Agroforestry Rwanda: Improving resilience of farmers' livelihoods to climate change through innovative, research proven climate-smart agroforestry and efficient use of tree resources in the Eastern Province and peri-urban areas of Kigali city.

Project objective

The general objective is to increase the pace and scale of agroforestry-based restoration of degraded agricultural lands and sustainable use of biomass energy, with associated improvements of land health, livelihoods and poverty reduction. **The specific objective** is to effectively understand and demonstrate the ecological, social and economic pathways to, and resultant benefits from, the scale up of agroforestry-based restoration and sustainable biomass use in Eastern Province and in the peri-urban Kigali city of Rwanda.

Background

The economy of Rwanda is greatly dependent upon its land, water and biodiversity resources, with the agriculture sector contributing about 29% of the GDP. About 96% of the rural households rely directly or indirectly on agriculture for their livelihoods, and 85 to 95% of households use fuel wood as a source of cooking energy. Nonetheless, Rwanda is very vulnerable to climate change, ranking twelfth most vulnerable country in the world (ND-GAIN Index). In recent years, extreme weather events in Rwanda increased in frequency and magnitude with floods and landslides reported in the Western province and Kigali City while drought devastated the Eastern Province. Furthermore, Rwanda has the highest population density in Africa (World Bank, 2015), and the rapid population growth in Kigali City and the Eastern Province has increased pressure on land, forest and water resources. The large gap between supply and demand in fuel wood is leading to over-exploitation and degradation of trees/shrub resources (both in forest and crop/agroforestry lands) with consecutive exposure of soils to erosion.

Photo taken by Modest BIZIMANA: Farmer Field School (FFS) Facilitators learning about Agroforestry systems in Gicumbi District, Rwanda

In 2010, the Government of Rwanda, aiming to resolve these challenges, committed to restoring the ecological health of two million hectares of land, which essentially represents the whole country. This commitment was the first in Africa, and a foundational commitment to the Bonn Challenge, a global target to restore 150 million ha of degraded land by 2020. Agroforestry provides a potential restoration solution to land degradation in Rwanda, and Eastern Province in particular, providing multiple benefits including the reduction of soil loss, increase of wood biomass, plant and soil carbon and soil nutrients, provision of essential farm resources such as a livestock fodder, fruits, and fuel wood for cooking energy and construction materials. Evidence has shown a positive relationship between tree cover and indicators of children's dietary quality and increased consumption of fruits and tree leafy vegetables. Agroforestry products ranging from timber and firewood to fruits and nuts (e.g., macadamia) are all trade goods sold locally as well as in the sub-national, national and regional commodity markets.

The Eastern Province of Rwanda targeted by this project presents 500,000 ha of agroforestry restoration potential (MINIRENA, 2014[1]), while the peri-urban areas of Kigali City present particular challenges including high population density and high climate disaster (landslide) risks. Agroforestry

1 Forest Landscape Restoration Assessment Report, MINIRENA, 2014

potential in these peri-urban areas is estimated at 40,000 ha with opportunities to develop horticultural value chains (MINIRENA, 2014).

The theory of change to achieve the objectives

The project seeks to increase uptake of innovative agroforestry options by the farmers and foster greater resilience through economic and ecological diversification, generating higher farm productivity and more diversified food through capturing more value from high commercial and nutritious agroforestry products. The project will use an evidence-based approach to generate knowledge and to propose a more diverse portfolio of agroforestry based landscape restoration options and improved cooking stoves technologies that will suit different landscapes and households circumstances in Eastern province and peri-urban areas of Kigali city.

Photo taken by Modest BIZIMANA: Farmer Field School (FFS) Facilitators learning about Agroforestry systems in Gicumbi District, Rwanda

The theory of change of the project is built around **five interlinked results**: (i) Tested knowledge on scalable agroforestry systems and components suited to the Eastern Province and peri-urban areas of Kigali City from an ecological services perspective (including biodiversity, carbon sequestration, water retention, microclimate and productivity); (ii) Tested and proven knowledge in the further development and diversification of climate resilient, high nutrition value chains from agroforestry landscapes suited to the Eastern Province and peri-urban areas of Kigali city; (iii) Locally tested expertise and knowledge on high efficient, durable, affordable and user-friendly improved cooking stoves (ICS) and their supply chains in the Eastern Province and peri-urban areas of Kigali City ; (iv) The most important socio-economic barriers to restoration and adoption of agroforestry practices in the Eastern Province and peri-urban areas of Kigali City are identified, tackled and new opportunities for economic incentives are implemented; (v) Institutional capacity to create enabling conditions for agroforestry-based landscape restoration and sustainable use of biomass energy enhanced.

The project will carry out research on agroforestry systems including assessment of biophysical conditions and ecosystemic services provision (**Result 1**), on value chains development and market opportunities to promote high-profitable and nutritious agroforestry products (**Result 2**) and on the socio-economic characteristics of the farmers, the barriers to adoption of agroforestry and the profitability of agroforestry systems and agroforestry technologies (**Result 4**). This knowledge will build the foundation for addressing economic, ecological and behavioral constraints to adoption of agroforestry systems and improved technologies (from production to cooking stoves). The knowledge will be translated into evidence that supports the adaptation, adoption and scaling out of technologies and evidence that inform policy decision in agroforestry based restoration activities The project will support an explicit gender transformative processes, understanding and prioritizing agroforestry based landscape restoration options that women and young people can benefit from. To be successful, the project will establish partnerships with districts and sectors for incorporating the application of research results in their plans for land restoration and natural resources management. This will increase the involvement and ownership of the local authorities, NGOs, private sectors and the visibility of the project.

However, it is also assumed that sustainable agroforestry practices by smallholders will be reached out if the present and future availability of biomass energy is used sustainably (**Result 3**). For this purpose the project will carry out studies to understand the supply and demand of biomass and analyse the use of current cooking stoves by housholds and test different option of improved cooking stoves. The project will provide technical assistance and financial support to individuals and small and medium enterprises (SMEs) to boost their expertise through iterative designs , testing and production of locally adapted ICS models.

Also for ease of understanding and uptake of innovative research results by farmers, private entrepreneurs and decision-makers, and to further facilitate the adoption of improved agroforestry technologies and innovations, it will be essential that actions are taken to remove the barriers through the development of new opportunities and economic incentives (**Result 4**). For this purpose the project will develop transformational mechanisms that incentivize farmers to adopt agroforestry systems and will test different agroforestry extension methods and services.

On the basis of scientific knowledge and evidence generated, targeted institutional capacity development activities and dissemination of research findings will be done (**Result 5**), particularly through testing and adapting/ improving the existing agroforestry monitoring and evaluation system in country by involving and promoting active participation of all stakeholders including beneficiary farmer groups in the development of indicators, methods and monitoring tools.

Main activities

This Agroforestry Action-Research project will be implemented mainly through 4 PhD fellowships provided to Rwandan Nationals who will conduct thematic research across the above mentioned expected results of the project. These PhD research fellows will be seconded by a number of Master students (about 15 to 20) who will also conduct internship research on sub-themes in collaboration with the PhD fellows and their promoters. The developmental aspects of the project will be implemented and coordinated on field by the project management unit set up at both ENABEL and IUCN. These aspects include on field engagement of actors and on field services provision (through public contracts) to supplement and sustain the research outputs towards the project development outcome and impact.

The main activities to be carried out to achieve to the above mentioned results will include, for **result 1** :

- ✓ typology assessment of existing agroforestry systems and components;
- ✓ assessment and characterization of existing agroforestry systems productivity;
- ✓ assessment of the trees contribution to the conservation of biodiversity and support to ecological functions;
- ✓ measurement of carbon sequestration potential across different agroforestry systems;
- ✓ measurement and modelling of effects of trees on water balance in semi-arid landscapes;
- ✓ assessment and modelling of microclimatic effects of the different agroforestry systems;
- ✓ development of scenarios and simulation of trade-offs between various environmental and socio-economic benefits of different agroforestry systems.

Under the **result 2**, the main activities will consist in :

- ✓ identification and characterization of existing high nutritious (fruits /nuts/fodder) value chains;
- ✓ the analysis of markets for selected potential fruits, nuts and fodder value chains.

Under **result 3**, key activities will focus on :

- ✓ assessing the biomass fuel resource potential of the Eastern Province and Peri-Urban areas of Kigali city, as well as modelling the sustainable supply of biomass, with a particular emphasis on sourcing options for different types of biomass fuels;
- ✓ inventory of existing improved cook stoves (ICS) technologies and characterization testing for efficiency, fuel consumption, health effects, cooking behavior, adaptability to locally available biomass and user acceptability;
- ✓ Cost-benefit simulations of changes in ICS technologies at household level context;
- ✓ technical assistance and financial support to individuals and SMEs to boost their expertise through iterative designs, testing and production of locally adapted ICS models.

For the **result 4**, key activities will consist in:

- ✓ investigating the barriers and causes to low adoption of agroforestry by generating evidence on key drivers to low adoption, as well as assessing real needs and expectations of the farmers;
- ✓ determine the economic household level benefit and costs associated with adoption of agroforestry under various scenarios while comparing with the non-adoption;
- ✓ assess the willingness of farmers to pay for agroforestry ecosystem services (including both private household and societal benefits);
- ✓ develop transformational mechanisms that incentivize farmers to adopt agroforestry systems;
- ✓ on-farm testing and comparison of different agroforestry extension methods and services.

Under the **result 5**, the activities will focus on:

- ✓ testing and adapting/improving the existing agroforestry monitoring and evaluation system in the country by involving and promoting active participation of all stakeholders including beneficiary farmer groups in the development of indicators, methods and monitoring tools;
- ✓ building the capacity of farmers and value chain stakeholders to uptake and apply appropriate agroforestry principles and practices;
- ✓ training the key public agency (central and local) staff involved in agroforestry extension service delivery, by involving them in analysis and testing of incentive mechanisms, and producing technical guidelines and manual on incentive mechanism implementation towards large scale of adoption of agroforestry;
- ✓ improving the national capacity in ICS testing and standardization;
- ✓ set up a national platform to improve the coordination of agroforestry research and resultant application of policy actions.

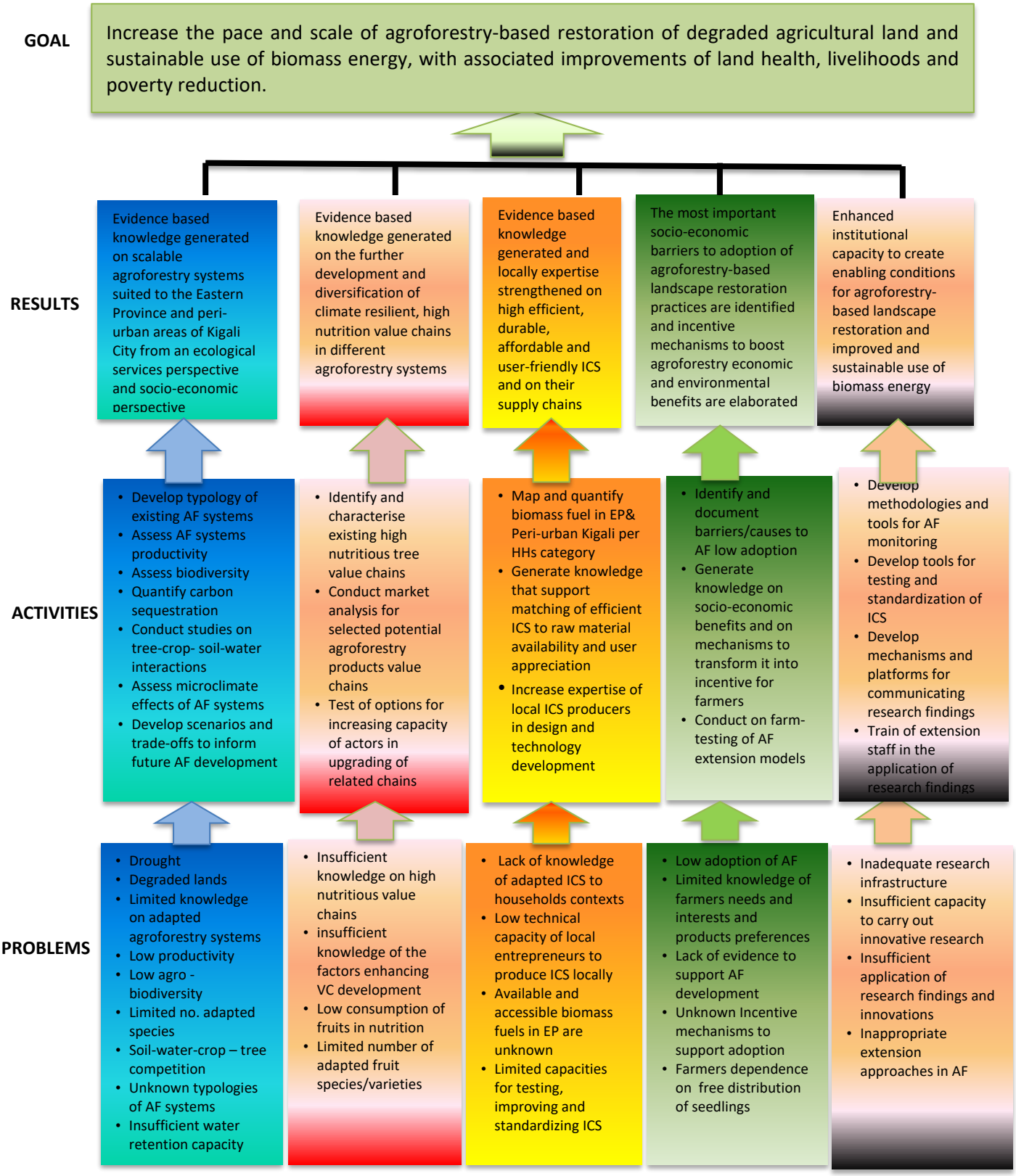
GOAL
Increase the pace and scale of agroforestry-based restoration of degraded agricultural land and sustainable use of biomass energy, with associated improvements of land health, livelihoods and poverty reduction.
RESULTS
Evidence based knowledge generated on scalable agroforestry systems suited to the Eastern Province and peri-urban areas of Kigali City from an ecological services perspective and socio-economic perspective
Evidence based knowledge generated on the further development and diversification of climate resilient, high nutrition value chains in different agroforestry systems
Evidence based knowledge generated and locally expertise strengthened on high efficient, durable, affordable and user-friendly ICS and on their supply chains
The most important socio-economic barriers to adoption of agroforestry-based landscape restoration practices are identified and incentive mechanisms to boost agroforestry economic and environmental benefits are elaborated
Enhanced institutional capacity to create enabling conditions for agroforestry-based landscape restoration and improved and sustainable use of biomass energy
ACTIVITIES
• Develop typology of existing AF systems
• Assess AF systems productivity
• Assess biodiversity
• Quantify carbon sequestration
• Conduct studies on tree-crop- soil-water interactions
• Assess microclimate effects of AF systems
• Develop scenarios and trade-offs to inform future AF development
• Identify and characterise existing high nutritious tree value chains
• Conduct market analysis for selected potential agroforestry products value chains
• Test of options for increasing capacity of actors in upgrading of related chains
• Map and quantify biomass fuel in EP& Peri-urban Kigali per HHs category
• Generate knowledge that support matching of efficient ICS to raw material availability and user appreciation
• Increase expertise of local ICS producers in design and technology development
• Identify and document barriers/causes to AF low adoption
• Generate knowledge on socio-economic benefits and on mechanisms to transform it into incentive for farmers
• Conduct on farm-testing of AF extension models
• Develop methodologies and tools for AF monitoring
• Develop tools for testing and standardization of ICS
• Develop mechanisms and platforms for communicating research findings
• Train of extension staff in the application of research findings
PROBLEMS
• Drought
• Degraded lands
• Limited knowledge on adapted agroforestry systems
• Low productivity
• Low agro - biodiversity
• Limited no. adapted species
• Soil-water-crop – tree competition
• Unknown typologies of AF systems
• Insufficient water retention capacity
• Insufficient knowledge on high nutritious value chains
• insufficient knowledge of the factors enhancing VC development
• Low consumption of fruits in nutrition
• Limited number of adapted fruit species/varieties
• Lack of knowledge of adapted ICS to households contexts
• Low technical capacity of local entrepreneurs to produce ICS locally
• Available and accessible biomass fuels in EP are unknown
• Limited capacities for testing, improving and standardizing ICS
• Low adoption of AF
• Limited knowledge of farmers needs and interests and products preferences
• Lack of evidence to support AF development
• Unknown Incentive mechanisms to support adoption
• Farmers dependence on free distribution of seedlings
• Inadequate research infrastructure
• Insufficient capacity to carry out innovative research
• Insufficient application of research findings and innovations
• Inappropriate extension approaches in AF

Figure. *Theory of change of the project showing the causal pathways from problems through activities via results towards the project goal.*

Organization

This Agroforestry Action – Research resulted from a joint application of the Belgian Development Agency (ENABEL) in Rwanda and the International Union for Conservation of Nature (IUCN). A division of Action Results has been defined between the two institutions, whereby IUCN is responsible for the component of research on agroforestry systems (**Result 1**) as well as the value chains development (**Result 2**), while ENABEL leads on results related to sustainable use of biomass energy (Result3) and socio-economics of agroforestry based landscape restoration (**Result 4**). The institutional capacity building (**Result 5**) remains cross-cutting in both components led by IUCN and ENABEL.

Given that the main implementation approach of this research project is through provision of PhD fellowships, IUCN is partnering with University of Ghent (UG) and University of Rwanda (UR) to train 2 PhD candidates, while ENABEL is partnering with the University of Leuven (KUL) and UR to train the other 2 candidates. For the successful implementation, the project will take a multi-stakeholder approach, involving other in country partners, mainly the International Centre for Research in Agroforestry (ICRAF), the Ministry of Environment (MoE) and the Rwanda Forestry Authority (RFA), the Rwanda Agriculture Board (RAB), and the Ministry of Infrastructure (MININFRA) through its Agency, Rwanda Energy Group (REG) for the matters pertaining to biomass consumption, as well as the Rwanda Standards Board (RSB) for the testing and certification of improved cooking stoves.

While ENABEL and IUCN ensure the day–to-day implementation and coordination of their respective results components, a steering committee chaired by the MoE and co-chaired by the EU Delegation in Rwanda (EUDEL) will oversee the overall project results coordination. For the operational follow-up of the actions, a technical committee chaired and co-chaired by IUCN and ENABEL will be set–up, which will meet at least once every quarter, while the steering committee will meet at least once a year. For the research protocols, methodologies and results validation, a scientific committee bringing together all involved research institutions will also be set up, and it will be coordinated by KUL.

Implementing organizations

IUCN (responsible for results 1, 2 and 5) and ENABEL (responsible for results 3, 4 and 5).

Project partners

University of Ghent, University of Leuven, University of Rwanda and ICRAF will be directly involved in the implementation of the project.

Other stakeholders

Ministry of Environment (MoE), Rwanda Forestry Authority (RFA), Ministry of Agriculture (MINAGRI) and Rwanda Agriculture Board (RAB), Ministry of Infrastructure (MININFRA) and Rwanda Energy Group (REG), Rwanda Standards Board (RSB).

Region

Eastern Province of Rwanda (7 districts) and peri-urban areas of Kigali City.

Funding and co-funding

IUCN coordination	€ 2,000,000
ENABEL coordination	€ 2,000,000

Total budget	€ 4,000,000

Duration

5 years (February 2020 - January 2025)