transport method via bicycle. Prolonged exposure to hot sun, poor secondary roads and corrugated pathways leads to further spoiling of product[4].

Dairy is a high energy and high water demand sector. Wood and in part charcoal, is still the predominant energy source used in domestic milk preparation for consumption. As processing is modernised, the demand for energy increases for the homogenisation and pasteurisation processes, storage, and for chilled transportation to and from plant. In modern systems, in other settings, water demand for quality forage for livestock, wash down in dairy and in processing plants is estimated as much as 1,000 litres per 1 litre of milk product. Low animal nutrition and limited access to water for quality forage is an issue in Rwanda. High acidity of the raw product is reported. Introduction of improved breeds, insemination programs, and animal husbandry extension is improving the quality, and value of milk production in Rwanda. Poor transport and storage

Figure 8.3: Rice paddies in West Province

methods are clear contributing factors. Cheese and yogurt production appears less affected. Cheese quality remains relatively high with adequate fat content. The 'zero grazing-movement of livestock' EDPRS target requires water to be delivered to each farm with the recent livestock assessment calling for detailed hydrological, groundwater and hydraulic investigation of the primary milk producing areas[5].

Horticulture

Rwanda's horticulture sector includes fruits, vegetables and flowers for both domestic and export markets. Given Rwanda's potential, current exports from the sector are low at about 2.5 million USD contributing about 5% of GDP. However, horticulture (defined as fresh and ornamental flowers, fruits, vegetables and shrubs) is one of the world's largest traded industries, generating around 57 billion USD (2004) annually, with Sub-Saharan Africa contributing only 5% to this trade[6]. There is high potential for growth in the sector through value addition and diversification, capitalising on Rwanda's regional and international competitive edge of climate, altitude and water resource.

Challenges include availability of adequate land to achieve the required economies of scale, knowledge of proper cultivation methods, export procedures and requirements such as laboratory testing and standards development[3]. Energy demand is also a concern for production, fresh transport especially floriculture's demand for air transfer, and the transport of inputs. Variability of rainfall is also a risk to the sector impacting yield and quality.

Cereals and Staples

Agricultural intensification is still MINAGRI's top priority, constituting almost 80% of the Ministry total budget expenditure. Intensification has focused on crop cultivation and encouraging the production of crops suited to the different agro-climatic regions of Rwanda, including maize, rice, Irish potatoes, cassava, wheat, beans, soya beans, and bananas. Farmers are also encouraged to pool their resources by forming cooperatives. Food security has improved greatly in 2009/2010. Key CIP crops have significantly increased in aggregate production and yield development. For example, maize has recorded a yield development of 211% from 2007 to 2010 [1].

Current Initiatives

Progress in the agriculture sector is acknowledged as steady with good progress towards MDGs, Vision 2020 and EDPRS targets. Rapid progress and success has been achieved under the programmes of the agricultural transformation strategic plan initiative (PSTA II)[7]. The high sectoral growth rate of 7.7% in 2009/2010 is accredited to the Crop Intensification Program (CIP) that has seen a rise in the use of fertilisers, improved quality of seed, and, through land consolidation, improved planting

Figure 8.4: Agriculture in North Province

techniques with the assistance of implementing agencies such as the Rwandan Agricultural Development Authority (RADA). Strong progress has been achieved in areas of soil erosion, land terracing and marshland development with projects such as the Land Husbandry, Water Harvesting and Hillside Irrigation (LWH). Notably production exceeded estimates in 2009/2010 over the last three growing seasons, although this is in part, attributed to favourable rainfall. Production increased 9.5% over the previous year[1]. The leading agricultural development initiatives and priority areas are:

- Crop intensification
- Land and animal husbandry
- Water storage and harvesting
- Irrigation and community based watershed management
- Agricultural transformation, modernisation and extension, land consolidation
- Post harvest storage and transport
- Agricultural finance, crop based credit, agricultural insurance
- Export market development
- Investment promotion
- Potential opportunities

There are potential options for reducing emissions in Rwanda's agricultural sector identified by the Stockholm Environment Institute (2009)[2]. There are a range of mitigation measures identified in the IPCC 4th Assessment report that could be considered to address these sources. Whilst measures on the whole are low or negative cost, the issues come with respect to implementation, particular across a sector that is often fragmented, with the prevalence of smaller farms and smallholders.

Cropland Management

- Nutrient management, particularly with respect to method and timing of fertiliser application, to improve N use efficiency.
- Reducing levels of tillage or introducing zero tillage farming practices. Soil disturbance tends to stimulate carbon losses through enhanced decomposition and erosion.
- Water management. Increased or more effective irrigation can enhance carbon storage in soils through increased yields and residue returns.
- Rice management. Reduce CH_4 emissions through various practices including draining and using alternative rice varieties.
- Agro-forestry is the production of livestock or food crops on land that also grows trees for timber, firewood, or other tree products.

- Returning cropland to alternate land cover, thus increasing the carbon storage in soils / vegetation.

Grazing Land Management and Pasture Improvement

- Grazing intensity (and timing) can influence the removal, growth, carbon allocation, and flora of grasslands, and therefore affects the level of carbon accrual in soils.
- Increasing productivity by application of fertilisers. This can increase yields and carbon storage, though it can also lead to N_2O emissions offsetting some of the benefits.
- Nutrient management – as mentioned above for croplands.
- Reducing biomass burning, as this can lead to CH_4 emissions from combustion, reduce the albedo of the land surface, plus contribute to climate change through different indirect ways.
- Introduction of legumes or grass species with higher productivity, or carbon allocation via deeper roots, has been shown to increase soil carbon.

Livestock Management

- Improved feeding practices, for example, feeding more concentrates, normally replacing forages. Although concentrates may increase daily methane emissions per animal, emissions per kg feed intake and per kg-product are almost invariably reduced.
- Specific agents and dietary additives – a wide range of specific agents, mostly aimed at suppressing methanogenesis, has been proposed as dietary additives to reduce CH4 emissions.
- Longer-term management changes and animal breeding. Increasing productivity through breeding and better management practices, such as a reduction in the number of replacement heifers, often reduces methane output per unit of animal product.

Other Measures

- Management of organic/peaty soils. Due to the high storage of carbon in such soils, use of these soils for agriculture can lead to CO_2/N_2O emissions in particular. This is because soils are drained, which aerates the soil, favouring decomposition. Emissions can be reduced by practices such as avoiding row crops and tubers, avoiding deep ploughing, and maintaining a shallower water table. The most important mitigation practice is avoiding the drainage of these soils in the first place or re-establishing a high water table.
- Restoration of degraded lands, which may lead to enhanced carbon storage. Such measures have strong synergies with adaptation.
- Improved manure management. Animal manures can release significant amounts of N_2O and CH_4 during storage, but the magnitude of these emissions varies. Methane emissions from manure stored in lagoons or tanks can be reduced by cooling, use of solid covers, mechanically separating solids from slurry, or by capturing the CH_4 emitted. The manures can also be digested anaerobically to maximise CH_4 retrieval as a renewable.

Climate Change

Agriculture is an important sector to Rwanda. The sector is crucial in transforming Rwanda to middle-income status. Periodic floods and droughts (extreme events) already cause major socio-economic impacts and reduce economic growth in Rwanda. Major flood events occurred in 1997, 2006, 2007, 2008, and 2009, where high rainfall resulted in infrastructure damage, fatalities and injuries, landslides, loss and damage to agricultural crops, soil erosion and environmental degradation[2]. In some regions of the country there have also been periodic droughts, for example in 1999/2000 and 2005/6. Seasonal yield

losses have been directly attributed to climatic variances e.g. coffee estimates reduced by 26% in 2009/2010 and significant Maize losses were experienced in the Eastern districts for the second 2010 growing season.

The impacts of these events are economically significant. The most severe of the recent events was the 2007 flood. The study has estimated costs of this event were 4 to 22 million USD (equivalent to around 0.1 to 0.6% of GDP) for two districts alone, accounting for costs of household damage, agricultural losses and fatalities[2]. However, wider economic costs are associated with damage to infrastructure, water system and contamination, soil erosion and direct and indirect impacts to individuals and the labour force. The range of potential effects and the high importance to the economy and livelihoods mean that this sector is a priority for future consideration. Further research and early actions must be a priority of Government.

Government Policy and Targets

The agriculture sector is recognised as having the leading potential to contribute to achieving MDG1 to alleviate poverty through sectoral growth and increased productivity, modernisation and development. Agricultural growth fell to 4.8% in 2001-2006, half of that registered in 1996-2000 (9.5%)[1]. It is essential to increase and maintain agricultural productivity to ensure Rwanda meets its annual growth target of 7-8%.

In the Government budget cycle for 2011-2012, the key policy areas are to ensure growth for exports and incomes, develop human resources and living conditions, and to ensure good governance and public accountability.

EDPRS 2008-2012 and the MINAGRI agriculture investment strategy (2010) calls for increased targets for:

- Sustainable management of natural resources, water and soil husbandry – 852,000ha of additional land protected against soil erosion, using radical and progressive terracing, 70 new valley dams and reservoirs constructed.
- Agricultural intensification promotion of both crop and livestock – proportion of households with livestock to rise from 71% to 85%, and improvements towards eradication of epidemic animal diseases, under the GIRINKA 'One Cow per Poor Family' program, RADA has distributed 30,453 cows to numerous families, from a level of 3,500 in 2006. Inorganic fertiliser inputs to increase from 11% to 40%, and improved seed use to rise 24% to 37%.
- Marshland reclamation – reclaimed area to increase in 2012 from 11,105ha to 30,000ha.
- Irrigation development – area under irrigation to increase in 2012 from 15,000 to 24,000ha, with hillside area irrigated expanded to 1,100ha (from 130ha), with legal provisions set for water user associations and riparian rights.
- Supply and use of agricultural inputs – increase in 2012 to 56,000MT fertilizer usage nationally (increased from 14 MT), production of 14,000MT of founded seeds (increased from 3,000 MT), crop intensification program expanded.
- Food and nutrition security and vulnerability management – Average availability per day increased in 2012 from 1,734Kcal to 2150Kcal, 49g to 55g of protein, 8.8g to 23g of lipids, additional measures include expanding the food and nutrition security monitoring system, and establishing 1000 hermetic storage facilities to an operational level.

Target Indicators are included in the Rwanda 2020 Vision for the agriculture and agribusiness sector, and are detailed in table 8.2.

Table 8.2: Vision 2020 Indicators for Agricultural Sector

Vision 2020 Indicator	Situation in 2000	Target in 2020
Population of Rwanda	7,700,000	13,000,000
Urban population %	10	30
Agricultural population %	90	50
Poverty % less than 1 USD/day	64	30
GDP per capita in USD	220	900
Growth rate of Ag sector	9	6
Modernised Ag lands %	3	50
Use of fertilizers Kg/Ha/yr	0.5	15
Financial credits for Ag sector %	1	20
Access to clear water %	52	100
Ag production Kcal/day/person % of needs	1612	2200
Avail of proteins/person/day % of needs	35	65
Road network Km/Km^2	0.54	0.60
Access to electricity %	2	35
Protected lands from erosion %	20	90
Non-Agricultural jobs	200,000	1,400,000

Stakeholder Mapping

The lead agencies of MINAGRI function as the implementation units for the PSTA II. The Rwandan Agricultural Development Authority, the Rwanda Animal Resources Development Authority, Institut des Sciences Agronomiques du Rwanda constitute the Rwanda Agricultural Board, and OCIR-Café, OCIR-Thé and Rwandan Horticulture Development Authority are organised under the National Agriculture Export Board. The creation of the Agriculture Sector-Wide working group has been instrumental in harmonising activities and contributing to a shared vision with the effective collaboration of implementing agencies, donors and support agencies, and key stakeholders.

Summary

Agriculture is an important sector in Rwanda, with security of production directly tied to poverty alleviation. Agriculture is a leading contributor to the national GDP (over 36.7%), and the primary source of food and nutrition supply for the predominantly rural population. Climate change risks associated with agricultural production have a direct and acute impact on the security of rural livelihoods. External economic fluctuations including energy (oil) prices and market vulnerabilities impact Agriculture's contribution to the economy. Continued intensification, enhanced production and processing such as coffee washing, milk and associated dairy sub-sector development and with the expansion potential of horticulture, will mean that the vitality of the sector will remain as a key contributor growth. Agriculture is the most pressured, complex and vulnerable sector to climatic change. Developing a mitigation strategy in tandem with an adaptation strategy is essential to ensure Rwanda's agriculture remains productive, secure, and more resilient, and moves towards being an energy efficient sector in the future whilst coping with climate impacts.

9. LAND

Rwanda has a very limited land resource. Attributed to the high population density, land is scarce with high competition for land use experienced throughout the country. The land area of Rwanda is just 24,688km^2 with 45.6% arable lands, 10.3% permanent crops, and 44.2% other use. Competition for land is likely to intensify in the decades to come, in consideration of an 18% urban population increasing at a rate of 4.2%. It is expected that over 50% of the population will be urban dwelling by 2020. Competition lies in renewed priorities for intensive agriculture, commercial and industrial development, rapid urbanisation, agroforestry and biomass demand, expansion of mining activity, and greater recognition of the need to protect Rwanda's regionally and internationally significant ecosystems including wetlands, the volcanoes national park, and remnant montane forests.

High density leads to high fragmentation of land holdings. The majority of the land has been under small holdings with the national average land parcel size of 0.35ha. It is estimated that over 8 million land parcels are available in the country for just 10 million people. Given the fragmentation, assembling land for intensive agriculture, industry and business development is likely to be relatively difficult and costly.

Current Status

Land Availability

Until recently, the majority of land in Rwanda was un-demarcated, un-registered and thus not ready for formal transaction. The majority of lands held were informal or under customary individual ownership and remained largely undocumented according to government statistics. The lack of established and reliable titles had greatly increased the risk of private transactions. The land tenure regularisation programme that commenced in 2005 is now making strong headway in addressing the need to formalise ownership. For the land that has records, it is for the most part recorded in the existing paper-based system that in its present format is unable to provide a complete view of all ownerships and their geographic location, thus making it difficult for planners or investors to identify available lands for development. Planners and administrators of land are effectively blind, restricting their ability to quickly make decisions based on multiple interests on land, to consider environmental scenarios, or to readily identify current use or the responsible authority in control. Until the land information is made electronic and in a usable format, competing interests in land will go unchecked and land use demarcation will remain problematic. Optimal land use will not be achieved and encroachment on sensitive areas will continue.

In order to help overcome problems in identifying available land in the meantime (prior to the completion of titling and land system modernisation), the GoR has moved to allocate areas for development such as the Special Economic Zones for commercial and industrial development and agricultural lands earmarked for land consolidation and intensive cropping.

Geographic Information System (GIS) in Support of Monitoring and Observation

At present, land information in Rwanda is segmented, scattered across different ministries and agencies. Sharing information is difficult whilst data remains mostly paper based. There is an emerging understanding in Rwanda of the potential benefits of an integrated, multi-purposed Land Information System (LIS) supported by available ICT and GIS technology. A number of key initiatives are underway by the GoR, including the National Land Tenure Reform Programme and Land Tenure Regularisation (LTR) Programme, the Land Administration Information

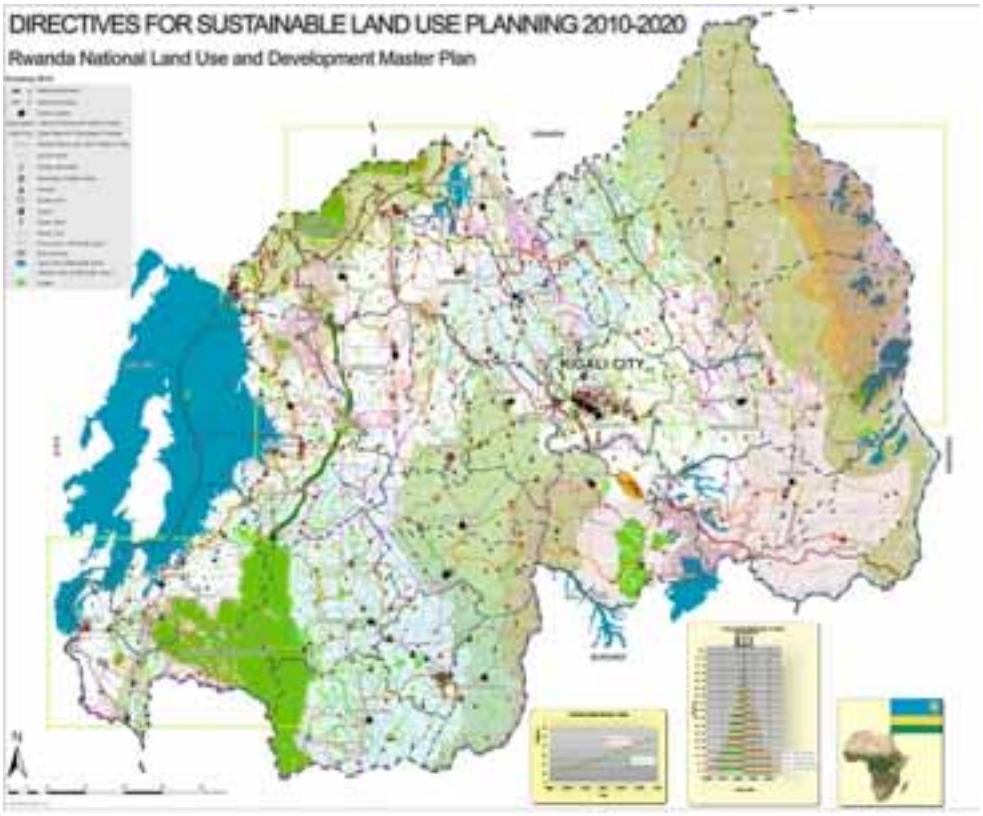


Figure 9.1: Directives for sustainable land use planning

System, and preparation of the National Land Use and Development Master Plan.

These are important building blocks of a viable LIS to aid land use management. The potential is for GIS-enabled monitoring of environment: climate, water, soils, agriculture, and integrated planning utilising the national framework GIS datasets as a backdrop as part of a national Rwanda Spatial Data Infrastructure (RSDI). This will enable consistency and harmonisation of sectoral data for accurate and detailed modelling of cross-sector trends and impacts. Regional data can also be introduced to obtain a view of entire catchments, to plan for potential hazards, or assist in weather forecasting. Incorporating health and demographic data, placing social trends in a spatial context, can greatly enhance the optimal placement of services. Real time sensor data can also be incorporated for early warning and decision support systems.

National and District Planning

Given such a limited land resource, perhaps the most important national priority is to ensure a sound, integrated and participatory approach to planning, zoning and land development approvals. In response, the NLC have prepared the National Land Use and Development Master Plan with the assistance of Swedish consultancy firm SwedeSurvey[1]. The national master plan, approved by Cabinet on the 19th January 2011, sets the national scale plan of current and future planned land use activities and priorities across the country. The master plan sets the framework for local authorities to prepare more detailed district plans to establish zoning for building and construction, agricultural development, urban centres and conservation areas. The plan features management strategies for ecosystems, population distribution and development of networks for rural and urban settlements, social services and

infrastructure, and conservation of protected areas such as wetlands.

In addition to the master plan, draft laws relating to land usage and development were also approved in January 2011. The next tasks in line with NLC's efforts to establish a comprehensive national planning framework include the preparation of the Urban Development Plan and the Area Action Plan. Until now, there has been little opportunity for national and district authorities to adequately plan for, and monitor, a new course, or vision, of development and growth within their respective communities. Thus, it has remained difficult for environmental and natural resource management priorities to be assessed against the growing activities of agriculture, industry, mining and urbanisation. Changes in land use or development approvals remained a largely ad-hoc process. The City of Kigali (KCC) has prepared a robust Conceptual Master Plan with assistance of United States based firm OZ Architecture in 2006-07 (approved by Parliament in 2008). In addition, KCC commissioned OZ to complete four Sub Area Plans (2 in Gasabo District and 2 in Kicukiro District) with guidance for detailed sub district planning. KCC together with Nyarugenge District (location of the CBD area) engaged Singaporean firm Surbana in 2008-09 to develop a 2030 Vision for the CBD. Considerations of climate change and low carbon growth will have an impact on the proposed plan and will need to be assessed in terms of transport options, energy use, planned infrastructure and environmental impacts at the National and District levels.

To the extent District plans exist today, many, particularly in the rural districts now require updating in relation to National Land Use and Development Master Plan. Without generally applicable land use plans all industrial development has in the past been addressed on an ad-hoc basis and there is an understandable reluctance to approve industrial uses in the absence of sound land use planning. For example, the existing Gikondo industrial zone, now under a relocation program, was established entirely in a sensitive wetland area. It is perhaps an object lesson in what can happen in the absence of an integrated approach to land use planning.

Approach to Sustainable Land Management

The National Environmental policy and the Organic Land Law address the need for and principles of sustainable land management. Any land policies and procedures to be designed must aim at supporting both efficient and sustainable use of land. Business interests must be promoted within the overall land policy frame, taking into account other important social and environmental objectives. Sustainable land management is a priority of IWRM (Integrated Water Resource Management) related programs for the transboundary basins including the Kagera and Congo basins with targets for prevention of land degradation and soil erosion and nutrient replacement. For these activities to succeed, establishing the current land use and responsible authority is necessary. There are three main categories of land type which are important to understand in approaching sustainable land management and land use change:

- Public Land – land held and occupied by the national and sub-national governments and their respective instrumentalities and used for public purposes only, e.g. roadways and government buildings.
- Private Land – land held by national and sub-national governments and their respective instrumentalities but are made available for private use.
- Individual Land – land held and occupied by citizens and legal entities under some form of private tenure, including ownership and long term

Figure 9.2: Terrain in the West Province

lease. Individual land includes both statutory and customary forms of tenure.

Ideally, land use and ownership maps (detailing the above land classifications) would be available to enable planners and policy makers to readily identify land managers, owners, and users. However, until land regularisation is completed this information remains mostly paper based, and difficult to integrate with for example; socio-economic data, or soils, agricultural or environmental datasets.

Land Tenure System and Regularisation

The approach to land tenure varies from country to country. In Rwanda, it includes forms of freehold tenure, state leasehold and community-based tenure (legally recognised indigenous tenure and community-based). Improper land use and management systems lead to erosion and deteriorating land quality, while rural productivity remains at low subsistence levels. Any agricultural transformation efforts to overcome land fragmentation have to deal with land reforms, with both redistributive reforms and land tenure reforms to make sure that the population (both men and women) enjoy the same rights on land, to improve the value of the land, to promote investment and to contribute to sustainable land use and management.

Land reform is an engine of development and plays an important role in enhancing peace, stability and equality if undertaken in a participatory and orderly manner, and plays an important role in the process of poverty reduction. Land formalisation allows access to credit (against the land), encourages land improvement, enables efficient collection of property revenue via district taxes and transfer fees, in turn, enabling government authorities to fund and action sound land management practices and undertake detailed planning.

Land Ownership, Land Use, Land Use Change

Land tenure regularisation has expanded to all 30 districts. At end of November 2010, about 3.2 million parcels had been

demarcated and adjudicated with title – 41% of the projected 7.9 million parcels in the whole country. More than 91% of parcels have been completed for Kigali City. All three central districts of Kigali are expected to be completed and cover at least 50% of the remaining 27 districts by June 2011. The remaining parcels should be completed by June 2012[2].

Kirehe district is now almost complete (in terms of demarcation and adjudication) having received additional assistance to accelerate titling through the community watershed management KWAMP program. Title issuance is expected to be completed by June 2011. Until recently, several western districts were progressing slowly due to a lack of aerial photography [2]. Updated detailed imagery is essential for efficient land identification and demarcation. More than 95% of Rwanda has been captured by high resolution aerial photography, an important resource/ tool for determining land use, and land use change, and for the monitoring of ecosystems.

Agricultural Land Consolidation

Agricultural intensification efforts under CIP have enabled farmers to take more profits at market and increase their yield[3]. Land consolidation, focusing production of particular crops in designated areas, has enabled farmers to consolidate and work together, with cooperatives, to produce higher amounts and be more connected to markets. The results have been substantial and are the main catalyst behind the current levels of high growth. Such productivity increases have enabled Rwanda to move away from being a country considered to be food insecure.

Current Initiatives

Land tenure regularisation via and titling is provided for by the Organic Land Law, making it mandatory for all land in the country to be registered. The Strategic Road Map for Land Tenure Reform (2008[4] was recently geared-up to accelerate the land registration process as agreed at the 2010 Kivu Retreat. Whilst it will be 1-2 years to yield benefits, the result will be a complete view of land ownership in Rwanda and system improvements offered by electronic document management with eventual connectivity across districts and stakeholders.

Modernisation of the Land Administration Information System (LAIS) is being led by the NLC with the assistance of Dutch Kadastre to support a suite of reforms to promote investment and facilitate business by streamlining the land registration system The LAIS is a parcel-based system of electronic land records enabled by advanced GIS and web-based database technologies. The system has the potential to contain existing data such as the existing cadastral records and maps that are stored at the NLC, Kigali City town hall and the District Land Offices of Kigali City.

The National Land Use and Development Master Plan led by NLC with assistance of Swedesurvey for national spatial planning, was released for appraisal in early 2010[1]. The plan will guide land users on the appropriate usage with aim to address the existing pressures on land and protecting the ecosystem. The plan will assist land users in making the most of Rwanda's limited land resources for the benefit of the nation. NLC are also collaborating with the Centre for GIS (CGIS) at the National University of Rwanda (NUR) who maintain a LIS of nationally important land and environmental data. Existing data within the sectoral line Ministries, Government agencies and private institutions is also being collated.

Building upon NLC's successful Land Tenure Regularisation programme (systematic land parcel mapping, ownership determination and land registration) pilot programme in 2007-2008, a ramped up programme commenced in early 2010 with strong support by DFID and other multi-donor partner agencies (SIDA, EU, etc.).

Potential Opportunities

The lack of clear and stable land use planning and zoning regulation in Rwanda has restricted the ability of district authorities to plan for a sustainable future that protects environmental, social and economic needs and ambitions of the community[5]. National spatial planning is now being addressed by the introduction of the National Land Use and Development Master Plan. The master plan now requires implementation by land related authorities and subsequent preparation of detailed district plans that will dovetail the master plan.

The explanatory notes of the National Land Use and Development Master Plan by SwedeSurvey in 2009 call for increased development of the detailed planning process within local authorities, capacity development of planning officers, and greater use and exploitation of GIS in the planning process. Currently, within the District Development Plans (DDP), existing conditions are listed in table format, where as a spatial representation would be far more meaningful. Issues such as urbanisation are not addressed in the 30 DDPs and the opportunity to encourage rural urban centres/regional cities is being lost.

The demographic data for the districts is inadequate. Instruments such as the Rwandan Household Living Conditions Survey (EICV) and other census data should be integrated and refined to the socio-economic conditions within each district. Agriculture data for the districts is also inadequate. Agriculture is a primary economic driver in Rwanda and has an important influence for the rural areas of the districts. However, the analysis of agricultural capabilities of each district is not well developed. Specific data on the existing agriculture production and agro-ecological/economic potential should be included in the analysis of land use planning and expenditures.

Climate Change

Increased competition for land resource will continue to grow with increased pressures from intensive agriculture and livestock. Encroachment on sensitive areas persists until land reforms are completed. Poor or limited access to land and productive arable lands contributes to urbanisation. Industrialisation further competes for the limited land resource. As the labour force shifts from subsistence agriculture to processing and manufacturing roles, the land demand for housing changes. Higher density urban development will become increasingly necessary.

If the changing demands and use of land is not managed by a rigorous planning and zoning regulatory framework, impacts in real terms are escalated uncontrolled development, increased energy demand and emissions, inefficient transport systems, over burdened water and sanitation systems leading to reduced livelihoods, environmental degradation, continued loss of biodiversity, food insecurity, poor air quality and health impacts.

Government Policy and Targets

Land regularisation efforts have been re-invigorated in 2010 through multi-donor assistance. Current targets set completion of the City of Kigali's three districts early in 2011 (already over 91% complete) and full regularisation achieved by mid-2012[2].

The agricultural lands consolidation is now supported by Cabinet decree in March 2010 to address land fragmentation and to allow farmers to work in cooperative arrangements to optimise land use and market potential through increased production. Furthermore, the area of marshlands to be reclaimed is to increase by 2012 to 30,000 ha for agricultural use which increases the production potential of farmer's across the nation. About 81% of arable land is now sustainably managed

against soil erosion which substantially exceeds the EDPRS/CPAF target for 2009/2010[3].

Stakeholder Mapping

Guided by the National Land Policy and Organic Land Law, responsibility for land use planning and land administration is today divided among several agencies and levels of government[5]:

Ministry of Environment and Land (MINELA) is the direct supervisor of the NLC and has several important mandates in land matters under the Organic Law. The Ministry is responsible for environmental compliance and establishes the rules and procedures for environmental impact review of land development projects.

National Land Centre (NLC) headed by a Director General, is a responsible agency of MINELA. It is the main counterpart for the ongoing work of systematic land titling, development of the national land information system, and development of the national spatial plan. NLC has ongoing responsibility for management and maintenance of the land registry, which it carries out through five provincial land registrars and the district land bureaus, and for oversight of leasing of state and district private land.

Ministry of Agriculture (MINAGRI) is taking an active role in development of agriculture and agribusiness, addressing land degradation, and addressing agricultural land issues.

Ministry of Infrastructure (MININFRA) has responsibility, through its Department of Planning and Human Settlements, to develop land use planning, the lack of which is seriously impeding development of Rwanda land markets and stagnating sound urban and rural development.

National Land Commission is a high level land policy forum for the senior stakeholders in government to consider proposed developments.

District Government, the Mayors and District Councils (30) are responsible for day to day implementation of land allocation and development control policies.

District Land Bureaus, are the line agencies responsible for implementing planning and development controls. They also serve as the district land registrar, providing cadastral (survey and deed plans) and registration functions.

Summary

The recent promulgation by Cabinet of the National Land Use and Development Master Plan and associated land use legislation is an important step in establishing a robust framework for integrated land use planning. Land regularisation through titling is expected to be completed in one to two years. Priority now is the preparation of detailed District Development Plans, preparation of the Urban Development Plan and Area Action Plan, together with continued regulatory reforms and development of capacity to support the planning and zoning framework. Without formal land arrangements, limited access to credit contributes to a poverty “lock”. Unequal distribution of land will lead to increased potential for conflict in the future. Uncontrolled land use change will lead to further loss of Rwanda’s unique natural and cultural heritage. Ultimately, optimal land use is not achieved, impacting Rwanda’s development and growth potential. Rwanda is now making positive headway in addressing sound management of its most limited resource.

10. WATER

Water is an abundant resource in Rwanda with a vast potential for development. The water resources mainly constitute lakes, rivers, marshlands and groundwater. The lakes cover a greater area than the rivers for the surface water resources. Due to its relief and its location in the African Great Lakes region, Rwanda has a very dense hydrological network. This network is divided (figure 10.1) into two main drainage basins; the Nile Basin to the east covering 67% of the land area in Rwanda and delivering 90% of Rwanda's national water resource; and the Congo Basin to the west which covers 33% of the land area and contains the remaining 10% of national waters all of which drain into the Congo River via Lake Kivu[1].

Both water needs and water utilization have increased in Rwanda as intensification in the agricultural and industrial sectors has increased water demand. Other competing sectors that are contributing to increased water utilization include domestic and hydro-power generation water requirements that have increased without the corresponding rise in the national water stock development. The increasing population has raised pressure on water resources resulting in reduced per capita volume of available water per year.

Kagera Basin

The Kagera River Basin is made up from territories of Burundi, Rwanda, Uganda and Tanzania and feeds into the Nile system. The total catchment area of the Kagera River basin is some 60,000km^2. The Kagera is the largest of the 23 rivers that drain into Lake Victoria and it delivers 34% of the annual river inflow to the lake. The lower Kagera Basin is one of the most important areas in Africa for agro-biodiversity and food production. The natural resources of the Kagera River Basin support the livelihoods of some 16.5 million people in Rwanda and downstream. The majority of these people are rural and depend directly on farming, herding and fishing. However, the resource bases for water and ecosystems are facing increasing pressures as a result of rapid population growth, agricultural and livestock intensification. This is characterised by progressive reduction in farm sizes and unsustainable land use and management practices. There are two rainfall seasons across the Kagera Basin, the longer southeasterly monsoon bringing rain between February and May, and the shorter north-easterly monsoon from September to November. The months of June, July, and August are generally dry.

Figure 10.1: River Basins in Rwanda

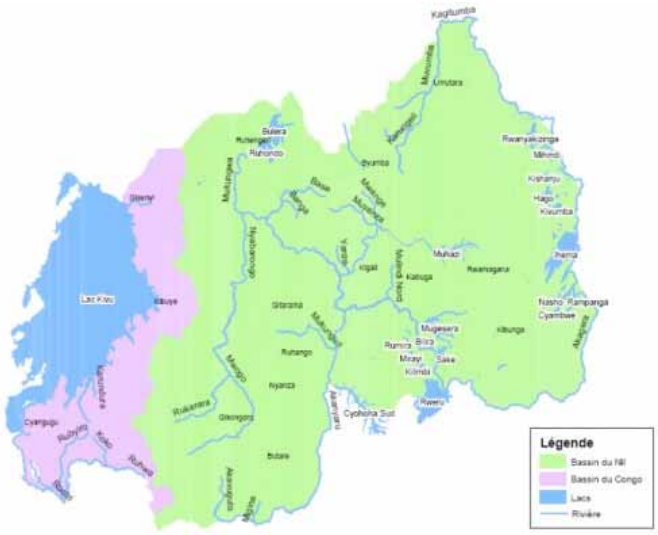


Table 10.1: Water Balance for 1993, 2000 and projected 2020 (million m^3/year)

	Year	1993	2000	2020 (low)	2020 (high)
Consumption	Household	31	36	108	396
	Industry	15	12	36	132
	Agriculture	722	102	306	1122
	Sub-total	768	150	450	1650
Supply	Total Resources	5000	6300	6300	6300
	Treated Waste Water	0	0	4	15
	Water Balance/ Deficit	4232	6150	5854	4665

Average rainfall over the basin amounts to some 1,000 to 1,200mm per year with high average rainfall up to 1,800mm per year in the western mountain ranges in Rwanda and Burundi, with a descending gradient towards the east down to 800mm per year. The average annual temperatures are 15-18°C in the westernmost and north-western mountain range, and up to 22°C in the central part[2].

Congo Basin

The Congo Basin of Central Africa, is the world's second largest river basin by discharge (average discharge of 42,000m^3/s). Angola, Cameroon, the Central African Republic, the Republic of Congo and the Democratic Republic of Congo constitute 92% of the Congo Basin's total surface area of 3,691,000km^2. In 2005, the total estimated basin population was over 77 million inhabitants[3]. The Congo Basin is one of the world's richest in terms of water resources and biodiversity. About 33% of Rwanda's land area (about 8,140km^2) is in the Congo River Basin, but this represents less than 0.002% of the basin's total area.

Water Balance

Rwanda's water balance is impacted by the nation's high population density, and its reliance on subsistence farming practices. Intensification of agriculture and increasing urbanisation and industrialisation are placing further demands on the water resource. The water balance for 1993 and 2000 shows the estimates for available fresh water resources and the water consumption through domestic, industrial and agricultural uses. Table 10.1 illustrates the large surplus of freshwater resources, and highlights the apparent potential for expansion and economic development of water consuming sectors[1].

Recent studies established projections for the 2020 water balance determined on the assumption that water consumption will vastly increase in line with infrastructure development and improved delivery to domestic, industrial and agricultural sectors. Based on the annual renewable water resource of 6,300 million m^3 per year, the vast water surplus may enable the system to be expanded by a factor of up to 40 when compared to the 2000 figures[1].

Groundwater in Rwanda is primarily within the vast alluvial aquifers adjacent to major rivers. Lesser amounts of groundwater can be found within the fractured bedrock of porous volcanic rock. It has been estimated that the total available groundwater resources of Rwanda have a renewable extraction rate of approximately 66m^3 per second[4].

Water Demand from Agriculture

The agricultural sector is the largest consumer of water in the country. Rwanda's agriculture is mainly rain-fed with some supplementary irrigation for rice from dams. The use of groundwater in this sector has not been explored. With agricultural intensification and food security strategies in place, it is certain

Figure 10.2: Mutobo River

that withdrawal by the agriculture sector will increase. Information on how much water is used for agriculture is not readily available – as water is utilised before it reaches the river system.

Sanitation

Open defecation has practically been eradicated and most of Rwandan households have built on-site private sanitation facilities. Although only about half comply with the international standards for an improved sanitation facility. Very few Rwandan households have flush toilets. The country has not invested in collective (water-borne) sanitation systems for urban areas, except three small sewerage systems in Kigali for about 700 households. Major hotels, hospitals and some industries have installed their own treatment systems. A conventional sewerage and treatment system for Kigali is in the planning process. Studies have estimated sanitation coverage at 45% (rural 44%, urban 54%) in 2008[5].

Domestic Waste Water

Most of the buildings in the urban areas are not connected to centralised waste water treatment systems or facilities, with the exceptions of high standing residential areas in Kigali namely Nyarutarama and the "Caisse Sociale" housing estates in Kacyiru and Kagugu. The rest of the buildings have individual sewage treatment systems that allow for the percolation of the treated effluent into the ground through leaching pits. This kind of localised handling of waste raises risk of groundwater contamination through malfunctioning and/or inefficient waste treatment systems. The main cause for this situation is the absence of centralized or sewage treatment networks for urban and peri-urban settlements[6].

Industrial Pollution

Many of Rwanda's industries do not have efficient waste treatment facilities in place and the resulting poorly treated effluent ends up in streams and marshlands. Even with a small number of operational industries as compared to other cities in the region, this unchecked pollution has considerably contributed to the deterioration of water resources in the Gikondo, Nyabugogo and Nyabarongo marshlands in Kigali[6]. Industries are a major contributor to water pollution mainly through the release of untreated effluent in streams, rivers and marshlands. Rwanda is addressing this issue through the regulatory role of REMA, continued development of industrial and waste water standards by the Rwandan Bureau of

Standards (RBS), and the recent establishment of land use and development laws and planning controls.

Current Initiatives

Transboundary Water Resource Management

Water and related resources management in both of the Kagera and Congo Basins' is being carried out through application of Integrated Water Resources Management (IWRM) principles. IWRM as defined by the Global Water Partnership[2,7] is "a process which promotes the coordinated development and management of water, land and related resources in order to maximise economic and social welfare in an equitable manner without compromising the sustainability of vital eco-systems". The pinnacle regional policy document is the 2008 Kagera Basin Monograph[2].

There are recent calls for strengthening IWRM with ecosystem services[8]. There are 263 transboundary river and lake basins around the world, and about 300 transboundary aquifers. Transboundary lakes and river basins account for an estimated 60% of global freshwater flow and are home to 40% of the global population. The large majority of carbon emissions from land degradation and deforestation take place in transboundary basins, the same regions of highest biodiversity value and threats of biodiversity loss.

The Kagera river basin is managed and supported through the Nile Basin Initiative – Nile Equatorial Lakes Subsidiary Action Programme (NBI-NELSAP) which in addition to Kagera countries includes the DRC, Kenya, as well as downstream nations Egypt and Sudan. in addition to strategic linkages with key agencies such as MINAGRI, REMA, NMS and CGIS NUR.

The East African Community (EAC) provides a framework for extensive political cooperation and integration, among Tanzania, Uganda and Kenya (which share Lake Victoria) as well as Burundi and Rwanda which have both recently joined. EAC has established the Lake Victoria Basin Commission (LVBC) to manage the entire basin area, including the Kagera. Important linkages are also found with the Environmental Programme and Action Plan of NEPAD (New Partnership for African Development) and NEPAD's Comprehensive Africa Agriculture Development Programme (CAADP) for integrating sustainable land management in agriculture and natural resource management.

A recent initiative which commenced in 2009/10, the FAO/GEF funded Kagera-TAMP project, supports the adoption of an integrated ecosystems approach for the management of land resources in the Kagera Basin which will generate local, national and global benefits including: restoration of degraded lands, carbon sequestration and climate change mitigation, agro-biodiversity conservation and sustainable use and improved agricultural production. Kagera-TAMP aims to help reinforce and make the respective NAPAs operational and contribute to effective harmonised implementation of UNCCD, CBD, UNFCCC and related conventions across the basin[9].

Potential Opportunities

The IWRM approach requires enhanced institutional connectivity that improves linkages between the natural sciences, the social sciences and public health priorities together with engineering innovation and public policy to overcome fragmentation of water governance[8].

Localised approaches of community watershed management are required to dovetail regional initiatives to connect bottom up and top down IWRM efforts with citizens, establishing heterogeneous networks of water management across Rwanda integrated with the national and district planning and construction/ development approval processes.

RBS is the peak National body for standards development with powers to define and maintain national standards, quality assurance and metrology. They are establishing definitive standards for water and wastewater quality, and introducing guidelines for re-use of wastewater effluents in activities such as mining, industry, agricultural production and processing.

Priority efforts lie; in improved integrated monitoring and observation of climate and the water balance, detailed assessment of water availability and groundwater reserves in comparison with increasing demands across water drawing sectors; increased aid to districts of vulnerable regions to prepare and implement measures of water conservation and storage; public sensitisation and awareness of innovative water conservation techniques and pollution prevention as part of extension efforts; realisation of irrigation in gravitated parameters from water flows in priority and vulnerable regions.

Future work needs are suggested to include:

- Improved monitoring of climate
- Improved monitoring of water resources
- Development of improved means for water conservation and storage
- Development of public awareness programme to improve uptake and innovative water conservation techniques and pollution prevention
- Introduction of gravity irrigation especially in suitable areas

Climate change impacts and vulnerabilities

Climate change models for the region predict increasing rainfall in humid areas, lower rainfall in dry areas and extended drought periods. Concern lies in the potential influence on the movement of the seasonal rain-belts across the region. Predictions of climate change impacts in the Kagera basin are contradictory (as with models for other areas) but are largely in accordance with wider studies on anticipated impacts of climate change in East Africa. Attributed to the uncertainty for Rwanda are the lack of robust rainfall and temperature data, in part due to past conflict, and largely to the factors of low capacity and minimal infrastructure of the country's observatory functions.

The livelihood of Rwanda's predominant rural population is acutely vulnerable to climate change, as they tend to live in the highest risk areas and lack the economic

Figure 10.3: Lake Kivu

and social resources and capacity to cope with current climate variance and adapt to longer term changes. Local economic and social conditions in many parts of the Kagera Basin have already driven poor people to marginal areas and forced them to over exploit natural resources to support their livelihood[9].

Government Policy and Targets

Rwanda is a signatory to the COMESA treaty for regional trade and Commerce, and for transboundary natural resource management and protection.

Countries sharing the Kagera Basin have all adopted various national strategies and action plans that address sustainable management of natural resources, biodiversity conservation, agriculture, forests, desertification and climate change mitigation. Ratification of the Convention to Combat Desertification (UNCCD) in the late 1990s by the four countries, and subsequent development of National Action Programme (NAPAs) for its implementation, has led to raised awareness at national to local levels of the close links between degradation and poverty.

The Rwanda Government has confirmed that reversing land degradation and biodiversity loss in the Kagera basin is a top priority in view of the serious impacts on resources and livelihoods. In addition to environmental conservation, Kagera TAMP actions should improve crop and livestock production and forestry and thereby improve income and food security[9].

The National Environmental Policy calls for the economic and social sectors: to use water without endangering the environment, to improve the conservation of wetlands, and to integrate environmental aspects into development policies, planning and all activities undertaken at local to national levels in a participatory manner.

The National Water and Sanitation Policy, in harmony with MDGs objectives and Vision 2020 targets, states that all of the population will have access to potable water and to sanitation services. The policy takes into account regional and international commitments related to IWRM and environment. The National Land Policy addresses the use, conservation and management of marshlands.

Summary

Rwanda is endowed with substantial freshwater resources. To that extent, regular rainfall patterns and low usage base has, until now, not promoted water storage and water monitoring as a necessity. There is a clear gap of observatory data and monitoring framework for Rwanda's water and climate. The challenges of rapid population growth, increased urbanisation and industry, environmental degradation and pollution are leading to accelerated depletion and degradation of the available water resources. Any significant increase in Rwanda's water demand will impact downstream nations, primarily the beneficiaries of the Kagera basin and riparian states of the Nile. However, the management of Rwanda's water and natural resources is complex and involves cross cutting issues spanning all sectors, and demands the participation of national and regional stakeholders. There is need for a review of the water management structures that will be required at Rwanda's transboundary management level to mitigate the future potential for difficulties in international water budgeting. Transforming the national reliance on rainfall, particularly rain-fed agriculture must be a priority reflected in sectoral development planning and public infrastructure spending. Low quality production and fluctuation in yields is stagnating Rwanda's development and growth potential.

11. FORESTRY

The present and future extent of forest coverage in Rwanda is central to sustainable development and climate change considerations. With an estimated 86% of Rwanda's energy provided by biomass, forest resources are under increasing pressure from a growing population and shrinking land availability. The balance of current supplies with growing demand, energy access and affordability are of primary importance for an energy secure future. In terms of climate adaptation and low-carbon development pathways, management of Rwanda's forests also represents an opportunity for synergies.

Sustainable forest management and rehabilitation remain at the heart of Rwanda's development strategies for conservation, transformation of agriculture, energy and the rural sector. In recent years, numerous studies and inventories have been carried out to establish a comprehensive baseline of natural and managed forests, and tree cover. Understanding dynamic linkages with agriculture, energy, water and mining sectors are also integral to the ongoing reformulation of national policies and strategies.

Since the 1960s, Rwanda's natural forest cover declined by an estimated 65%[1]. This dramatic decline was particularly evident in the period following the 1994 conflict as returnees and refugees sought refuge and cleared land in protected areas. Although natural forests are under continuous pressure from encroaching communities, improved park management and the creation of buffer zones has helped to stabilise the situation. Nevertheless, sustainable management of a continuously increasing fuel wood deficit and land scarcity remains a significant challenge.

Current Status

Forest cover

In 2007, a satellite-based mapping exercise with ground truthing was completed to establish a baseline of Rwanda's forest and woodlot coverage[3]. Due to resolution constraints, only areas with a surface of 0.5 hectares or higher, crown coverage of more than 20% and tree height of greater than 7 metres were considered. Inventory results indicate coverage of around 240,746 ha in, or approximately 10% of the surface of national dry lands. The coverage includes 80,000 ha of humid natural forest,

Figure 11.1: Forest coverage 2007.[3]

consisting mainly of two blocks in the protected areas of Nyungwe National Park in the southwest and Volcano National Park in the northwest. Other national reserves include the forests of Gishwati and Mukura, the savannah and gallery forest of the Akagera National Park and remnants of gallery forests and savannas of Bugesera, Gisaka and Umutara. Forest plantations dominated by non-native species including eucalyptus, pine and other young plantations and coppices occupy roughly 115,000 ha, with the remaining coverage consisting of smaller areas of dry forests, bamboo and bush land.

Significantly, small woodlots, scattered agroforestry and other managed trees below 0.5 ha were not included in the inventory. According to the National Forestry Policy, these forest resources represent and additional 222,520 ha equivalent to conventional forests. Moreover, the official forest coverage of Rwanda is estimated at 21% of the country area, consisting of 8% natural and 13% manmade forest[1].

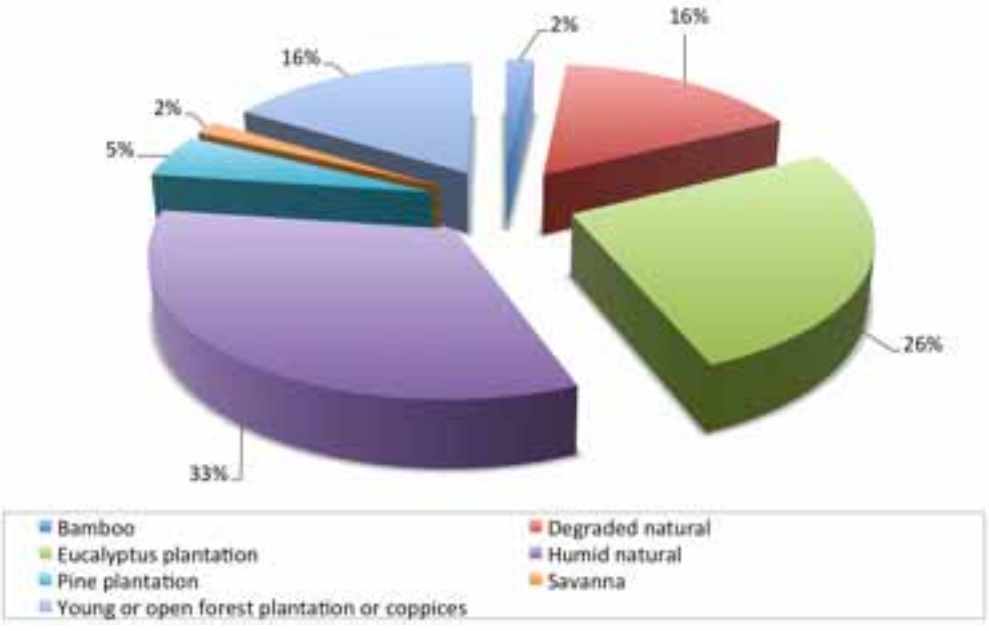
Fuelwood and Charcoal sector

The production and use of fuelwood and charcoal is of critical importance to Rwanda's economy and energy supply needs. In 2007, the value of firewood and charcoal was on the order of US$122 million, or 5% of GDP[4]. In terms of charcoal, the supply chain is not only a source of rural employment, but also a key income generating opportunity as farmers consider trees as a crop from which they can earn income and respond to market signals. In addition, work by GIZ in 2008 found that Rwanda may well be the only country in Africa where the relation between charcoal and deforestation no longer exists as virtually all charcoal is produced from planted trees on private and community lands.

As highlighted in background work for the Biomass Energy Strategy (BEST) in 2008 [4], fuelwood (including charcoal) is a vital and appropriate source of energy in Rwanda for the time being due to the following attributes:

- Affordability: All convenient alternatives (electricity, LPG, etc) and others (methane from Lake Kivu) are significantly more expensive
- Secure: It does not depend much on external influence or foreign exchange
- Green and renewable: It is a renewable source of energy that can be utilised in

Figure 11.2: Coverage by forest type[3]



a clean, efficient and climate 'neutral' fashion.

Nevertheless, Rwanda faces a serious woodfuel deficit, which directly impacts the availability and affordability of biomass energy including charcoal. In work carried out in 2005 by the FAO Woodfuel Integrated Supply/Demand Overview Mapping (WISDOM), it was found that 42% of Rwanda's rural population is in high deficit of woodfuel energy needed to meet basic needs, with 39% in medium-high deficit[5]. Thus, the majority of the population is currently struggling with a deficit of subsistence energy and the gap between supply and demand is widening each year (see figure). This has significant implications for the charcoal sector in particular as more efficient and improved supply and demand side management would reduce deficit burdens. To address concerns regarding deforestation and over exploitation, the Ministry of Infrastructure (MININFRA) developed a Biomass Energy Strategy (BEST) in 2008[4]. The strategy has three key elements:

- Reducing biomass consumption through efficient stoves and improved charcoal-making techniques
- Substitution of alternative energy sources for biomass
- Producing more biomass through increasing production of woodfuel resources
- To support this strategy, a woodfuel mapping exercise was done in 2009
- Total investments, including equipment and rehabilitation of plantations, were estimated at 119 million USD, of which a direct public contribution of $52.5 million is public, 42.4 million USD private, and 24 million USD from improved taxation system and valuing environmental benefits.

Current Initiatives

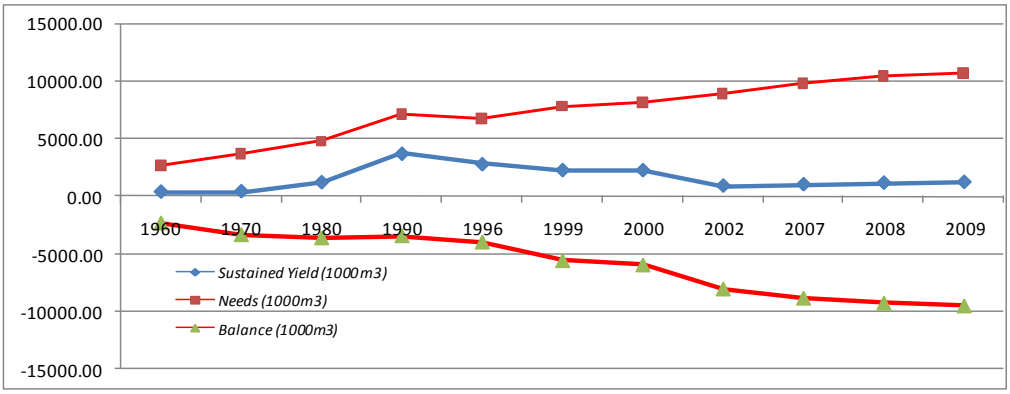
In recent years project initiatives in the forestry sector have increased with funding from key development partners, including governments of Belgium and the Netherlands. Investments are primarily focused on reforestation activities, as well as capacity building at central and District levels within public and private forests.

PAREF II

As a continuation of the PAREF I afforestation initiative, the Belgian Technical Cooperation (BTC) in partnership with Rwanda's National Forestry Authority (NAFA) is supporting the PAREF II initiative. The Dutch Cooperation also provides support. The project aims to support the GoR's overall framework of the National Forest Policy, and objectives of the EDPRS and Vision 2020 by achieving the following intermediate results:

- Institutional capacities at the decentralised level are reinforced in the field of reforestation and forestry management
- Afforestation of 10,000 ha created and/ or rehabilitated in the 9 selected

Figure 11.3: Imbalance between needs and sustained yield of wood in Rwanda, from 1960 to 2009[1]



Districts (7 in the Western Province and 2 in the Northern Province) and required mechanisms for their rational management put in place
- Valorisation of wood energy is improved.

Through PAREF I & II, a total of 15 Districts will be covered with investment of roughly 13 million Euro between the period of 2008 and 2012[2].

CATALIST and SEW

Another major forestry programme underway in Rwanda is the CATALYST project supported by the Netherlands Directorate General for Development Cooperation (DGIS). CATALIST stands for "Catalyze Accelerated Agricultural Intensification for Social and Environmental Stability" and covers the Great Lakes region of central Africa, including 6 Rwandan Districts (Burera, Rulindo, Bugesera, Nyanza, Nyamagabe, and Nyaruguru). The project started in 2009 and focuses in part on tree planting on private land, complimenting PAREF work which intervenes on public lands. Project activities are also oriented around establishing and/or strengthening the capacities of farmer and agro-input dealer organisations. Activities are carried out by staff from the organization IFDC working with and through farmers' organisations, among other partners.

A sister project to CATALIST is the Sustainable Energy through Woodlots and Agroforestry in the Albertine Rift (SEW) project. Also started in 2009, the goal of SEW is to decrease competition for land use between energy and agricultural production by improving wood production, use and income from woodlots and agroforestry plantings. Project beneficiaries include fuel wood-producing farmers, charcoal producers and other stakeholders of the commercial wood value chain, and consumers of energy from wood who will benefit from stabilised fuel prices[6].

SCC – Vi-LIFE Agroforestry

Vi-LIFE is a Swedish NGO working in Rwanda as a chapter of the Lake Victoria Regional Environmental and Sustainable Agriculture Productivity Programme (RESAAP). Project activities are focused on increased farm productivity using sustainable agroforestry practices and local business development through improved civil society organisations and marketing among small-scale farmer. RESAPP activities are being carried out in 25 administrative sectors distributed in 3 districts namely Gicumbi and Rulindo in the Northern Province, and Gasabo in the Kigali city area[7].

Other Projects and Research

In addition to the above initiatives, significant work in the area of forestry and sustainable land management is being carried out by a number of national and international institutions. These include:

- World Agroforestry Centre (ICRAF) conducting agroforestry and SLM pilot work with the Rwanda Agricultural Development Authority (RADA)
- Rwanda Agricultural Research Institute (ISAR) work on seedling research, production and dissemination for reforestation activities
- Rwanda Institute for Scientific and Technological Research (IRST) conducting work with planting of Jatropha for biofuels production
- Wildlife Conservation Society (WCS) and other organizations in the Albertine Rift researching the sensitivity of ecosystems and biodiversity to climate change, and possible adaptation measures

Potential Opportunities

Within the forestry sector, there are a number of opportunities with regard to promoting climate resilience and low carbon planning. Strong synergies exist between adaptation and mitigation measures in particular. Activities such as reforestation of degraded land and watersheds, agroforestry, and other

sustainable land management practices contribute to retention and regeneration of soils and carbon sequestration, while supplying food (including fodder), fuel and fibers that promote income generation, food security and climate resilience.

Provisioning and regulatory services of natural and manmade forest ecosystems are already nationally recognised opportunities for sustainable development that additional financing from international adaptation and mitigation funds can support. This support is available in the form of the Adaptation Fund, LDCF, Green Fund, and Afforestation/Reforestation activities from the Clean Development Mechanism (CDM) under the UNFCCC, as well as the Voluntary Carbon Market (VCM) and other financing mechanisms, some of which Rwanda is currently benefiting from (e.g. LDCF). In addition, work is being carried out by a number of institutions including the World Bank's Global Environment Facility (GEF) to realise opportunities for biodiversity conservation and climate resilience.

In addition, significant opportunities for supporting adaptation-mitigation synergies exist in the improved management of Rwanda's National Forestry Fund, as part of institutional and financial frameworks for environment and climate financing. Preferred options highlighted in Rwanda's revised National Forestry Policy provide a valuable guide for initial actions that would benefit from technical analysis of carbon credit opportunities in particular[1]:

- Re-surveying all Classified Forests with a view of rationalising boundaries
- Undertaking afforestation and reforestation initiatives to expand the country's forest cover
- Supporting the local authorities to manage forests
- Development of management plans for all Classified Forests; and 10-year management plans for Districts as provided under the draft Forestry Law
- Undertaking scientific research for promotion of innovation, maintenance of sustainability and competitiveness, and ensuring progressive improvement in forestry policy and practice
- Monitoring and assessing forest health and factors affecting it as a basis for strategic responses to potential threats of sustainability

Climate Change

While human-induced pressures in the form of land-use change, overharvesting, overgrazing by livestock, fire and introduction of new species are leading threats to forest ecosystems, climate change constitutes an additional threat. Changes in rainfall regimes and increased temperatures may exacerbate disturbances such as fire, pests, drought, and heat waves that negatively impact forest provisioning and regulatory functions. However, understanding such impacts remains a challenge as land-use change and vegetative feedback modeling is in very early stages[8]. Improved understanding and monitoring of these impacts in the Rwandan context is essential, particularly in light of endemic biodiversity and forest ecosystems that are sensitive to climatic factors.

Government Policy and Targets

In recognition of the economic and environmental benefits of sustainable forest management, the GoR has worked to reform and restructure the policy and management of Rwanda's natural and manmade forests. The Ministry of Mining and Forestry (MINIFOM), and its implementing agency, the National Forest Authority (NAFA), are leading this process. In line with Vision 2020 and EDPRS, Rwanda is committed to environmental protection, diversification of energy sources, erosion prevention, and reduced woodfuel consumption and implementation of a reforestation strategy. The major objective of the EDPRS for the

forestry sector is to provide an adequate and sustainable supply of forest products and manage forestry resources for poverty alleviation by income and employment generation. To realise this objective, Rwanda has adopted a National Forestry Policy that aims at ensuring present forest cover is well managed and increased to 30% of country total area by 2020[1]. In addition, revision of the 1988 Forestry Law is underway. Implementation of the Forestry Policy will be carried out in accordance with the activities detailed in the National Forestry Strategy[9] by government and development partners with the following objectives:

- Increase forest and agroforestry resources in order to meet the national needs in timber and non-timber forest products and services for public, personal and commercial uses.
- Manage forests to optimize economical as well as ecological functions such as soil erosion control, climate regulation and biodiversity conservation in a sustainable manner.
- Provide institutional support to forestry actors in order to improve the quality of products and services renders by these actors.
- Other key policies and initiatives to achieve these objectives include observance of National Tree Planting Week and improved management National Forestry Fund in support of implementation activities.

Stakeholder Mapping

A wide range of actors are involved in Rwanda's forestry sector. The Ministry of Mining and Forestry (MINIFOM) oversees government activities in the sector and supervises the work of the National Forestry Authority (NAFA), which has the responsibility of coordinating forest management and agroforestry development. In addition, key government ministries with activities linked to the sector include the Ministry of Infrastructure (MININFRA) that works in biomass energy issues including the charcoal sector, as well as the Ministry of Agriculture (MINAGRI) that uses agroforestry techniques for improved land management and the Ministry of Lands and Environment (MINELA) working in ecosystem restoration and biodiversity conservation. Key development partners operating in the sector include governments of Belgian and the Netherlands. Public work is complimented by activities of national research and teaching institutions including ISAR, IRST, KIST, and ISFM, among others. Relevant private actors include organisations such as Vi-Life, ICRAF, IFDC, WCS and the Clinton Foundation working in forestry, agroforestry, biodiversity/conservation and carbon development projects. In addition, owners of private forests, tea factories (e.g. Sorwathe), timber and charcoal supply chain companies play important roles in the sustainable management and productivity of forests.

Summary

Rwanda's forest resources present both a significant challenge and opportunity for sustainable development, climate reliance and mitigation considerations. Improved management has largely stabilised natural forests and protected areas, fuel wood demands of a growing population constrained by scarce land resources pose a daunting structural limitation to the sustainability, availability and affordability of forest provisioning and regulatory services. Opportunities exist to improve the efficiency and extent of resources, it is clear that alternative energy sources will be needed in the future. Financial support for adaptation and carbon project development in the forestry sector provide possible opportunities in the sector. Although issues of additionality and other technical considerations may limit the feasibility of the latter under compliance carbon markets, synergies between adaptation and mitigation activities are strong and warrant further investigation.

12. CONCLUSION AND NEXT STEPS

This Baseline Report illustrates the dynamic and rapidly changing picture of development in Rwanda. A highly motivated and focused government is, with the assistance of donors, NGOs and private companies, moving rapidly towards the targets laid out in Vision 2020 of becoming a middle-income country by 2020. The sectoral reviews show that wide-ranging opportunities are currently being explored in Rwanda. There is however a need to review the options, to ensure that those chosen not only promote the development of Rwanda in the most efficient way but also protect the environment and reduce the country's vulnerability to economic shocks. The choices must also be analysed with respect to their resilience to the predicted climate changes due to man-made GHG emissions.

This will be done during the next stage of the study, involving the following components:

- Stakeholder engagement
- Sectoral review and integration
- Report climate finance options
- Contribute to the establishment of a Climate Centre
- Strategy development

Figure 12.1 shows the simple timeline of the project which started in November 2010 and will be completed at the end of July 2011 with a Strategy launch. Nine months is a short time to develop a national strategy and more work will be required after July 2011, both on implementation and further data gathering and analysis.

Stakeholder Engagement

Although a large number of stakeholders contributed to the Baseline Report, demonstrated by the list of acknowledgements, there are further individuals and groups who can contribute to answering these questions. Similar studies in other countries show that stakeholder engagement is crucial for successful strategy development. This is a core value for Rwanda, shown most obviously in Vision 2020, and is a core component of this project. Any stakeholders who wish to be involved are invited to contact the research associates, whose email addresses are listed at the front of this report.

Sectoral Review and Integration

Following the completion of the baseline report, the research associates, with input from the expert advisors and stakeholders will develop 'Sectoral Working Papers' which will cover the following areas for each sector:

- Vulnerabilities and Opportunities for climate compatible development
- Focus areas and options analysis

Figure 12.1: Project timeline

Table 12.1: The Strategic Framework

Focus Areas WHY	Polices and Actions WHAT	Stakeholders WHO	Timescale WHEN	Measurables HOW	Sources of Finance

- Review of global best practice
- Strategic framework (table 12.1)

Sectors will be reviewed in an integrated way so that recommendations on use of resources can be made. Education and health were not covered in detail during the Baseline Report, but their importance was recognised and they will be included as separate sections in the next stage. The Working Papers will be delivered on May 2nd when the project will enter the consultation phase where the ideas and opportunities discussed will be shaped into realistic options that can be implemented in Rwanda. The research associates will develop a roadmap for implementation, including other work programmes that will be required. This will be used to develop the draft National Strategy document by mid-June.

Access to Climate Finance

One of the most important barriers to development in Rwanda is funding. Progress on climate finance for developing countries has recently been made at the international negotiations in Cancun in December 2010. For Rwanda to capitalise on this opportunity, local capacity in sourcing, applying for and obtaining international development finance needs to be developed. There are other financing opportunities including carbon credits, especially for energy projects, and these will be reviewed and compiled into a separate report which will form an appendix to the National Strategy.

Establishing a Climate Centre

There is insufficient climate data for Rwanda which prevents the development of reliable climate models and hence climate projections. These are essential if Rwanda is to incorporate changes in climate into its economic and social planning. Work is already being done by the UK Met Office and MIT in Rwanda, and the Smith School aims to work with them to establish a Climate Centre. A separate report detailing the requirements for a Climate Centre will form an appendix to the National Strategy.

Strategy Development

The work done on Sector Working Papers, roadmaps, consultation will contribute to the development of the Strategy. Opportunities to learn from previous national climate change and low carbon development studies will be exploited. The strategy will present a vision for Rwanda in 2050. It will be guided by principles and pillars determined by the government of Rwanda. It will address adaptation and mitigation as well as energy security and will seek to enable Rwanda to be a global leader in climate change and low carbon development.

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Stakeholders

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ACRONYMS AND ABBREVIATIONS

AAP	Africa Adaptation Programme
ADB	Africa Development Bank
BEST	Biomass Energy Strategy
BEV	Battery Electric Vehicles
BTC	Belgian Technical Cooperation
CAADP	Comprehensive Africa Agriculture Development Programme
CBD	Central Business District
CBO	Community-based Organisation
CCIOU	Climate Change and International Obligations Unit
CDF	Community Development Fund
CDKN	Climate and Development Knowledge Network
CDM	Clean Development Mechanism
CFL	compact fluorescent lamp
CGIS	Centre for Geographical Information Systems
CIP	Crop Intensification Programme
COMESA	Common Market for East and Southern Africa
CPI	Corruption Perception Index
CTCN	Climate Technology and Technical Network
DDP	District Development Plans
DFID	Department for International Development
DRC	Democratic Republic of the Congo
DRR	Disaster Risk Reduction
DNA	Designation National Authority
EAC	East African Community
EAPMP	East Africa Power Master Plan
EAPP	East African Power Pool
ECCAS	Economic Commission of Central African States
EDPRS	Economic Development and Poverty Reduction Strategy
EFR	Environment and Fiscal Reform
EIA	Environmental Impact Assessment
EU	European Union
EWSA	Energy, Water and Sanitation Authority
FAO	Food Agriculture Organization
FECOMIRWA	Federation of Mining Cooperatives
FONERWA	National Fund for the Environment in Rwanda
GDP	Gross Domestic Product
GEF	Global Environmental Facility
GHG	greenhouse gas
GIS	Geographic Information System
GoR	Government of Rwanda
GTZ	German Technical Cooperation Agency
HDI	Human Development Index
HEV	Hybrid Electric Vehicles
HFO	heavy fuel oil
ICE	Internal Combustion Engine
ICF	Investment Climate Facility for Africa
ICRAF	World Agroforestry Centre
ICT	Information and Communications Technology
IFC	International Finance Corporation
IMF	International Monetary Fund
INC	Initial National Communication
IPP	independent power producer
IRST	Institute for Research in Science and Technology
ISAR	Institut des Sciences Agronomiques du Rwanda

IWRM	Integrated Water Resources Management
JICA	Japanese International Cooperation Agency
JV	joint venture
KIST	Kigali Institute for Science and Technology
kWh	kilowatt-hour
LAIS	Land Administration Information System
LDC	Least Developed Country
LDCF	Least Developed Country Fund
LIS	Land Information System
LTR	Land Tenure Regularisation
LVBC	Lake Victoria Basin Commission
MDG	Millennium Development Goals
MIE	Multilateral Implementing Entity
MINAGRI	Ministry of Agriculture and Animal Resources
MINALOC	Ministry of Local Government and Social Affaires
MINEDU	Ministry of Education
MINECOFIN	Ministry of Finance and Economic Planning
MINICOM	Ministry of Trade and Industry
MINIFOM	Ministry of Forestry and Mines
MINELA	Ministry of Environment and Lands
MININFRA	Ministry of Infrastructure
MININTER	Ministry of Internal Security
MINIRENA	Ministry of Natural Resources
MOU	Memorandum of Understanding
MW	megawatt
NAB	National Agriculture Export Board
NAFA	National Forestry Authority
NAMA	Nationally Appropriate Mitigation Actions
NAPA	National Adaptation Programme of Action
NBDF	Nile Basin Discourse Forum
NBI	Nile Basin Initiative
NCTA	Northern Corridor Transit Agreement
NDBP	National Domestic Biogas Programme
NEDA	National Energy Development Agency
NELSAP	Nile Equatorial Lakes Subsidiary Action Program
NEPAD	New Partnership for African Development
NGO	non-government organisation
NICI	National Information and Communications Infrastructure
NIS	National Investments Strategy
NIE	National Implementing Entity
NLA	National Land Authority
NPR	National Paved Roads
NTEP	Nile Transboundary Environmental Action Project
NUR	National University of Rwanda
ODI	Overseas Development Institute
OGMR	Office of Geology and Mines in Rwanda
PEI	Poverty Environment Initiative
PES	Payment for Ecosystem Services
PPIAF	Public Private Infrastructure Advisory Facility
PPP	Public-Private Partnership
PRSP	Poverty Reduction Strategy Paper
PSF	Private Sector Federation
PSP	private sector participation
PV	photovoltaic

R&D	research and development
RAB	Rwanda Agricultural Board
RADA	Rwanda Agricultural Development Agency
RARDA	Rwanda Animal Resources Development Authority
RCAA	Rwandan Civil Aviation Authority
REDD	Reducing Emissions from Deforestation and forest Degradation
RHODA	Rwandan Horticulture Development Authority
RBS	Rwanda Bureau of Standards
RCM	Regional Climate Model
RDB	Rwanda Development Board
RIG	Rwanda Investment Group
RECO	Rwanda Electricity Corporation
REMA	Rwanda Environmental Management Authority
REMP	Rwanda Electricity Master Plan
RGRES	Rwanda Geothermal Resources Exploration Strategy
RNDB	Rwanda National Dairy Board
RSDI	National Spatial Data Infrastructure
RTDA	Rwandan Transport Development Agency
RURA	Rwanda Utility Regulatory Agency
RWASCO	Rwanda Water and Sanitation Corporation
RWF	Rwandan Franc
RWH	Rainwater Harvesting
RRA	Rwanda Revenue Authority
SADC	Southern African Development Community
SEA	Strategic Environmental Assessment
SEI	Stockholm Environment Institute
SIDA	Swedish International Development Agency
SIDS	Small Island Developing States
SIG	Sector Implementation Group
SNC	Second National Communication
SNV	Netherlands Development Organisation
SSP	Strategic Sector Plans
SSATP	Sub Saharan Africa Transport Policy
SWAp	Sector Wide Approach
UNCCD	United Nations Convention to Combat Desertification
UNDP	United Nations Development Program
UNEP	United Nations Environment Program
UNFCCC	United Nations Framework on Climate Change Convention
UNIDO	United Nations Industrial Development Organisation
USD	United States dollars
VAT	Value Added Tax
VCM	Voluntary Carbon Markets
VUP	Vision 2020 Umurenge Programme
WB	World Bank

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