

COMBINING MULTIPLE METHODOLOGIES TO ASSESS LAND DEGRADATION AND TARGET RESTORATION INTERVENTIONS

Remote sensing



Remote sensing data, coupled with on-the-ground measurements, enables robust spatially explicit assessments of key indicators.

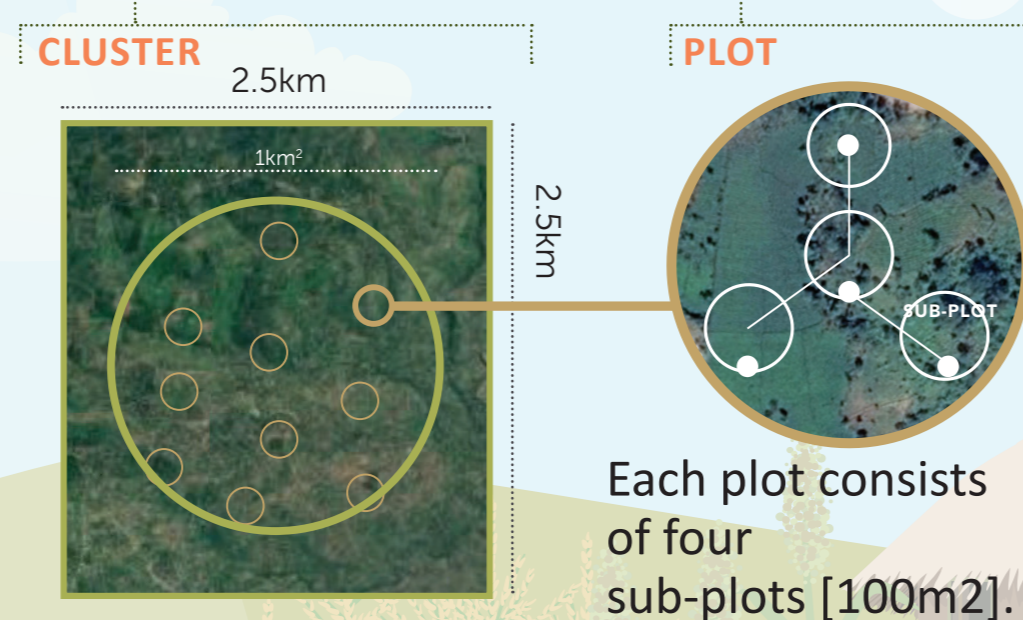


Systematic field sampling - using the LDSF



Assessing soil and ecosystem health using data collected using the Land Degradation Surveillance Framework (LDSF)

The LDSF uses a nested sampling design to monitor key soil and land health indicators. Each site is 100 km², with 160-1000m² sampling plots.



Citizen science using the Regreening App



Geo-referenced data tracking implementation of land restoration activities on the ground using the Regreening App.

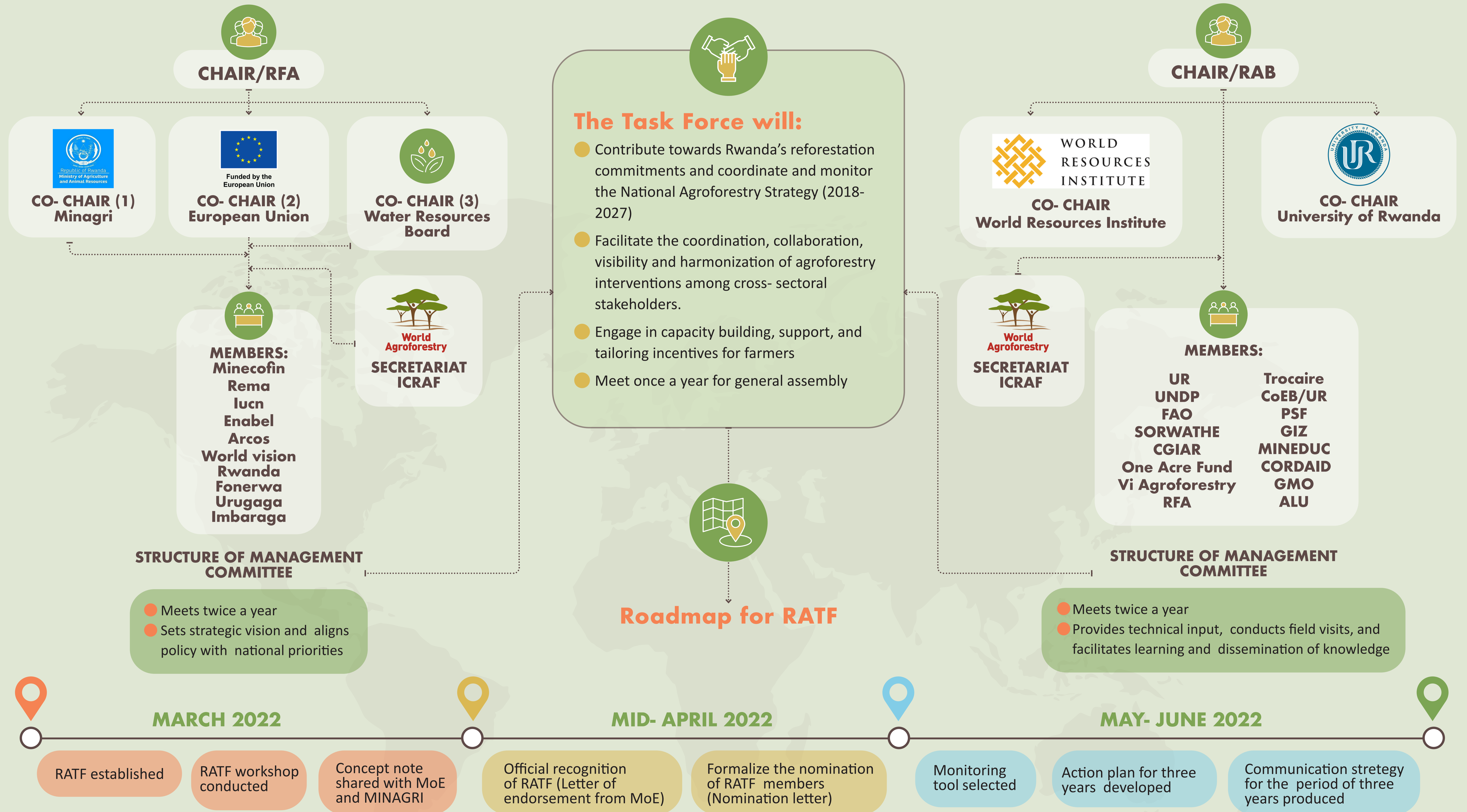


Engaging stakeholders in data collection - to track interventions and their impact

Interactive dashboards to review multiple sources of evidence for decision making



ESTABLISHMENT OF RWANDA AGROFORESTRY TASKFORCE



THE REGREENING AFRICA APP

Citizen Science for Tracking Land Restoration

The Regreening Africa App is a free mobile-based Android application designed and developed by World Agroforestry (ICRAF), to help partners and users collect information on how farmers are managing and protecting trees on their farms.



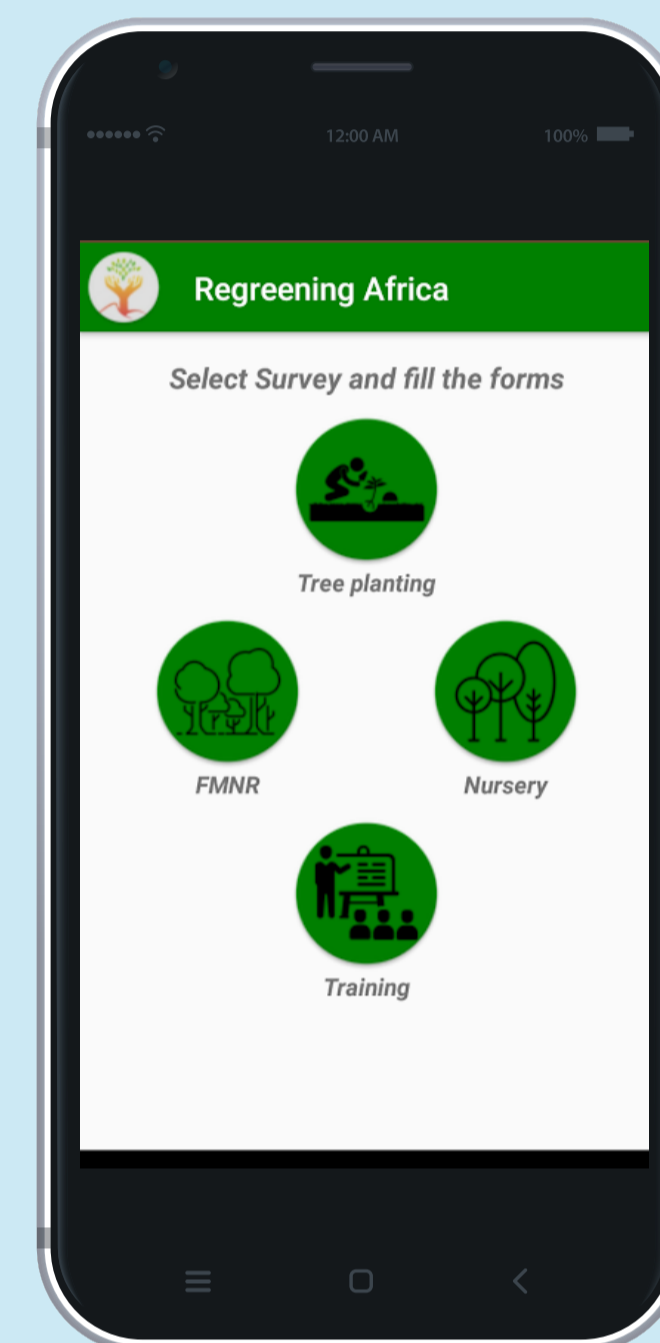
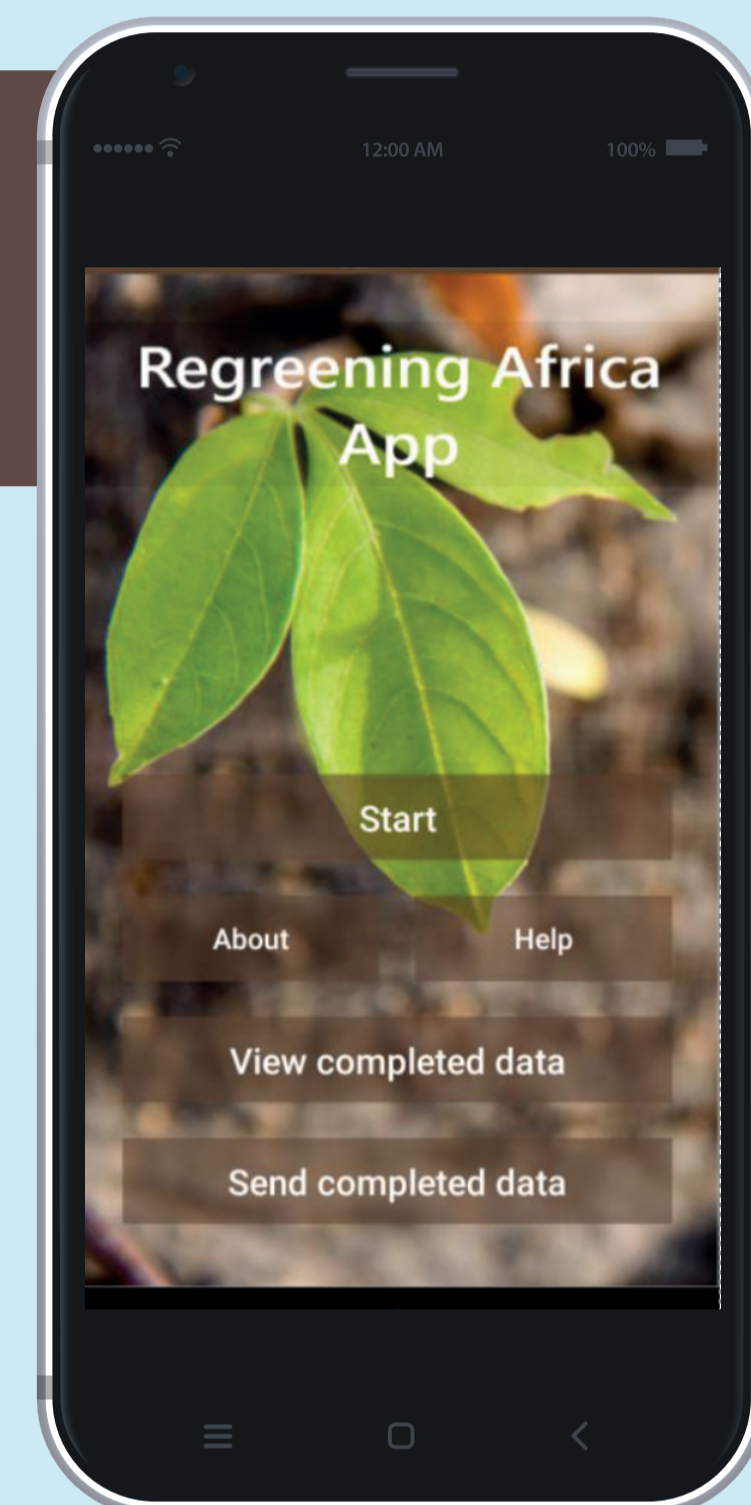
Regreening Africa App has four modules

 **TREE PLANTING MODULE**

 **FARMER MANAGED NATURAL REGENERATION (FMNR) MODULE**

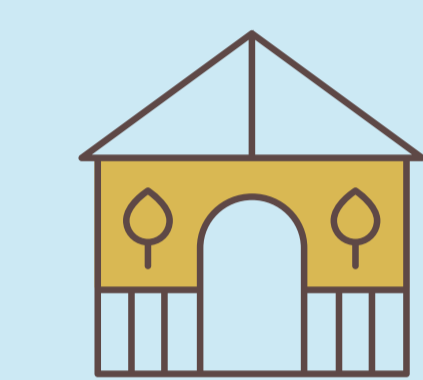
 **NURSERY MODULE**

 **TRAINING MODULE**

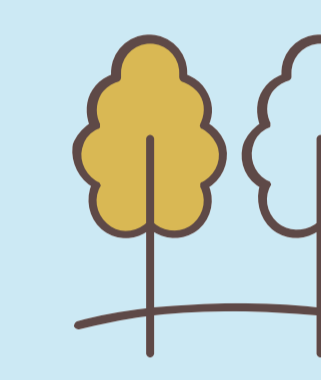


 **68 youth** were trained on the App and collected data

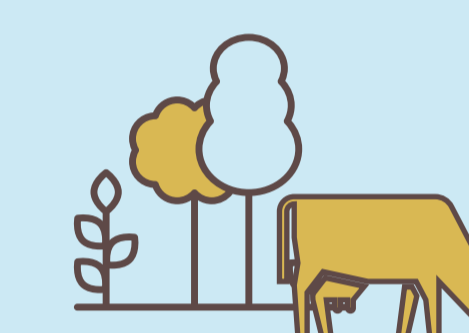
 Partners wish to **continue using the App beyond the project**



26 378
Total Households
*Total farmer/ group/institution surveyed



68 891
Total Trees
*Individual trees surveyed



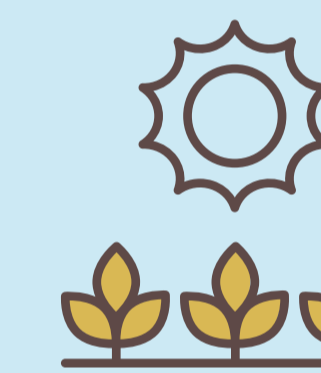
4
Total FMNR Plots
*Total FMNR plots surveyed



68 891
Total Nurseries
*No. of nurseries recorded



28 465
Total TP Plots
*Total Tree Planting plots surveyed



75 627
Total Area (ha)
*Total area under restoration

MAIN SPECIES IN TREE PLANTING



G. Robusta
Silky Oak, Giriveriya



Eucalyptus spp.
Eucalyptus



S. betaceum
Tree Tomato, Ibinomoro



E. camaldulensis
Red River Gum



S. spectabilis
Ikasiya



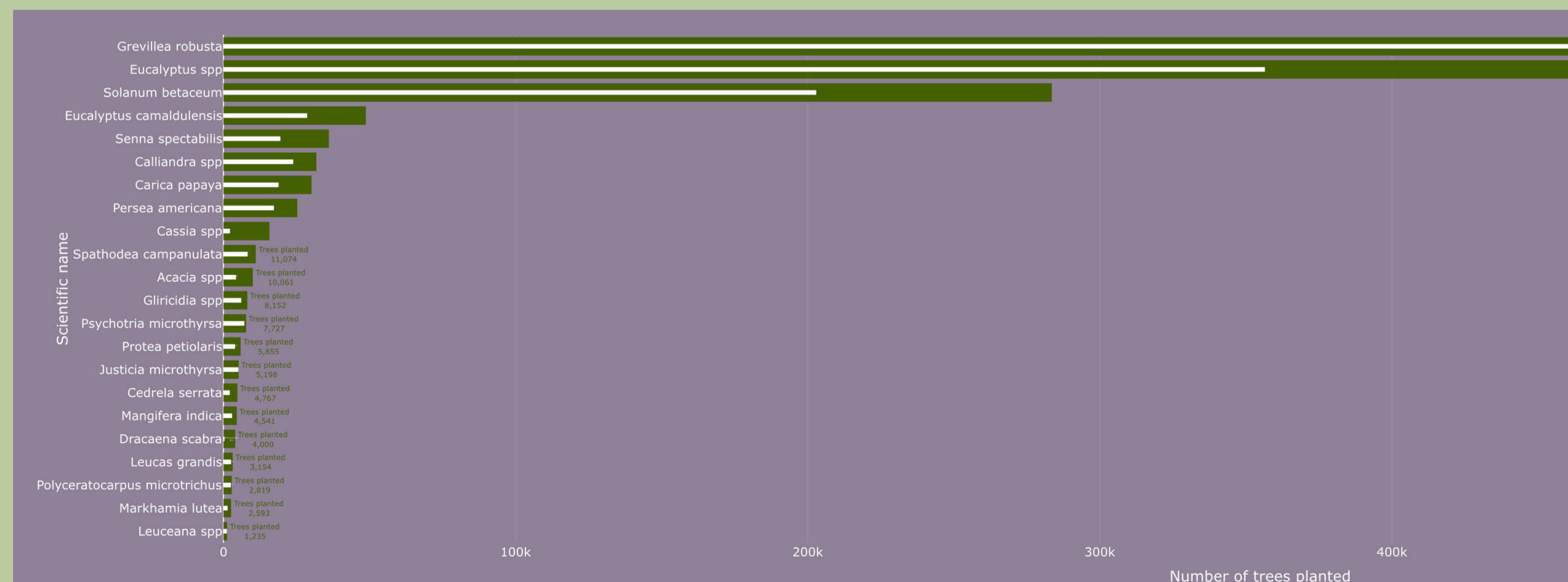
Calliandra spp.
Powder Puff, Kariyandara



C. papaya
Papaya, Ipapayi

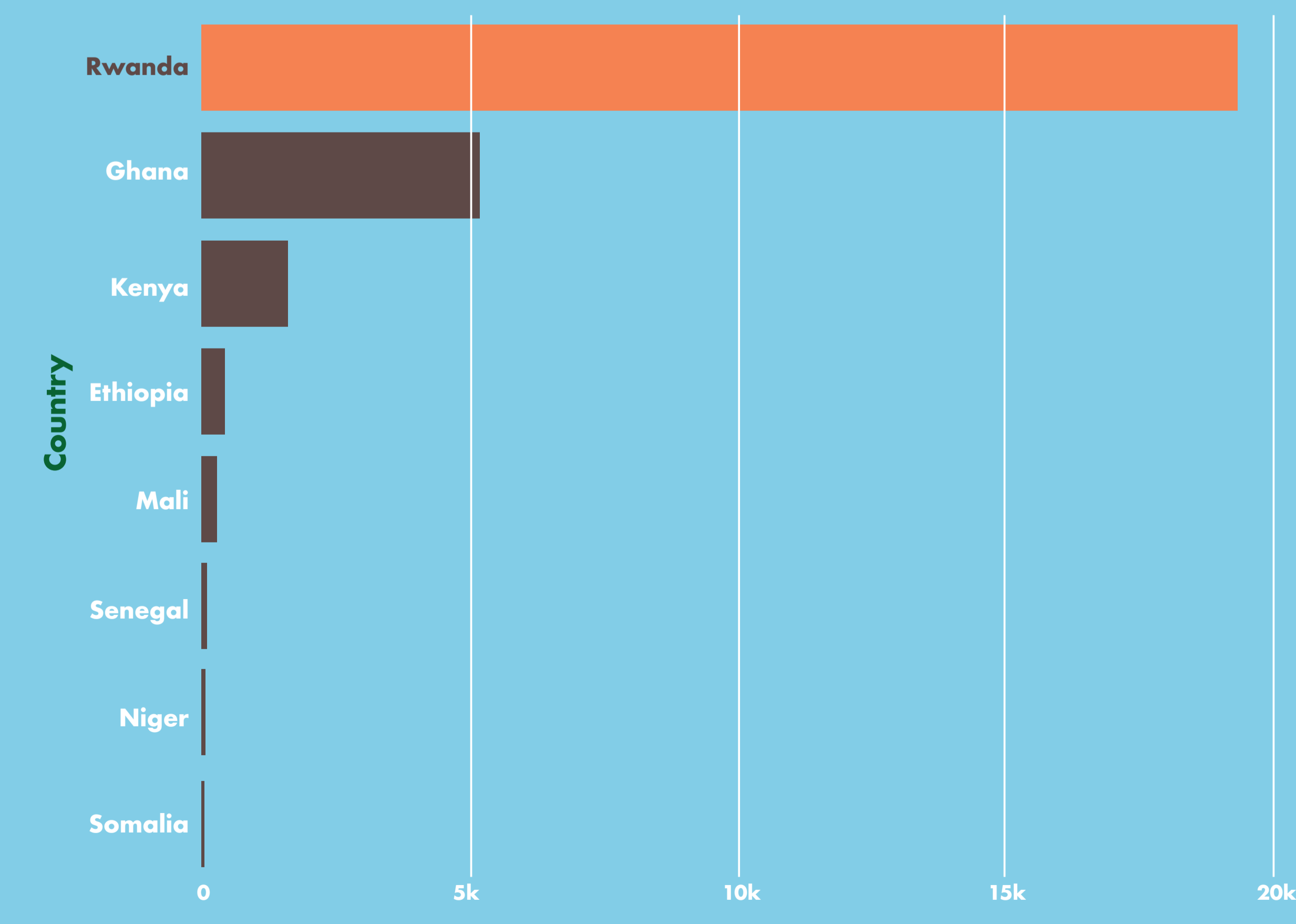


P. americana
Avocado, Avoka



FARMERS USING APP FOR TREE PLANTING

Tree planting module - number of farmers



COMMUNITY VOICES



“ I never thought that tree planting would yield such huge returns. Apart from land restoration, I am now convinced that agroforestry trees and fruit trees are a source of food and money. I am investing most of my efforts in expanding tree tomato farming.”

Bugenimana Damien, farmer in Kayonza District

LIVELIHOODS

This project benefited us highly, through savings from the small amount I received from nursery work I was able to buy 2 goats which later led me to a bull, I sold the bull at 400,000 RwF and bought a house.”

Ngenzi Vianey, Bugesera District

“ You cannot be our cooperative member and not afford a goat in your household. Our members are paid 2000 Frw per day. We have started planning to assist our members save for the future.”

Cooperative leader. Nshogoza Didace, 45 years old

“ We encourage farmers to plant fruit trees for them to have healthy children. When they sell firewood, they afford health insurance on time.... All you need to do is to show them an example. I have 125 trees in my farm while I have 3 avocado's, 15 mandeleine, 28 oranges, 2 mangoes in my homestead.”

Mukashyaka Coletha, 60 years old, lead farmer in Kayonza

“

My future plan is to produce enough fruits so I can invest in fruit processing and juice making.”

Kanusu Pierre, Fruit tree farmer in Gatsibo



“

Three years ago, I received training from World Vision on tree nursery establishment and management. Thanks to the quality of tree seedlings provided, which included early maturing fruit trees, my life has gradually improved. Money that was hard to come by is no longer the case, as school fees for my children is always paid on time. I can even afford to pay labourers to cultivate my farm.”

Murekatete Patricia, farmer in Nyagatare District.

“

I planted the trees and the neighbors laughed at me, but in the summer the neighbors came and asked me for hay.”

Harelimana Theoneste

“

Many women used to think that nurseries were for men, but now their attitude has changed.”

- Louise

“

You cannot be our cooperative member and not afford a goat in your household. Our members are paid 2000 Frw per day. We have started planning to assist our members save for the future.”

Cooperative leader. Nshogoza Didace, 45 years old



CHANGING PERSPECTIVES AND TRAINING

“

We will not stop doing tree seedlings production because we have been given all the training and we received many benefits out of it.”

Aimble Ngendahayo, Nyagatare District

I think we have some knowledge on agroforestry and tree management. We would like to have exposure to more practical or field exchange visits to learn from early adopters in other areas.”

Bazimaziki Jackline, female lead farmer in Mimuri sector, Nyagatare District.

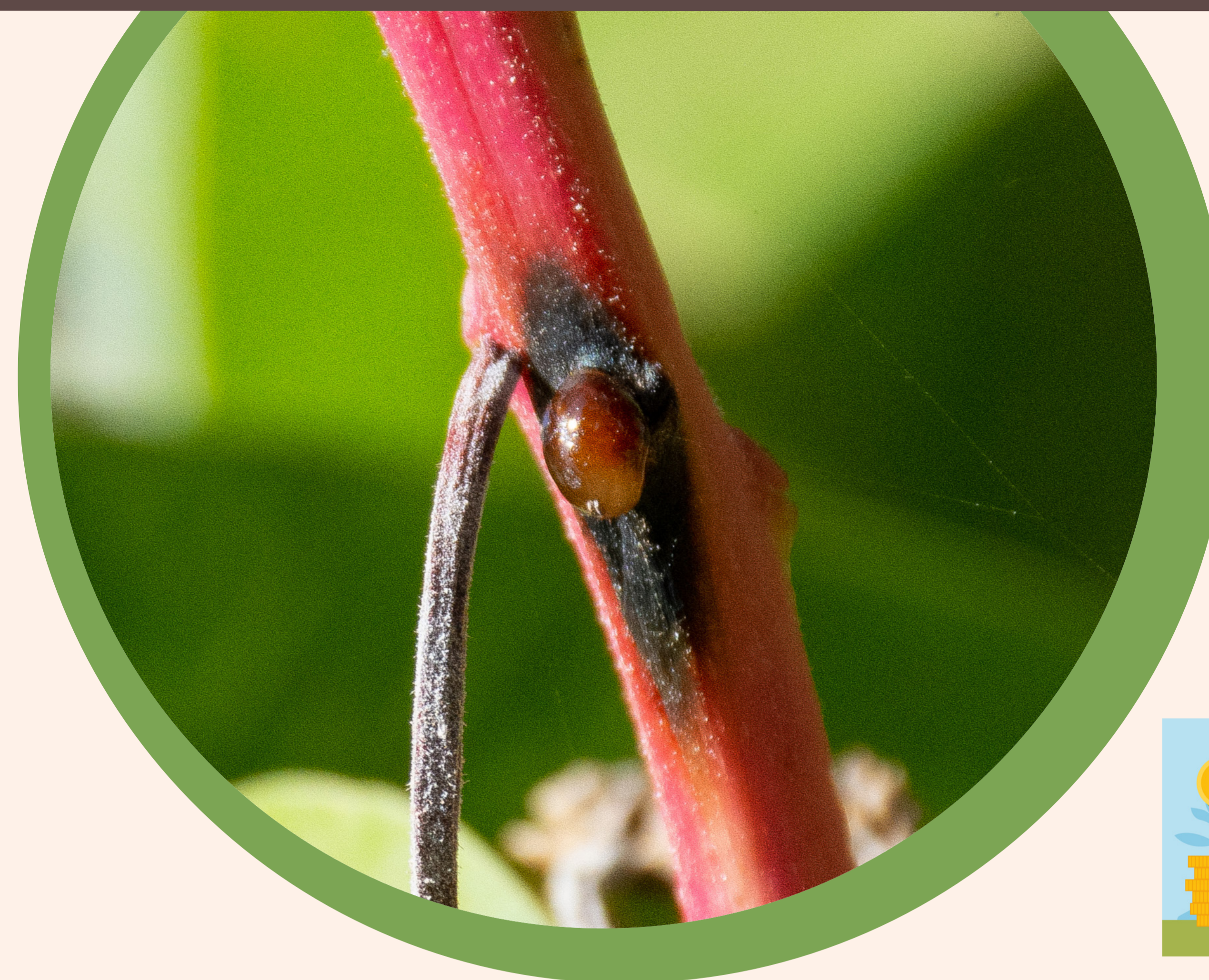


TREE PESTS AND DISEASES:

A CRISIS FOR AGROFORESTRY-BASED RESTORATION IN RWANDA

Background information

- In 2011, Rwanda committed to restoring 2 million hectares of degraded and deforested land in a global effort by 2030 — it seemed like a daunting task.
- By 2018, Rwanda, along with South Korea, Costa Rica, Pakistan, and China, was regarded one of the leading countries in the world with its successful restoration program.
- In line with national targets, the RA project has similar ambitious goals of restoring & transforming degraded ecosystems.
- The realization of this goal is through tree planting and FMNR. Tree planting is the main approach, and a large amount of high-quality germplasm is required!
- Multiple tree species are being promoted, but farmers have a strong preference for exotic species including food tree species e.g mango, avocado, citrus spp, and tree tomato- for financial and food reasons.



Design Technical Implementation (DTI) intervention

Capacity building of:

- ToTs (WVR technical team and cooperative leads) in partnership with RAB- Rwanda Agriculture Board, ICRAF GHU- ICRAF Germplasm Health Unit, RFA-NTSC-Rwanda water and Forest Authority (RFA) National Tree Seed Centre (NTSC), with aim to understand the impact, identification and mitigation tree pest and diseases.
- ToTs (WVR technical team and cooperatives leads) in partnership with RFA-NTSC on quality seed sourcing and procurement, with aim of quality sourcing of germplasm and linkages to local seed center
- Field Visit to fruits orchards for pest and disease assessment and discussion with farmers.
- From 2 trainings, 19 ToTs have been trained, such trainings will be replicated to increase knowledge through multiplier effect

Despite strong background in restoration program, major challenges

- Availability of diverse tree species seeds is limited, posing the risk of restoration based only on a handful of species.
- Recent outbreaks of native and non-native pests and diseases affecting trees, more on fruit trees, jeopardize restoration efforts and pose a threat to livelihoods and food security.

This is expected to worsen due to climate change, increased trade, porous borders, poor quality germplasm, human movement & intensified agriculture to meet food and cash demands of a growing population

Joint efforts are needed, regionally and nationally to build capacity to combat this menace



Some of pests and diseases observed on farms

- Native and non-native pests and disease with wide host range were observed on farms.
- Some of pests and diseases observed threatening main trees species on farms include:
 - ◆ Mealybugs on *Markhamia lutea*, *Mangifera indica* and *Citrus spp.*
 - ◆ Aphids on citrus spp and tree tomato
 - ◆ Fruit fly and scale insects on mango
 - ◆ Canker and termite damage on *Grevillea robusta*
 - ◆ Mosaic virus on cassava and tree tomato
 - ◆ Anthracnose on mango and tree tomato
 - ◆ Scab disease on Avocado
 - ◆ From lit review, there is occurrence of bio invasions of bronze bug and eucalyptus gall wasp on eucalypts.

Pest and disease observed on farms



Mango with mealybugs



Larva of citrus butterfly feeding on citrus leaves



Anthracnose on Tamarillo



Mango fruit damage by fruit fly



Whiteflies on Tamarillo leaves



Scale insects on Mango fruit



Some of root causes for the pests not controlled

Different ways pests spread

Poor farm management

Poor quality planting material

Lack of collective action

Climate change

- Spread of new pests e.g mealy bug and mosaic viruses- Spread through markets and material exchange
- Outbreaks going unnoticed due pest have multiple hosts
- Limited knowledge of pest management solutions
- Farmers do not follow advice
- Lack of practical solutions
- Counterfeit chemicals
- Poor soil fertility, nutrient management and tree management
- Misuse of chemical and over-reliance on one chemical over time
- Seeds and other vegetative material spread of mosaic virus in tree tomato could be attributed to sharing of diseased planting material
- An effective management of some pests requires concerted effort and collective action

Grevillea robusta



Resinous canker



Termite damage on bark



What are key gaps?

- Knowledge gap on pesticide use
- Insufficient surveillance and pest risk assessment
- Lack of baseline studies on impact of pest and diseases
- Lack of incorporation of tree health strategy in restoration programs
- Insufficient information on current status of trees health,
- Outbreaks going unnoticed
- Low uptake of IPM
- Poor quality planting material
- Poor farm management
- Difficulty recognizing pest and disease
- Undocumented pest of indigenous trees
- Lack of collective action in management



Recommendations

- Document pests and diseases of Agroforestry trees and develop mitigation strategies
- Promotion of sustainable models to reach out to farmers with pest and disease management services
- Strengthen the capacity of agriculture extension services
- Introduction of cost-efficient information systems to detect and monitor pests and disease
- Enhancing linkages with relevant government agencies e.g. RAB, CABI, ICIPE
- Incorporate tree health in tree-based strategies
- Collaborate and partner with other pest management initiatives
- Training and capacity building

KEY INTERVENTIONS AGAINST LAND DEGRADATION

Tree Biomass Incorporation

- Use of fertilizer trees, e.g. *Gliricidia sepium*, *Calliandra calothyrsus*, *Leucaena diversifolia*, *Senna spp*
- Improves soil fertility, soil organic carbon, soil water storage

Regreening App

- Important tool to monitor and visualize trees planted
- Promotes citizen science and local ownership of initiative

Tree Management

- Pruning and Coppicing to reduce competition
- Weeding
- Manuring

FMNR

- Promoting indigenous species and management
- Provides livestock shade, fodder, timber, and firewood while restoring landscapes

Tree planting

- Saplings of *Grevillea robusta*, *Eucalyptus*, and *Solanum betaceum* most common
- Used for fruit, fodder and other non-timber product value chains, and are commonly planted as boundaries, along roads, among crops, or within home gardens for household

Nurseries and Rural Resource Centers (RRCs)

- Tree nursery cooperatives are playing an important role in producing seedlings in communities for improved tree planting outputs and scaling
- 4 RRCs were established to demonstrate and disseminate technical knowledge and improved planting materials, as well as provide training in entrepreneurship and value chains

LESSONS LEARNED AND LONG-TERM CHALLENGES



Finance and Financial Incentives

- Access to starting capital and building entrepreneurial skills key to encouraging adoption of agroforestry
- Aggregating producers into groups provides support, connections, and an avenue for training
- Rural households will take up agroforestry if benefits and infrastructure of value chains are clear
- To promote tree-based value chains, tree nurseries should be managed to generate income and become sustainable



Tree Diversity and Quality

- Must shift from centralized distribution of fast-growing exotic species seeds (especially Eucalyptus) to diversified, high-value, locally-appropriate native species
- Farmers should be encouraged to practice FMNR
- Mixed quality of seeds distributed for producing fruit and other agroforestry products limits agroforestry adoption and success
- Challenges of responding to pests and disease across tree species requiring research and training



Adoption Bottlenecks

- Agricultural dependence on rainwater discourages irrigating or watering trees in dry season, limiting tree survival rate
- Small farm sizes, fear of trees negatively affecting crops
- Limited access to quality germplasm, especially due to free seedling distribution
- Value chains for most agroforestry products insufficient



Environmental Factors

- Constraints to successful tree growth included droughts, pests/diseases, inappropriate seeds for local realities, and COVID-19 restrictions
- The advisory and research capacity of ICRAF provided improved, resilient tree varieties
- Improved nursery production led to higher survival rates



Sector Neglect

- Previous lack of recognition or emphasis of agroforestry in national policy and development projects
- Lack of alignment between forestry, agriculture, and environmental policies and laws leads to gray area of tree product usage for farmers
- Gap in policy to promote planting trees on-farm and FMNR in rangelands
- To integrate agroforestry more broadly, World Vision Rwanda livelihoods projects should incorporate evergreen agriculture into their plans and implementation



Local Ownership

- Training materials should be translated into Kinyarwanda
- Local collectives and businesses producing seedlings enhances value chains; a major challenge to their growth is that seedlings are being given out for free
- Bottom-up decision making best for long-term sustainability



KEY OUTCOME CHALLENGES

MAIN SUCCESSES



Strong Technical Capacity

- Programming, training, field visits enhance capacity of government experts, development agents, and beneficiaries
- Focus on lead farmer training (512 lead farmers)



Successful Uptake Practices

- Lead Farmers
- Annual community tree planting days (Umuganda)
- Media (radio, TV, newsletters)
- Joint Action Forums (held monthly at district level, including all development partners and seeking mayoral approval of decisions)



Policy and Government Agency Support

- Formulation of National Agroforestry Strategy to meet landscape restoration goals
- Taskforce on Agroforestry involving multiple government ministries, NGOs, cooperatives, private forestry sector



Suitability of Agroforestry Practices

- **Tree planting** works best to restore rangelands and provide timber, fodder, and additional income
- **FMNR** provides benefits in farmland for ecosystem and soil health, additional value through firewood and timber
- **Fruit Orchards** established with female beneficiaries provide enhanced household nutrition and income source



Sustained Movement with National Uptake

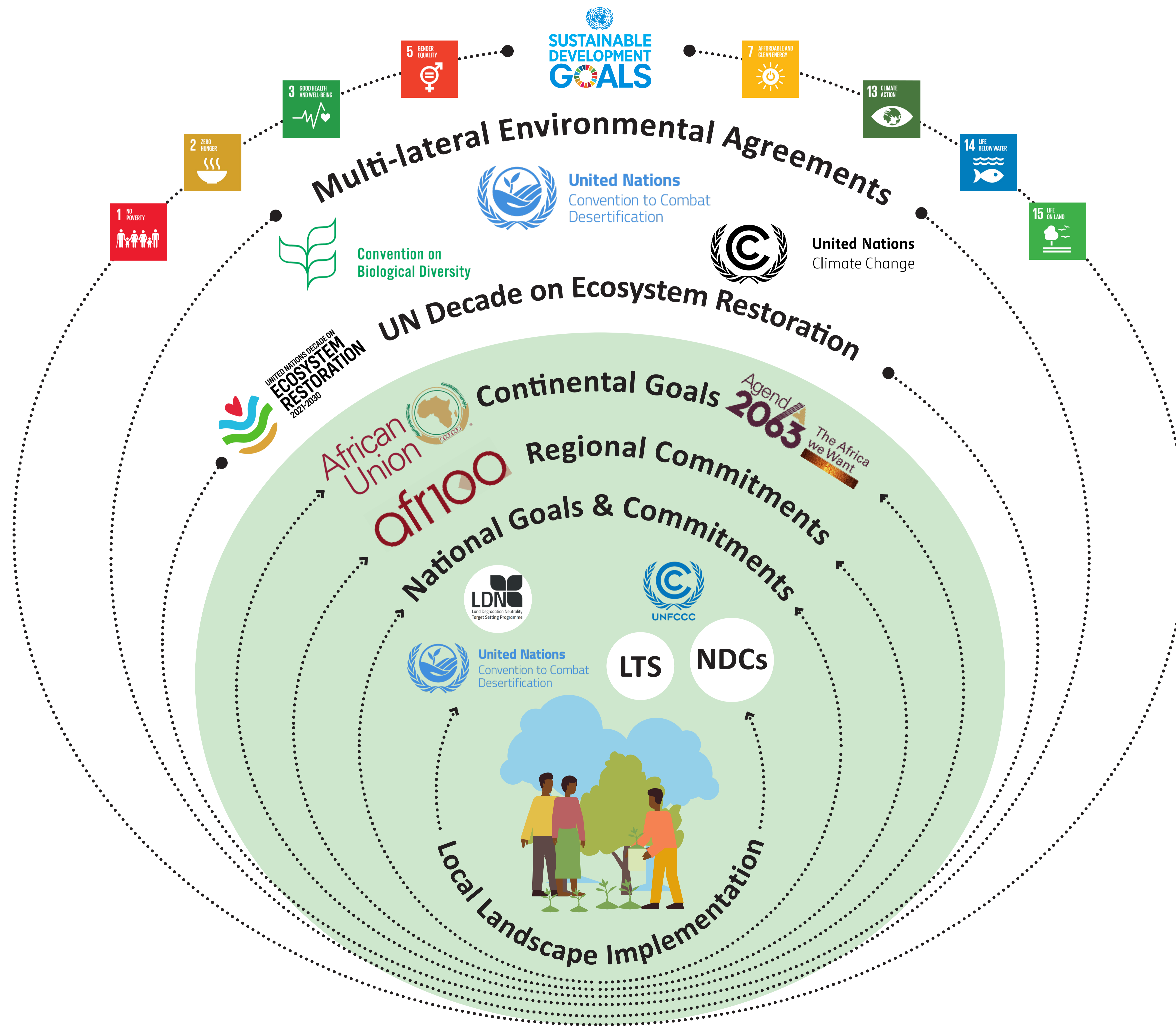
- Coalition of international and national NGOs, government ministries, research institutions, civil society organizations
- Collaboration with government has benefited ambitious national reforestation targets and increased support of agroforestry



Mindset Change

- Participatory approach with Lead Farmers
- Strengthened Savings for Transformation Groups
- Farmers have begun practicing biomass incorporation to increase soil organic carbon with fertilizer trees
- Many farmers adopting on-farm trees like G. Robusta for timber
- Fruit trees for consumption enhances diets, reduces malnutrition
- Ownership of Regreening practices by Government of Rwanda, embedding Regreening into contract performance agreements between mayors and president

NESTED GOALS AND TARGETS



NUTRITION



Papaya



Tree tomato



Mango

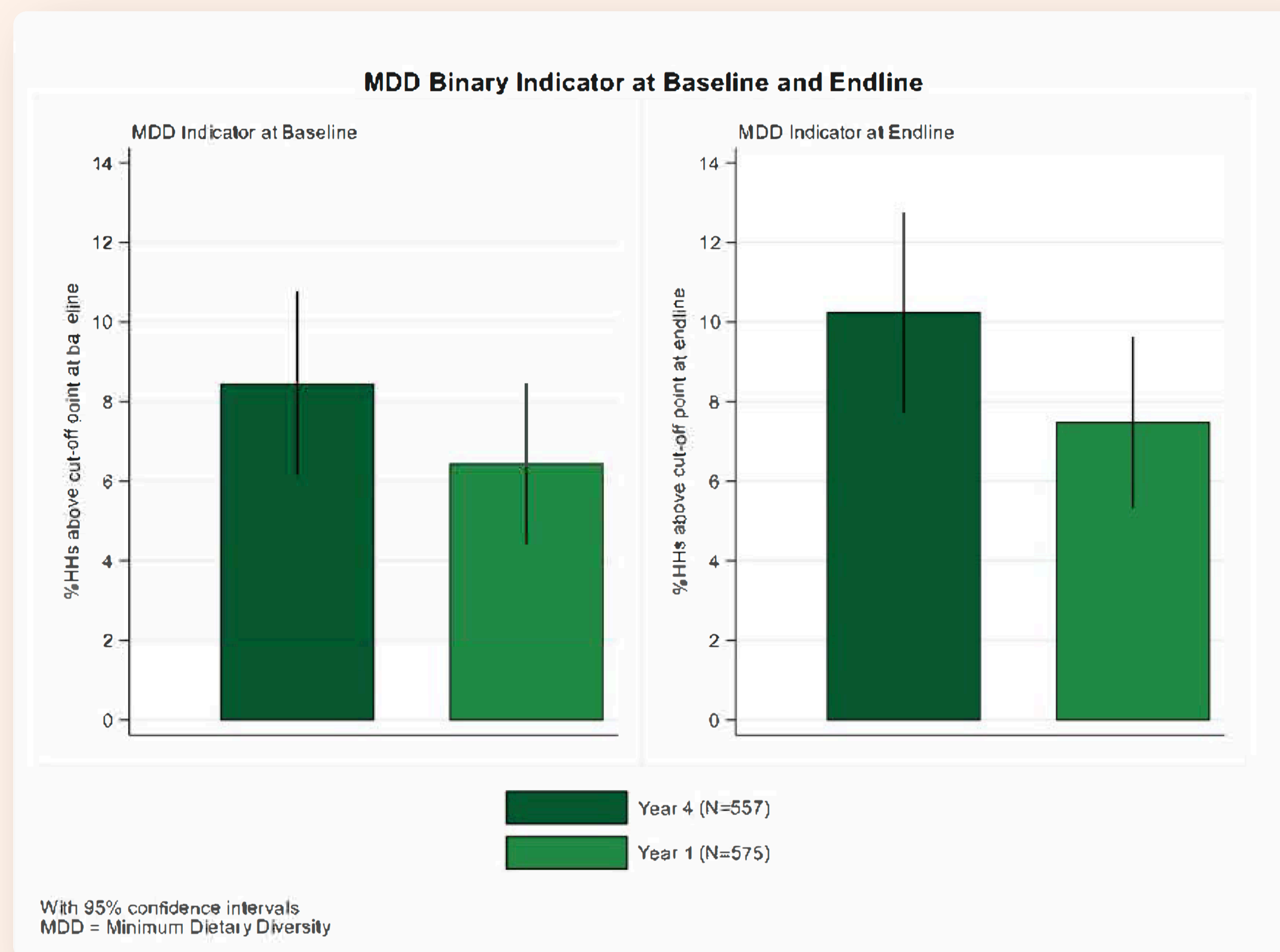


Avocado fruit,
Avocado oil

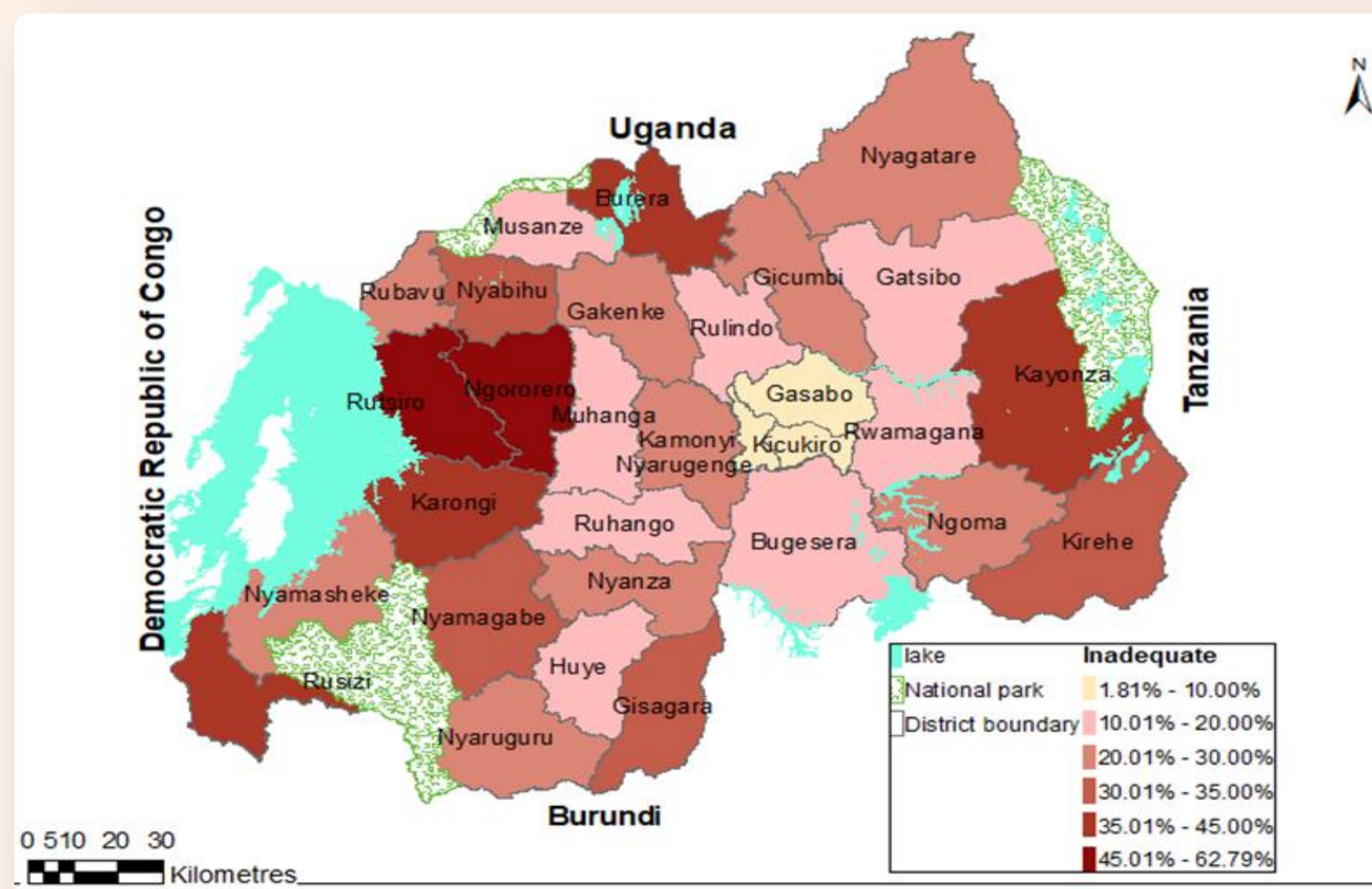


Growing Fruit Trees

- Especially in home gardens, fruit trees provide increased household nutrition along with income
- Popular species include tree tomato, mango, avocado, and pawpaw
- Consuming fruit to enhance diets and reduce malnutrition has been a critical mindset change, as previously all fruit was sold at markets



Across the program, an increase in household Minimum Dietary Diversity (MOD) has been observed

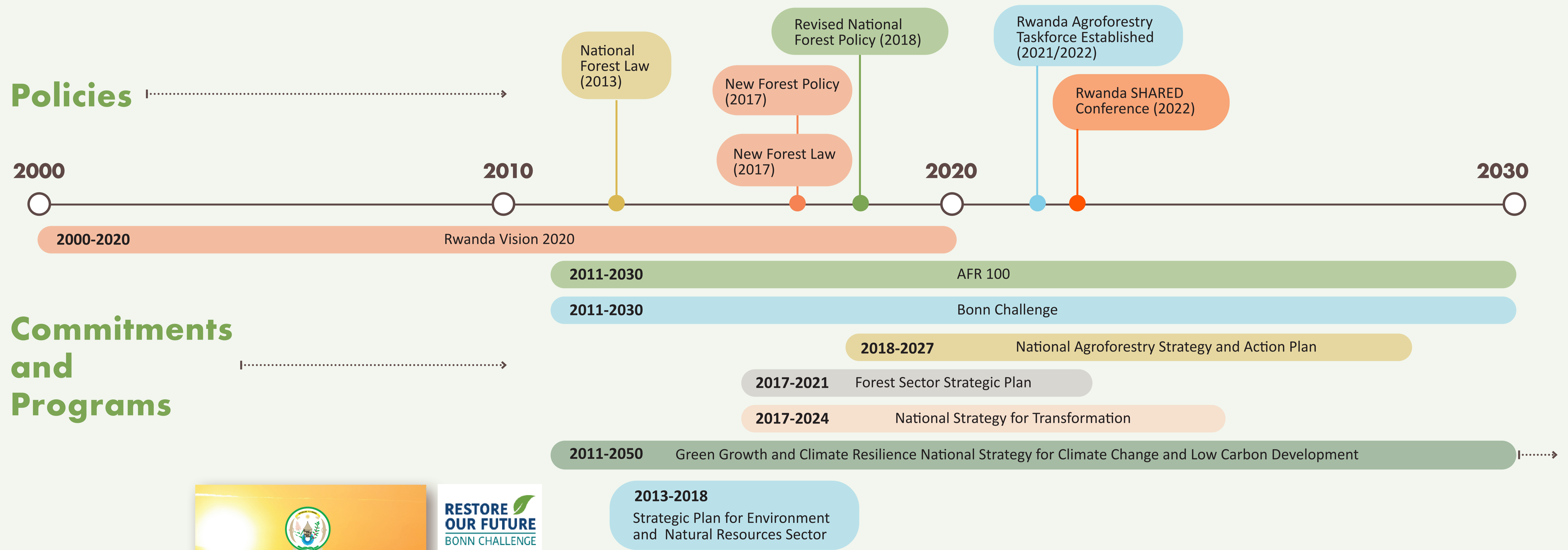


Inadequate food consumption in Rwanda by district in 2018
Source: Comprehensive Food Security and Vulnerability Analysis (WFP, 2018)

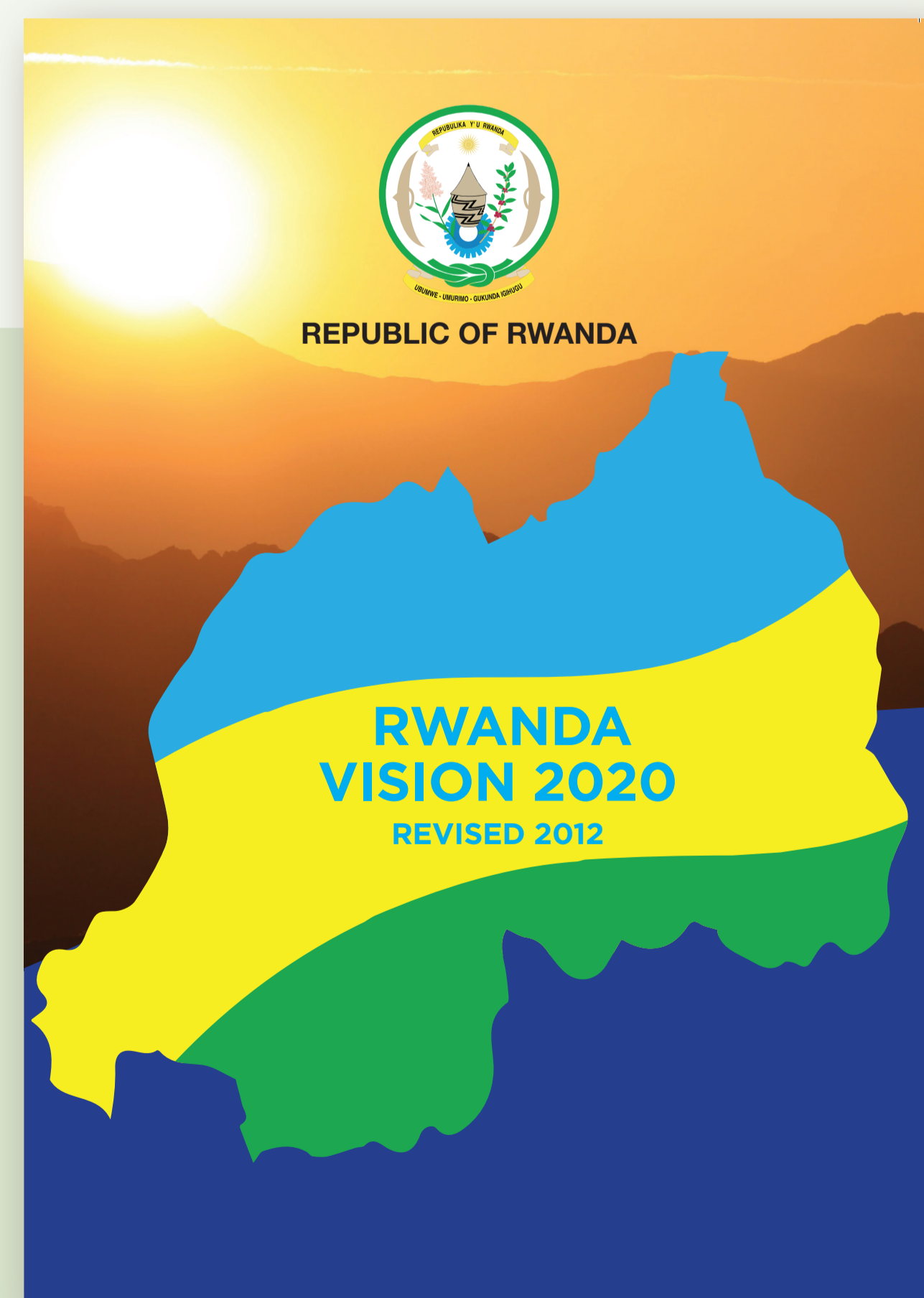
Food insecurity and malnutrition have been challenges in Rwanda, with program districts like Kayonza and Nyagatare having high rates, shown in this map from 2018 around start of program

POLICY AND PLANNING ENVIRONMENT

Steps towards Sustained, Nationwide Restoration Movement



Commitments and Programs



- **Bonn Challenge/ AFR 100 (2011-2030)** - Bring 2 million ha deforested and degraded land into restoration -- highest proportion of land committed by any country
- **Rwanda Vision 2020 (2000-2020)** - rev. 2012, halt and reverse environmental degradation, includes agroforestry as contributor to sustained development of intensified, productive agriculture, private sector based rural economy, value chains
- **Agroforestry Strategy and Action Plan (2018-2027)** - promoting leadership, synergies, coordinated action to adopt agroforestry tech at scale to enhance agricultural landscapes, watersheds, rural communities; includes Agroforestry Task Force led by Dr. Athanase Mukuralinda
- **National Strategy for Transformation (2017-2024)** - double agroforestry coverage from 6 to 12% by 2024. Translates SDGs to national targets. "The Rwanda we want" 2050.
- **Revised National Forest Policy (2018)** - country- wide forest cover 30% by 2020, woody biomass reduced to 50% of national energy consumption, 10.25% country protected areas
- **National Forest Law (2013)** - New Forest Policy (2017), Forest Investment Plan (2017) all support wide- scale promotion of agroforestry. Many other national policies support AF, including environment, land, land use, and energy policies -- Green Growth and Climate Resilience National Strategy for Climate Change and Low Carbon Development (2011-2050) and Five Year Strategic Plan for the Environment and Natural Resources Sector (2014-2018) -- as well as environmental law
- **Forest Sector Strategic Plan (2017-2021)** - increase number of scattered trees on cropland and agroforestry areas to 50 trees/ha; developing and intensifying agroforestry techniques on all suitable lands, increase agroforestry in crop lands up to 85%

Regreening Africa fits into a larger Rwandan effort at land restoration, evidenced by ambitious national targets for reforestation and agroforestry and growing policy and legal support of agroforestry livelihoods

VALUE CHAINS

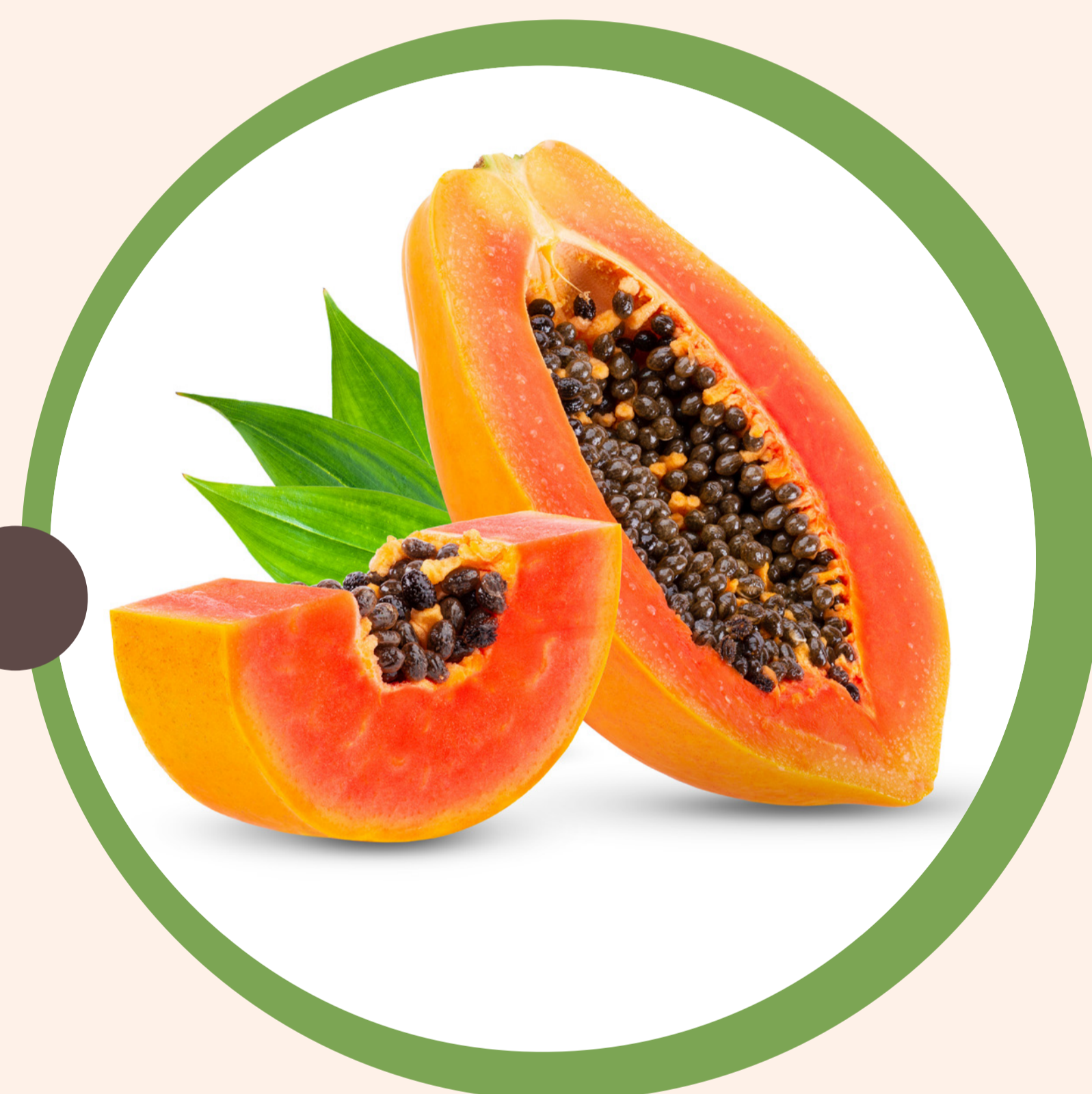


High value crops incentivize adopting regreening practices



Fruit is a natural choice:

- Household income from large domestic market
- Short- cycle agroforestry product -- fast- growing trees Enhanced household nutrition
- Favorable government policies ('Feeding the Cities' program)



Papaya



Tree tomato



Mango



Avocado fruit,
Avocado oil

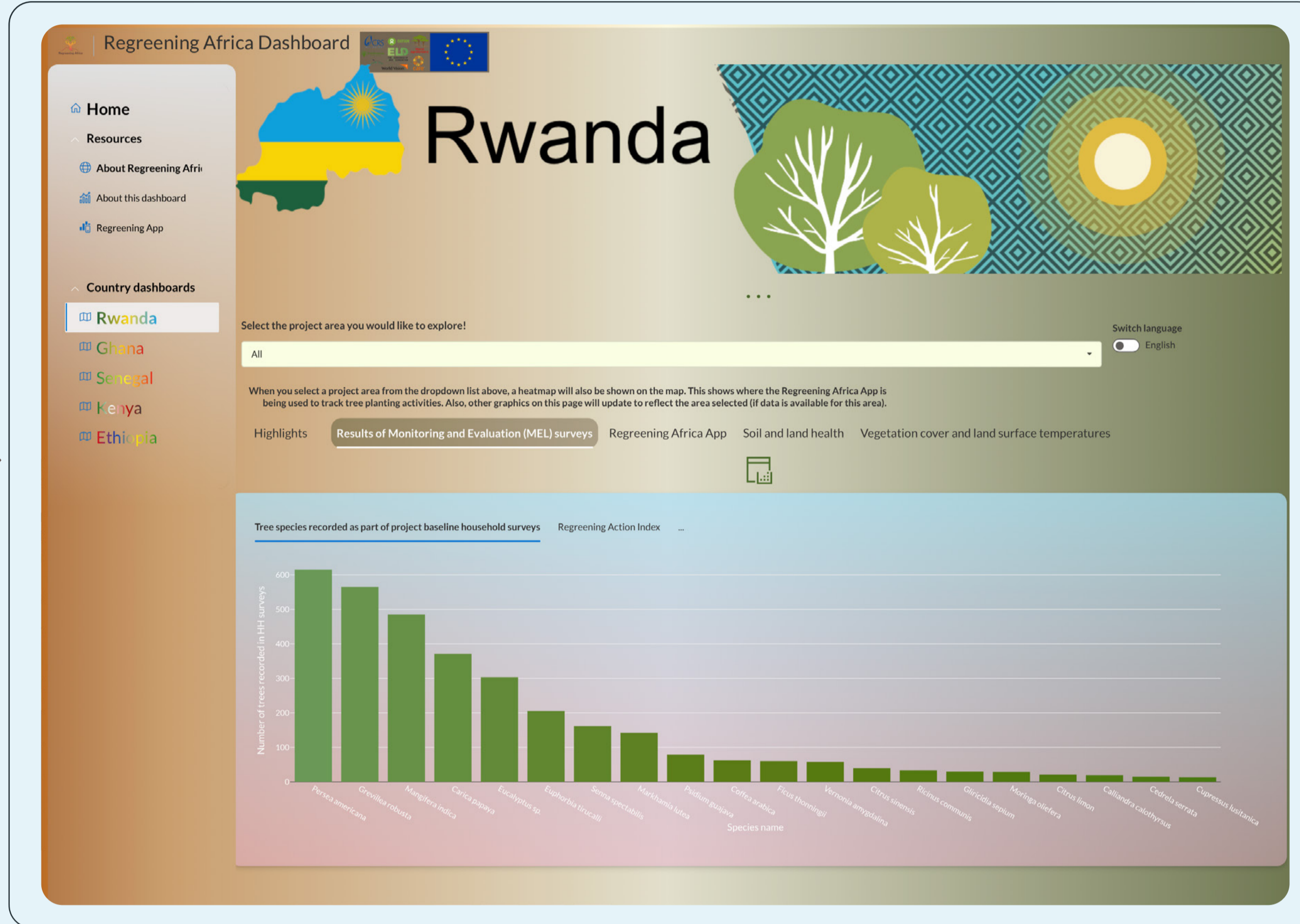


Program Support

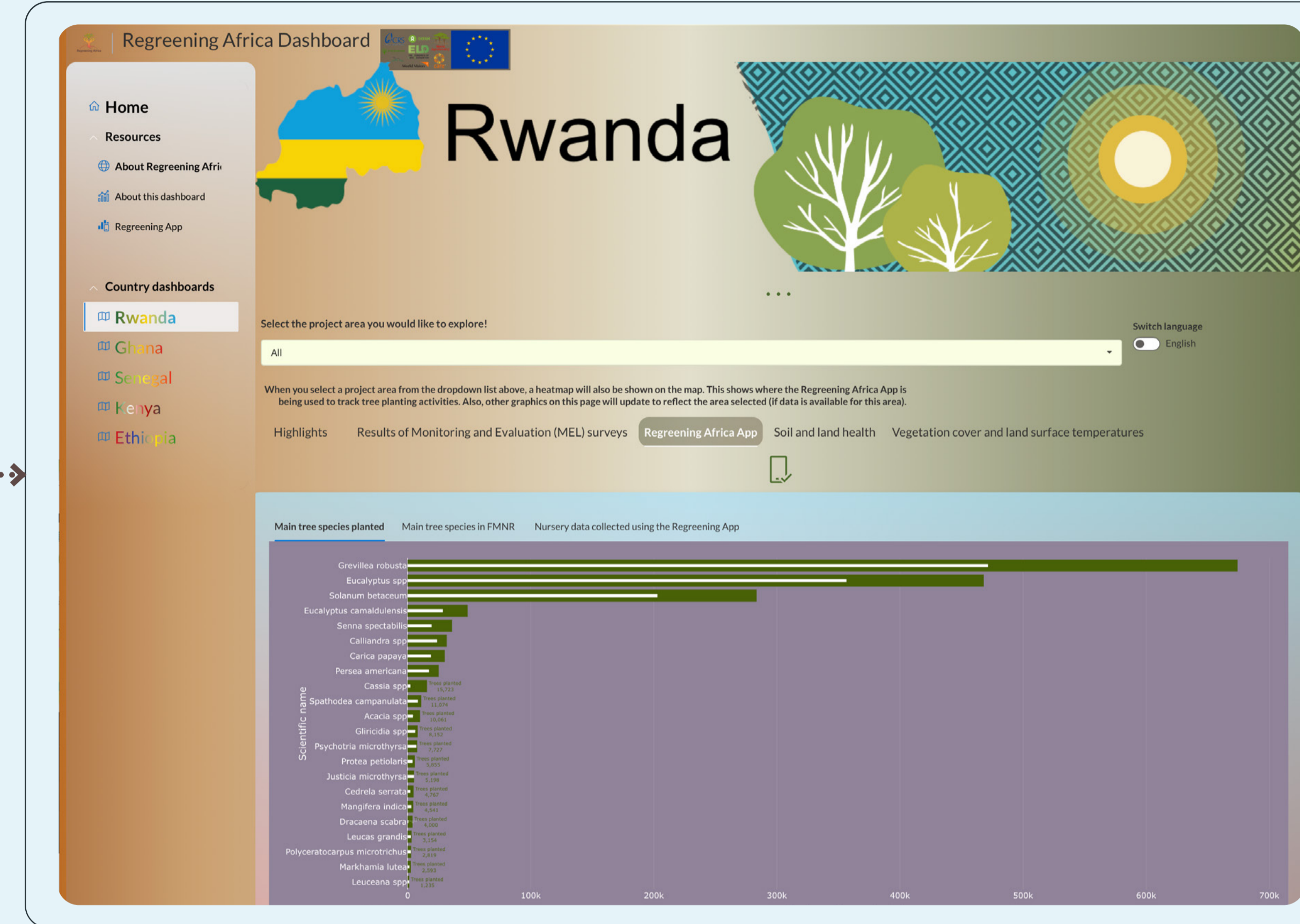
- Improved and disease/pest- resistant fruit varieties accelerated 64 farmer cooperatives and nurseries engaged
- 16 beekeeping collectives identified across the four districts and supported in integrating trees in their practice



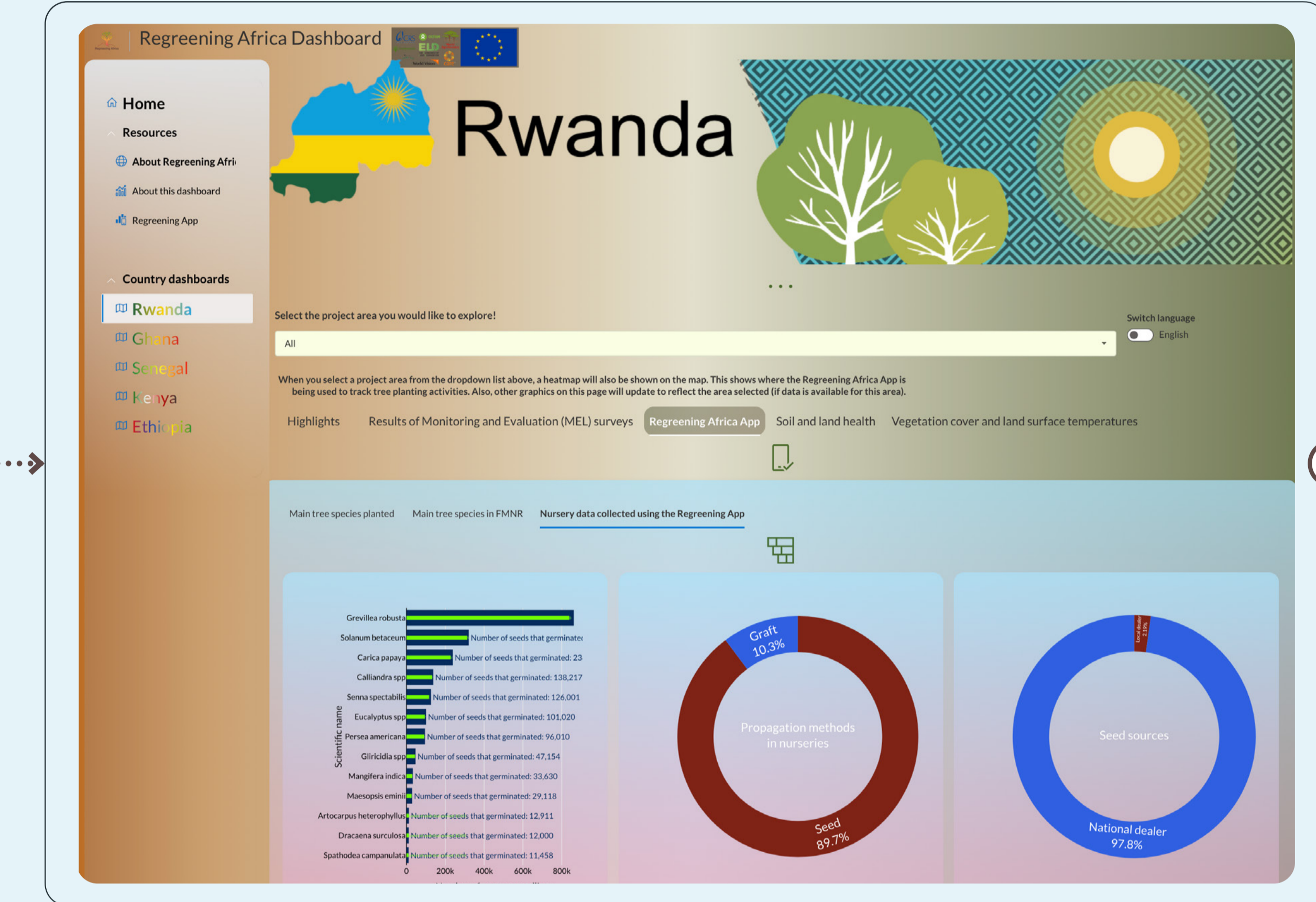
RESULTS OF MONITORING AND EVALUATION (MEL) SURVEYS



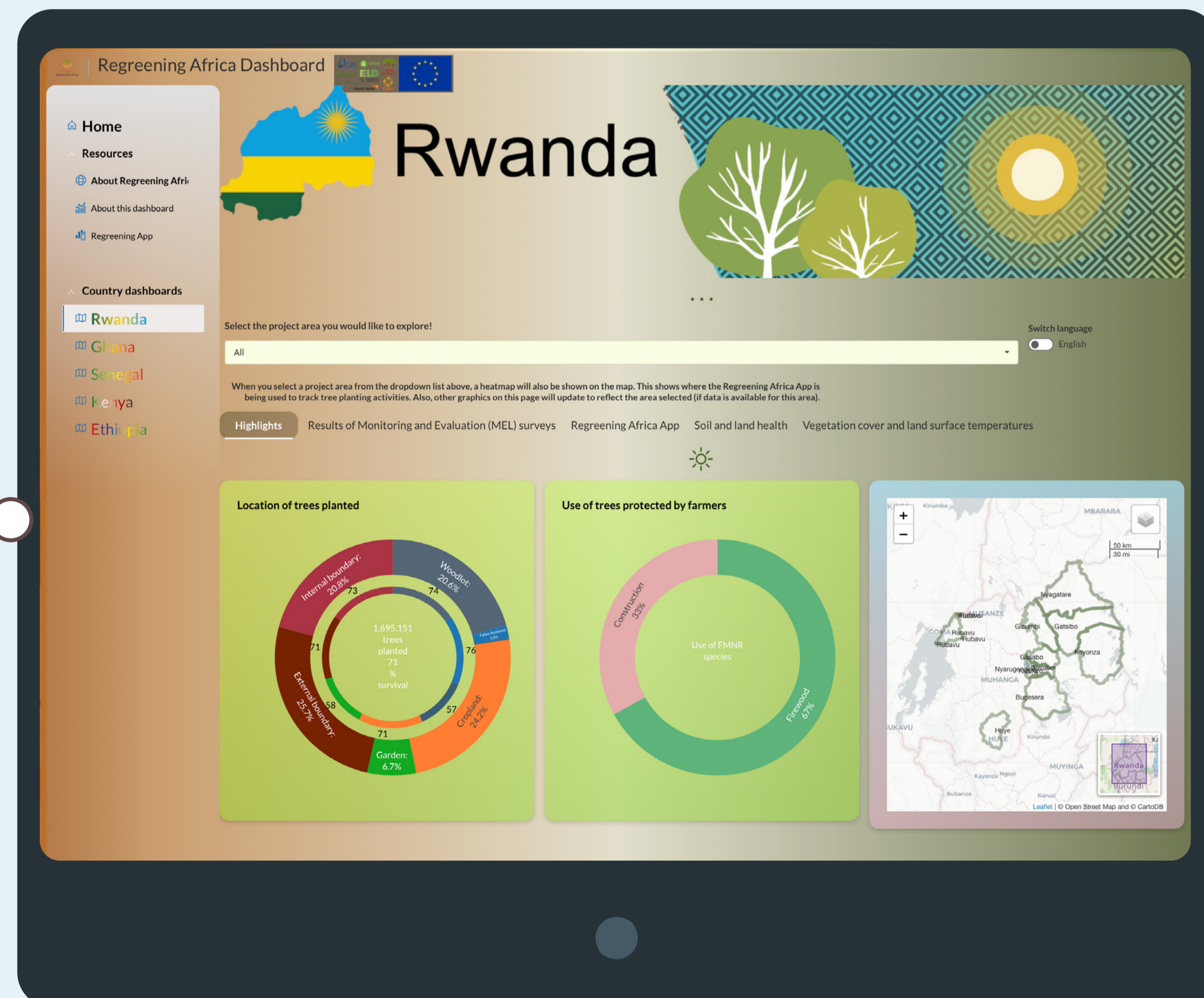
REGREENING AFRICA APP



REGREENING AFRICA APP



PROJECT HIGHLIGHTS



VEGETATION COVER AND LAND SURFACE TEMPERATURE



SOIL AND LAND HEALTH

