

Emerging in a Changing Climate – Sustainable Land Use Management in Rwanda

Dr Mathew WARNEST, Bahrain, Eng. Didier G. SAGASHYA, and
Dr Emmanuel NKURUNZIZA, Rwanda

Key words: Sustainable Land Use Management, Land Tenure Reform, Spatial Data Infrastructure, Green Growth, Climate Resilience, Food Security

SUMMARY

Durban COP17 December 2011 (UNFCCC 2011). The World held its breath for a global commitment to reducing greenhouse gas emissions in a bid to steady human-induced climate change. During the proceedings, one unique country, Rwanda, set fourth its ambitious national strategy for charting a green growth and climate resilient future.

The mountainous central African nation of Rwanda (refer map 2009) is one of the World's least developed countries with one of the highest population densities, and is notably one of the lowest emitters of Green House Gases (GHGs). Rwanda is an early mover in tackling its economy's exposure to external oil prices and commodity market fluctuations at a time its development and investment growth is expanding. Rwanda's appetite for greater access to energy, resources and land is rapidly increasing at full *crescendo*.



To achieve Rwanda's ambitions, to transform to a prosperous, food secure, knowledge based economy, the Government has embarked on a low carbon development path that works to address renewable energy access and use, resource efficiency and climate resilience. Central to this strategy is optimal use of land. Rwanda's land size is just 26,338 sq km for a population of 11 million increasing at nearly 2.8 per cent per annum. Urbanisation is increasing at 4.4 per cent, and agricultural production contributes more than 36.7 per cent of export earnings. Pressure on land is extremely high.

Key to Rwanda's success, the landlocked and populous nation is rapidly establishing an integrated approach to planning its urban and rural environments, finalising land tenure reforms, and improving land information systems to support these activities. This paper brings to light Rwanda's national green growth and climate resilience strategy. It provides a glimpse into Rwanda's broad achievements in sustainable land use management that are regional and African continent best practice, and provides lessons of guidance for other emerging nations setting upon a course of low carbon development and climate change resilience. Readers are encouraged to explore the national strategy and supporting sector working papers from which this paper draws.

Emerging in a Changing Climate – Sustainable Land Use Management in Rwanda

**Dr Mathew WARNEST, Bahrain, Eng. Didier G. SAGASHYA, and
Dr Emmanuel NKURUNZIZA, Rwanda**

1. INTRODUCTION

In Jon Liu's recent mini-documentary "Rwanda: Emerging in a Changing Climate" (EEMP 2011) he captures the efforts and ambitions of this unique central African country to forge a sustainable future, resilient to the impacts of climate variance and sensitive to ensuring energy efficiency.

Rwanda is a country with purpose. Set amongst the undulating mountains of the Albertine branch of the East African Rift, Rwanda will easily remind visitors of dramatic vistas akin to Swiss agricultural hillsides or to the rolling mountains of Northern Laos. The small landlocked nation set at the very source of the Nile is fast becoming one of the continent's most attractive places to do business with an economy that has held growth at 7-8% for most of the past decade. Comparison now is aligned with the likes of the economic powerhouse Singapore that in 30-40 years transformed itself from an aid dependent nation. Rwanda's determined Government is committed to poverty alleviation, economic development and securing the future for its over 11 Million population.

But challenges lie ahead. Indigenous energy is in short supply, tempered by large transport distances from neighbouring sea ports, oil fuel is up to two-fold the price to import. Hydro-electricity potential of the country has mostly been captured and is not sufficient to sustain the growing population, increasing urbanisation, and expanding industrial sector. Rwanda imports all of its oil-based products that fuel 39 per cent of Rwanda's electricity generation capacity, and its entire transport sector – import and export costs are very high. The economy is greatly exposed to regional and global oil and commodity price fluctuations. Agriculture contributes over 36.7 per cent to GDP (2010) with an estimated 90 per cent of the population involved in subsistence farming practices, highly dependent on favourable growing seasons. Energy availability and productive capacity concerns have driven Rwanda to look for alternative measures to ensure its development trajectory remains on course.

This paper aims to bring attention to Rwanda's world leading approach towards realising a green economy harnessing innovative renewable energy technologies, and further how land reform, national land use planning, and spatial tools are being recognised as essential in order for Rwanda to best manage its growing demand for land, water and natural resources. At the same time, achieving food security for a growing population, decoupling the economy from non-renewable energy and forging resilience to climate change. Rwanda is one of the few countries on target to achieve Millennium Development Goals (MDGs).

2. BIG GOALS, A UNIFIED APPROACH, SMALL STEPS

Rwanda is unique in its unified sector coordination of development partners to the Economic and Poverty Reduction Strategy (EDPRS) through a Sector Wide Approach (SWAp) mechanism. Rwanda has focused its development path to metric-based targets and collaborative monitoring to review progress tied directly to the central budget and planning process. Highlighted are ambitious goals of 50 per cent electricity connectivity and 1000MW domestic power generation by 2017 that aims to harness geothermal (beneath the volcanic North Eastern districts) and suspended methane gas (within Lake Kivu) energy potentials. Other targets include extensive irrigation and water storage infrastructure to secure agricultural production, intensive hillside irrigation and terracing, allocation of ‘One Cow per Poor Family - GIRINKA programme’ and the child nutrition milk-for-schools programs. Even at the village level, Integrated Development Planning is meeting the foremost fundamental community needs through ‘model village’ goals to build better, more resilient sustainable communities. Attention is also focused towards environmental protection of Rwanda’s globally significant biodiversity, and emerging plans to transform the capital Kigali into a financial hub and IT services based metropolis founded upon a knowledge-based economy. Rwanda is most definitely “*a country in a hurry*”.

3. PEOPLE, OIL, AND FOOD

The Economist feature report ‘The 9 billion-people question’ (2011) highlights these very challenges. Within just four years, global peak food prices returned in early 2011, rising above those levels experienced in 2007-08. Back then, millions fell further into poverty, sparking food riots in developing nations, export bans, and sparked fears of a global land rush. By 2011, it occurred again and the era of cheap food concluded. Adding further concern is climate change to which agriculture is both part cause and victim. For Rwanda, already facing very high import and distributions costs, and regional non-tariff barriers – the estimated impact is doubled.

Rwanda has the highest population density in Africa, and the population is growing at 2.8 per cent per year. It is predicted that the population will more than double from 11 million today to 26 million by 2050, with a population density of 987 people per square kilometre (UN 2011). Urbanisation is increasing, at 4.4 per cent per year, with over 1 million people living in the capital city, Kigali. As urbanisation increases, pressure on the land will increase demanding greater attention to infrastructure planning, transport, and affordable housing solutions to retain efficient, green and liveable urban centres. A key challenge is managing the workforce transformation from a subsistence agriculture base to a highly skilled knowledge-based society.

Peak oil is widely discussed. Often with the view, new technologies will be realised to meet growing demand. Less discussed, is peak phosphorous. The key ingredient of mineral fertilisers, phosphorous is both energy and emission intensive to process and the global stock is diminishing at a rate deemed to coincide with peak oil. For agricultural production and

export, these two factors pose great risk to viability of the sector and will directly impact food security. The answer – renewed vigour in agro-ecological practices is emerging, ensuring biomass and nutrients are returned to soils, efficient irrigation, that land is farmed sustainably, and that processing, storage and transport of produce is efficient. Termed ‘Climate-Smart Agriculture’ is now not only viewed as attaining resource efficiency, but securing economies dependent on agricultural production in the long term, isolating them as best possible from external risks (Juma 2010, The Economist 2011, UNHCR 2011).

In the context of vulnerability within the agriculture sector there are two main areas that require attention, although overlap exists between the two areas. The first dimension is the dependency on externally sourced carbon-based commodities and technologies, including agro-chemicals, fuel, equipment, seeds and imported food products. This dependency means that the sector remains vulnerable to global price rises in foods and oil-based products. The second dimension is directly related to the potential impacts of climate change, such as increased rainfall variability and extreme rainfall events resulting in droughts, heavy rain storms and crop failures, rising temperatures leading to increased crop and/or livestock pests and disease, and other problems associated with soil drying and weed infestation. In such cases these problems can then be exacerbated through inappropriate land management techniques with long-term consequences for food production, export-market orientated cash crops and national food security. The following figure 1 illustrates the possible progression of vulnerability over time and the impacts this may produce (SSEE 2011a).

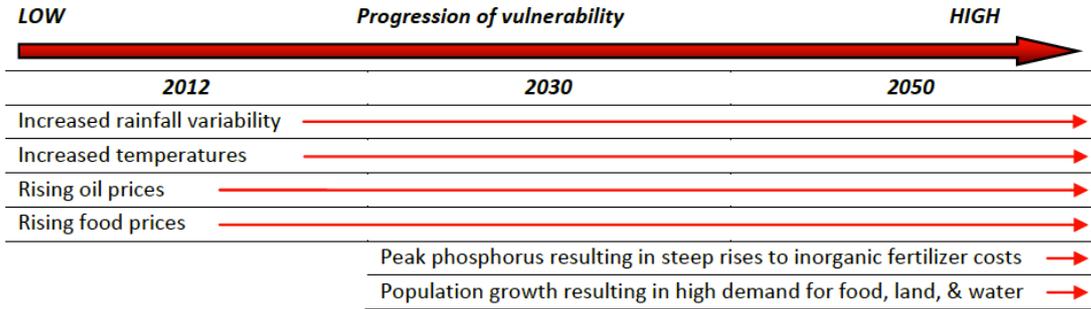


Figure 1. Possible progression of Climate Change Vulnerability (SSEE 2011a).

During the East African Famine of late 2011, Rwanda, although graced with more favourable climate and soils than its more Northern / Easterly neighbours, still faced challenges. Met directly with smart agricultural sector management; such as calling upon farmers to retain produce rather than selling at attractive prices with the impending risks of next growing season failure, and smart macro-economic management to minimise regional commodity pressure, Rwanda was able to withstand the crisis and proved food secure throughout. Attention to post harvest handling and storage infrastructure and policies have contributed to this resilience.

4. WEATHERING THE CLIMATE

Before long-term climate change is considered, capacity to cope with existing ‘known’ weather patterns is a constraint for many emerging nations. For the past decade and beyond, Rwanda’s climate is marked by a moderate dual wet season (season A and B) where the second oscillation experienced is less strong. The mean high-altitude of Rwanda, conducive soil structure, and relatively high rainfall are ideal for productive agriculture. Limitations include steep slopes, leached soils on hilltop ridges, restricted land access due to population, and limited water storage and distribution infrastructure. The North-Western mountainous districts are the most productive with influence of rich volcanic soils and higher rainfall, whereas the Western regions are lower in mean altitude and considerably more exposure to low rain periods. Extreme weather events such as severe storms, hail, flooding and drought are being experienced leading to crop losses, impacts to infrastructure, damage to feeder roads and to the dwellings of farmers. Coping with existing weather variance is the first priority.

In many emerging nations, limited observatory data and records challenge the assessment of longitudinal climate variance. Well maintained stations and diligent record keeping are required to make assertive conclusions with 30 years regarded as minimum to identify trends. Resilience to existing weather means weather observatory services are required to provide short-term and advanced warning systems both for farmers and form a key component of crop insurance and finance mechanisms.

5. A CHANGING CLIMATE

Rwanda is currently highly vulnerable to climate change as it is strongly reliant on rain-fed agriculture both for rural livelihoods and exports of highland tea and coffee. It also depends on hydropower for half of its electricity generation, a driver of economic growth. Farmer’s claim the bi-annual seasons no longer reflect the weather being experienced. Rwanda has experienced a temperature increase of 1.4°C since 1970, higher than the global average, and can expect an increase in temperature of up to 2.5°C by the 2050s from 1970. Rainfall is highly variable in Rwanda but average annual rainfall may increase by up to 20 per cent by the 2050s from 1970. Early signs suggest rainfall intensity is increasing which may lead to a greater risk of flash flooding, landslides, and thus crop losses and structural damage.

Temperature rise may increase the spread of vector-borne diseases, air-borne and water-borne diseases, impacting on animal and human health, that may negatively affect crop yields – impacting food security and export earnings. Higher temperatures result in higher altitudes at which tea and coffee may be grown that may significantly impact land availability, and may then spur land use competition.

In Rwanda, and in the East African region in general, an incomplete understanding of the seasonality and climate variance has led to seasonal losses. Severe rainfall and floods, and extended drought periods are commonplace. Scientists are working hard to better understand the future pattern of change of the Inter-tropical Convergence Zone (ITCZ) and the African equatorial rain belt of which Rwanda finds itself at the cusp.

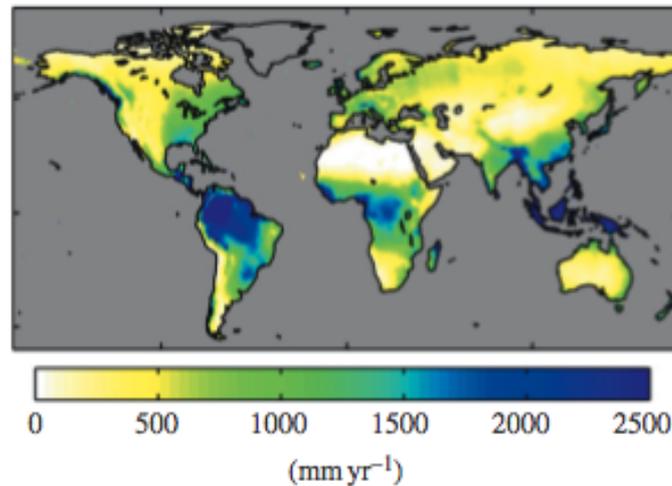


Figure 2: Changing baseline climatology (F. Fung et al 2011)

Rwanda is now investing in rehabilitating the National Meteorological Service both for weather forecasting (with the assistance of the UK Met Office Hadley Centre) and establishing a world class climate observatory (University of Oxford’s Smith School of Enterprise and Environment, and the World Meteorological Organisation), that when complete will provide improved long term monitoring of Rwanda’s environment. Also leading climate observation efforts is MIT University with plans to establish an advanced MEDUSA sensor for regional and global measurement of GHG emissions. Early Warning Systems are also part of this rehabilitation plan.

6. AGREEN GROWTH AND CLIMATE RESILIENCE STRATEGY

The Rwandan National Strategy on Climate Change and Low Carbon Development (GoR 2011) was developed over a period of nine months, from November 2010 to July 2011, as a collaborative effort between the Government of Rwanda, the Smith School of Enterprise and Environment (SSEE) at the University of Oxford, and the donor agencies UK DFID-Rwanda and the Climate and Development Knowledge Network (CDKN). The project was coordinated by the Ministry of Natural Resources (MINIRENA), and was directed through a Steering Committee consisting of ten Cabinet Ministers. A team of researchers, national counterparts and appointed interns covered ten primary sectors across the Government of Rwanda and their stakeholders. The National Strategy was launched at the 17th Conference of Parties (COP17) held in Durban, South Africa in December 2011 – available via <http://cdkn.org/project/a-strategic-framework-for-rwanda/>

7. ADDRESSING THE LAND ISSUE

Realising adaptation to climate change and achieving a low carbon growth path is ostensibly rooted in achieving land tenure (property ownership) security and instigating a robust integrated framework for development planning and sustainable land management – improved land information management is essential. With land tenure comes responsibility to manage the land in accordance to planning codes and the economic incentive to improve the asset.

Box. 1 Land Management and Planning Vision 2050

- **Rwanda is renowned globally for its Green Economic development** success whilst preserving its natural and cultural heritage.
- **Land and Planning Framework** that achieves optimal land use and promotes land improvement and protection of biodiversity.
- **Environmental Management Plans** under EIA process are monitored and enforced.
- **Strategic Environmental Assessment** plans applied to key development zones, such as industrial parks, agricultural zones, tourism zones, National Parks, and major projects.
- **An Active Land Market** supports economic growth, investment, and wealth creation.
- **Modern land tenure system** supports land valuation and property revenue systems at the district level. Revenue supports GIS based integrated planning, hazard mapping, community based NRM and planning.
- **Formalised Land Tenure** allows the greater population access to credit mechanisms, supporting land improvement
- **A vibrant financial services sector** through secure land tenure and active land market promotes investment.
- **National Spatial Data Infrastructure provides detailed mapping** and monitoring of land use and land use change, supporting integrated planning, part of national ICT.
- **National Spatial Data Infrastructuresupports national and district hazard mapping**, early warning system of active sensors, and future modelling and disaster mitigation.
- **Communities are informed of local hazards** and maintain event readiness through practised community and household disaster management plans tailored to individual communities.
- **Spatial information supports health care** planning, CENSUS, decision making of government and is accessible by private sector and individuals.
- **Information sharing and access policy** promotes efficient Government, that makes decisions on the best and most complete information available whilst preserving individual rights to privacy.
- **Farmers and districts understand their responsibilities for sustainable land management** practices with improved land husbandry.
- **Soil erosion and land degradation overcome** through improved land husbandry and maintenance of hillside region interventions such as radical terracing, trenching, progressive terracing and afforestation.
- **Early investment in infrastructure** and planning in transport, energy and sanitation, enables the City of Kigali and regional settlements to grow and prosper maintaining cultural and natural heritage.
- **Rwanda's urban environs are healthy and productive centres** for commerce and trade.
- **Over 25 Million Rwandan's enjoy an improved livelihood** and have greater access to employment, health care, education, and wealth creation.

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. Business and industry further compete 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, overburdened water and sanitation systems leading to reduced livelihoods, environmental degradation, continued loss of biodiversity, food insecurity, poor air quality and health impacts. A Vision of Land Use Planning and Management in 2050 is proposed in Box 1. The vision targets are provided as a guide to planners and administrators to consider where Rwanda is at now to where it may wish to be in 2050 when it surpasses middle income country (MIC) status supporting a knowledge-based economy, market-based agriculture, and progressive green industry. The 2050 vision statements are principle ideals that will assist framing the climate change and low carbon development policies and guide the short, medium and long term action agenda (SSEE 2011b).

8. WHY SPATIAL IS KEY

Spatial information and systems are integral to addressing humankind's struggle against poverty, food security and economic development. The spectrum of spatial tools and disciplines that are employed to fight poverty are exactly those that define the spatial and related professions:

- Comprehensive information on land use, land ownership (tenure), land use change.
- Planning tools to enable optimal land use and development in the urban and rural landscape.
- Foundation infrastructure to support efficient, equitable, and secure land transactions that support stable property markets and promote investment.
- Environmental mapping and monitoring to protect biodiversity and protect natural and cultural heritage.
- Multi-spatial solutions for integrated water resource management, optimal storage and distribution to facilitate water security.
- Tools to improve spatial modelling of climate data and microclimate variances through to better agricultural-climate observation (i.e. integration of climate, soil, water, land use, and crop suitability).
- Tools to reduce and overcome land desertification, monitor soil quality and land use practices including agriculture and animal husbandry, crop selection, soil and land rehabilitation.
- Comprehensive knowledge of the geology and geophysical resources of the country from mineral resources to ground water and geothermal potential.

- Spatial metric tools that allow accurate area-based monitoring of poverty and environment indicators of the central government budget and planning process – often tied to household (Census data), intervention program areas, impact of humanitarian aid or resource distribution.

9. IMPORTANCE OF TENURE TO SUSTAINABLE LAND MANAGEMENT

The approach to land tenure varies from country to country. In Rwanda, it includes forms of freehold tenure and leasehold tenure. Improper land use leads 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 tenure regularisation, started in June 2009 and has expanded to all 30 districts. At end of March 2012, about 10.04 million parcels had been demarcated (*photo of demarcation process across: the woman is the claimant*) and adjudicated– representing 97 per cent of the total projected parcels in the whole country. Up to now, 5.8 million parcels have been digitised while 6.5 million are have been entered into the database. Leasehold title issuance in all three districts of Kigali City and in Kirehe District (Eastern Province) have been completed. In general 2.7 million leasehold titles have been approved, with 2.5 million of them printed and 1.1million collected by land owners. The remaining parcels should be demarcated by June 2012 and leasehold titles issuance is set to be completed by December 2013. Progress updates are regularly published and mapped on the Department of Lands and mapping website <http://www.nlc.gov.rw/>



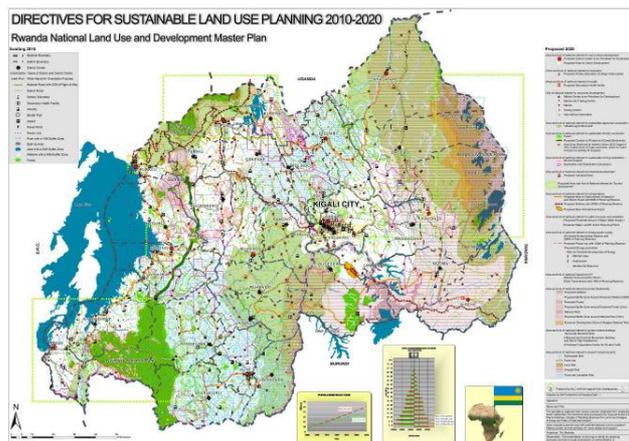
10. AGRICULTURAL LAND USE CONSOLIDATION

Agricultural intensification efforts under the crop intensification programme (CIP) have enabled farmers to take more profits at market and increase their yield. Land ‘use’ consolidation, focuses on production of particular crops in designated areas. It has enabled farmers to consolidate efforts 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.

11. COMPETITION FOR LAND

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 needed.

The recent promulgation by Cabinet (January 2011) of the National Land Use and Development Master Plan (*Map across shows directives for sustainable land use planning 2010-2020*) and the approval of land use planning legislation by Parliament (March 2012) are important steps 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 Plans, 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.

12. NEXT STEPS

For the immediate future in Rwanda, it is less about minimising GHG emissions, than addressing the Nations' growing dependence on non-renewable energy, protecting production, and the bulk share of the economy from potential oil shock amongst other vulnerabilities. Rwanda is a relatively very low emitter of GHGs and will remain so for at least the next decade. Future emissions, however, will have an adverse impact on the environment and health of Rwandans. Instrumental in realising a green growth future for Rwanda and other equally ambitious countries hoping to achieve sustainable communities and resilient growth in their economies, is the role of comprehensive spatial information. Informed policy based on measurable indicators and integration of various location based sectoral-data is essential for decision-makers to chart an informed course of action for communities. As a community of practice, the land management and spatial science disciplines have much to offer developing and emerging nations. Linkages with international efforts in tackling climate change, food security, poverty, and resource efficiency is a call that should not go unheard for the profession to remain relevant in a rapidly changing world.

For Rwanda, through a unified community-wide approach to the development effort, humble observation and testing of new techniques, an entrenched system of goal setting and review, accountability combined with the determination to succeed means progress is being achieved. Looking far beyond the immediate challenges, rapidly emerging Rwanda is unique in ensuring the steps taken today will secure the future of the next generations to come.



13. REFERENCES

EEMP(2011) ‘Rwanda in a Changing Climate’, Environmental Education Media Project (EEMP), Climate and Development Knowledge Network (CDKN), UK AID, Kigali, Rwanda, Available: <http://cdkn.org/2011/12/new-film-released-%E2%80%93-rwanda-emerging-in-a-changing-climate/> (Available 10 December 2011, various editions available).

F. Fung et al. (2011), Phil. Trans. R. Soc. A. 2011

GoR (2011), Rwanda Green Growth and Climate Resilience Strategy, National Strategy for Climate Change and Low Carbon Development, Government of Rwanda, prepared with assistance of Smith School of Enterprise and Environment (SSEE), University of Oxford, Kigali, pp. 99. Available: <http://www.smithschool.ox.ac.uk/wp-content/uploads/2011/03/Rwanda-Green-Growth-Strategy-FINAL-high-res.pdf>

His Excellency President Paul Kagame speaking at the World Economic Forum, Davos, Switzerland (2011), www.abndigital.com, March 2011.

Juma, C. (2010), The New Harvest: Agriculture Innovation.

SSEE (2011a), Agriculture and Food Security Sector: Working Paper, prepared by Dr Adam-Bradford, A., Rwanda National Climate Change and Low Carbon Development Strategy, prepared for Government of Rwanda, Smith School of Enterprise and Environment (SSEE), University of Oxford, Kigali, Oxford pp.26

SSEE (2011b), Land Use Planning and Management, Sector Working Paper, prepared by Dr Warnest, M., Rwanda National Climate Change and Low Carbon Development Strategy, prepared for Government of Rwanda, Smith School of Enterprise and Environment (SSEE), University of Oxford, Kigali, Oxford, pp. 101. Available: http://www.smithschool.ox.ac.uk/Land-SWP-final_proofed.pdf

The Economist (2011), The 9 Billion-People Question, Feature Article, February, pp.16

Twitter (2012) Rwanda Land Tenure Reform Progress Status, Twitter, Available online, https://twitter.com/#!/Lands_Rwanda/status/192887980774535168. (Accessed 03 April 2012).

UN (2011), World Population Prospects: The 2010 Revision. Population Division of the Department of Economic and Social Affairs of the United Nations Secretariat.

UNFCCC (2011), 17th Conference of the Parties (COP17) to the United Nations Framework Convention on Climate Change, Durban South Africa, 28 November – 09 December 2011. <http://www.cop17-cmp7durban.com>

UNHRC (2011), Report by the Special Rapporteur on The Right to Food, Olivier De Shutter,

United Nations Human Rights Council, Available <http://www.srfood.org> (April 2011).

Map source: (2009) The World Fact Book

DISCLAIMER

The views expressed in this paper are those of the contributing authors and do not necessarily reflect those of the Government of Rwanda, the Kingdom of Bahrain, the Smith School for Enterprise and Environment, University of Oxford, the Climate and Development Knowledge Network or United Kingdom Aid, Environmental Education Media Project, donors or agencies discussed throughout. This paper draws from the author's in country experience and background research conducted in the preparation of a series of sector working papers contributing to the Rwanda National Strategy for Green Growth and Climate Resilience.

CONTACTS

Eng. Didier Giscard Sagashya
Deputy Director General, Department of Lands and Mapping
Rwanda Natural Resources Authority (RNRA)
Ministry of Natural Resources and Environment (MINIRENA)
Kigali
RWANDA
Email: didier.sagashya@nrc.gov.rw
Web site: <http://www.nrc.gov.rw>

Dr Emmanuel Nkurunziza
Director General, Rwanda Natural Resources Authority (RNRA)
Ministry of Natural Resources and Environment (MINIRENA)
Kigali
RWANDA
Email: emmanuel.nkurunziza@nrc.gov.rw
Web site: <http://www.nrc.gov.rw>

Dr Mathew Warnest
Advisor to the Director General, Survey
Survey & Land Registration Bureau (SLRB)
Diplomatic Area
KINGDOM OF BAHRAIN
Tel. +973 1751 5309
Email: mathew.warnest@slrb.gov.bh
Web site: <http://www.slrb.gov.bh>

BIOGRAPHIES

Eng. Didier G. SAGASHYA is, since June 2011, the Deputy Director General in charge of Department of Lands and Mapping within Rwanda Natural Resources Authority; a newly established agency following a merger of the National Land Centre, National Forestry Authority, Geology and Mining Authority as well the department responsible for Integrated Water Resources Management. Prior to the current posting, Eng. Didier had been Deputy Director General of Rwanda's National Land Centre for almost 4 years. He holds MSc in Urban and Regional Planning obtained from Heriot-Watt University – Edinburgh – UK in 2007, and a BSc in Civil Engineering and Environmental Technology obtained from Kigali Institute of Sciences and Technology (KIST) in 2004. Eng Didier is playing a key role in the on-going land reform including land registration in Rwanda; his interests are security of land tenure, land administration and land use planning. Didier worked for Kigali City Council as Director of Inspection Unit from 2004 to 200 before moving to Rwamagana District, in 2006, as Director of Land, Housing, Physical Planning and Infrastructure.

Dr Mathew WARNEST since 2012, holds position as the Advisor to the Director General, Survey at the Survey & Land Registration Bureau of the Kingdom of Bahrain. Mathew has over 10 years experience in the public and private sectors in land administration and spatial information management. In 2010, he was appointed Research Associate to the University of Oxford's Smith School of Enterprise and Environment heading land, agriculture and water sector contributions to the Rwandan National Strategy for Green Growth and Climate Resilience launched at UNFCCC COP17 in Durban South Africa in December 2011. In addition, in 2009, he was appointed by the International Finance Corporation (IFC), World Bank Group as part of a small multi-disciplinary team to undertake a 'Business Access to Land' for investors' assessment for the Government of Rwanda. Having started his career in Australia, Mathew has devoted most of his career life to the developing world, especially South East Asia and Sub-Saharan Africa. Residing in Freetown throughout 2009, he led the assistance program for upgrading the land registration system of Sierra Leone sponsored by the Investment Climate Facility for Africa. Based within the Ministry of Lands, Country Planning and Environment, and as member of the IFC/World Bank Doing Business Committee for Sierra Leone, he oversaw the introduction of a modern electronic land registration and mapping system and the computerization of historic land records. His recent experiences include contributions to the Philippines' land sector development framework contributing to the economic development and poverty reduction strategy to 2030. He has previously contributed to setting pathways for national land information system development in Indonesia and Cambodia. Mathew holds a Doctorate of Philosophy (Engineering) from The University of Melbourne, Australia.