REPUBLIC OF RWANDA
RWANDA AGRICULTURE AND ANIMAL RESOURCES DEVELOPMENT BOARD (RAB)

Huye - Rwanda

RAB STRATEGIC PLAN

2020 - 2024

Rwanda Agriculture and Animal Resources Development Board (RAB), P.O. Box 138 Huye or 5016 Kigali-Rwanda,

infos@rab.gov.rw, www.rab.gov.rw

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LIST OF ACRONYMS AND ABBREVIATIONS

AGRA:	Alliance for Green Revolution in Africa
ASARECA:	Association for Strengthening Agricultural Research in East and Central Africa
AUDA:	African Union Development Agency
CAADP:	Comprehensive African Agriculture Development Program
CABI:	Centre for Agricultural and Biosciences International
CGIAR:	Consultative Group on International Agricultural Research
CIAT:	International Centre for Tropical Agriculture
CIMMYT:	International Maize and Wheat Improvement Centre
FAO:	Food and Agriculture Organization of the United Nations
FARA:	Forum for Agricultural Research in Africa
GDP:	Gross Domestic Product
HoReCo:	Horticulture in Reality Corporation
IRRI:	International Rice Research Institute
LODA:	Local Administrative Entities Development Agency
MCC:	Milk Collection Centre
MINAGRI:	Ministry of Agriculture and Animal Resources
NST:	National Strategy for Transformation
PSTA:	Strategic Plan for Agricultural Transformation
RAB:	Rwanda Agriculture and Animal Resources Development Board
RARICO:	Rwanda Animal Resources Improvement Cooperative
RYAF:	Rwanda Youth in Agri- business
SDGs:	Sustainable Development Goals
WTO:	World Trade Organisation

FOREWORD

National development targets of Vision 2020 and implementation of PSTA -1, PSTA-2 and PSTA-3 have led to steady growth of Agriculture and Livestock sectors which have grown by 5-7% yearly. The NST-1 has set the higher target to achieve 11% of national GDP growth and agriculture growth target of 8%. To achieve this ambitious goal, research and development efforts should strategically focus on the most promising and highly performing technology innovations and addressing the knowledge gaps in the most critical areas. The new RAB strategic plan lays the basis of sustainable agriculture and livestock sub-sector growth through innovations leading to achieve high productivity and quality of the agricultural produce.

The RAB Strategic Plan is tightly linked to the PSTA-4 and NST-1 with ambition to accelerate transformation and economic growth of the Agriculture and Livestock sub-sectors and improve the wealth and wellbeing of the Rwandan population. With this new Strategic plan, RAB will leverage innovative research and advisory service delivery to build up knowledge and skills in technology implementation and professionalize agricultural businesses to achieve maximization of productivity. This may be achieved through promoting digital innovations to enhance access to services and facilitating cross linkages within value chains, and strengthening collaboration and partnership among all stakeholders and building technological skills at all levels along the value chains.

Dr. Magnifique Ndambe Nzaramba

Board Chair, RAB Board of Directors

PREFACE

To achieve the development targets of the NST-1 and PSTA-4, RAB needs to streamline research innovations with strategic approaches to improve knowledge delivery, increase technology adoption, reach more beneficiaries and promote innovations helping to maximize productivity and profits, improve product quality and reduce post-harvest losses and make innovations sustainable in a long run.

Therefore, the new RAB Strategic plan 2020-2024 focuses on innovative research and advisory service delivery; sustainable agriculture intensification and development of climate resilient technological adaptations; agriculture commodity value chain and market development. This could be achieved along with strengthening organization capacities and resources through staff capacity building, effective resource management and development of efficient communication pathways within the institution and with development partners. The new RAB Strategic plan will operate for the period of 2020-2024 and contribute to the delivery of the national targets for agriculture and livestock as set in PSTA-4.

Patrick Karangwa (PhD)

Director General, RAB

EXECUTIVE SUMMARY

The Rwanda Agriculture and Animal Resources Development Board Strategic plan outlines the priority interventions and estimates required resources for the period of 2020-2024. This strategic plan is developed to align its interventions and operations with the PSTA 4, which is the agriculture sector's strategic document under Rwanda's National Strategy for Transformation. It builds on the achievements and successes of the previous strategic plan of 2013-2018, the current institutional reform into decentralized organs, current situation analysis based on secondary and primary data, and suggests new approaches of improving crop and animal resources productivity and production that increase performance of the agriculture sector and the country's economic development. It proposes the strategic orientations and formulates the key strategic objectives and proposes the implementation plan.

Since the operationalization of the previous strategic plan of 2013-2018 to date, RAB has entered into a new reform to improve its performance through the reinstatement and effective operationalization of stations and recognition of research and technology transfer programs which both constitute pivotal drivers in the delivery mandate of the institution.

A number of success and achievements were noticed during the implementation of the previous strategic plan that include high yielding and biotic and abiotic stress crop variety development for different major crop commodities, development of improved agronomic and post-harvest practices for optimum crop productivity such as new fertilizer formulas and integrated soil fertility management options, development/adaptation of improved animal husbandry practices with much focus on embryo transfer and pest control methods, agriculture and livestock technology transfer approaches, Institutional capacity development in terms of research and technology transfer infrastructures such as construction of modern drying and storage facilities, acquisition of mobile soil-testing laboratory, and empowering and promoting proactive participation of all gender categories in agriculture development.

While significant improvement has been made so far, a current situation analysis of international, national and regional policies and strategies as well as a SWOT analysis, points out strategic areas of focus in the current strategic plan that contribute to PSTA-4 targets achievements and sustainable development goals related to agriculture. Results from this analysis revealed critical factors linked with economic, social, environment, technology and areas of weakness that should be given much emphasis in this strategy. These include mainly, economic growth affected by COVID-19, inflation and fluctuating exchange rates, rapid population growth within land scarcity context, low rural population incomes, fair satisfaction of agricultural sector services delivery, low engagement of youth in agriculture, low women access to resources and opportunities, low-level technology adoption and inadequate innovation in production, processing and value addition systems, climate change and depletion of natural resources and outbreaks of diseases and pests, poor human resource management, lack of clear institutional moral values, low budget and poor procurement processes. However, good commitment of stakeholders at national, regional and international level, as well as supportive Government leadership, constitute a big opportunity for this strategy to tackle the mentioned challenges.

Given the mandate of a key player in the process of agriculture transformation through research and technology transfer, RAB is therefore expected to develop and transfer appropriate technologies in agriculture and animal husbandry that will enable the

transformation articulated in the overarching national strategy for transformation (NST1), PSTA 4, as well as Vision 2050.

In this context, the present strategy is designed around the following strategic areas as reflected by the basis of the theory of change of this strategy:

a. Research, innovation, extension and advisory services

This strategic area will focus on improving agronomic knowledge and technology through promoting digital innovations to enhance access to services and facilitating cross linkages within value chains. In terms of basic research and innovation, especially on developing improved varieties and breeds. Innovative projects will be promoted through PPP and developing innovative networks and beneficial partnerships with research institutions and the private sector. Such PPP shall be in line with tools for developing land for greenhouse testing facilities and for testing hydroponics and as well as promoting private sector providers of extension services, to increase adoption of developed technologies at scale.

b. Sustainable agricultural intensification and resilience

This component will focus on promoting sustainable and resilient production systems for crops and animal resources. It will encompass heavy investments in improving land productivity and animal production, such as irrigation infrastructure development, soil erosion infrastructure development, fertilizer use, animal feed production, social security and mitigating protein deficiency at the household level though inclusion of small-stock animals in the Girinka program, and nutrition sensitive agriculture through increasing kitchen garden and school gardens and promoting the production and consumption of highly nutritious fruits and vegetables.

c. Agriculture commodity value chains and market development

Emphasis will be on improving markets, value addition and linkages between production and processing. This refers to access to key input markets such as fertilizers, insurance, and finance as well as upstream activities such as aggregation, promotion of value addition, and market infrastructure. Specifically, it is envisioned in collaboration with the private sector, the establishment of hard and soft infrastructure along the value chain that include storage facilities, drying grounds, cold room facilities, and fully functioning of Milk Collection Centres. Market access for farmers will be promoted through enhanced market analysis, use of digital innovations and tools to facilitate market information and harnessing innovation platforms and linkages between different players within value chains.

d. Strengthening organization capacities and resource management

This strategic area will focus on strengthening RAB's organizational and management capacities to deliver on the 3 previous areas and its mission as a whole. This will primarily require organizational reform, to enhance the capacity to deliver on the strategy and moving the institutional focus from market actor to market enabler. It will also contribute in increasing public private partnerships and incentives to invest in delivering the strategy while enhancing internal capacities through short and medium-term training at MSc and PhD levels in various domains where gaps in human capability have been identified.

To ensure successful implementation of various activities under this strategy and deliver on the priority areas of PSTA 4, there must be a strong collaboration with a range of stakeholders including public institutions at central level, Government decentralized entities such as districts, private sector and farmer's organisations. A strong coordination will be set to ensure effective collaboration among these actors with focus on efficient communication with farmers in terms of innovation messages and collecting feedback from farmers.

CHAPTER 1: INTRODUCTION AND BACKGROUND

1.1. Importance of Agriculture in Rwanda

The agriculture sector remains the backbone of the Rwandan economy. It provides employment and incomes to about 70% of the population, mostly smallholder farmers in rural areas (NISR, 2018). It also contributes up to 27% to the national gross domestic product (GDP; NISR, 2019abcd). Additionally, agriculture provides 90% of the country's food needs. The overall agricultural sector performance expanded at an average of 5.7 % over the last ten years (NISR, 2019abcd). Agriculture plays an indirect role with regard to food accessibility, stability, and use. Agricultural production is a determinant for farmers' incomes and their access to food.

The National Strategy for Transformation (NST1), the Government Programme for 7 Years (7YGP) (2018-2024), hinges on past performance and lays the foundation for accelerated transformation and economic growth to propel Rwandans to a higher standard of living. The NST1 priorities are the modernization of agriculture and increased productivity to drive agricultural growth. Anchored on NST1 and 7YGP, the Strategic Plan for the Transformation of Agriculture (PSTA IV) has articulated four strategic programmes as drivers of agriculture transformation from the largely subsistence status to market-oriented. One of the four strategic programs is the Research, Technology Transfer, Advisory Services and Professionalization of farmers (MINAGRI, 2018). The PSTA IV focuses on increasing crop and livestock productivity, improving natural resource management, and empowering farmers to respond to market requirements (MINAGRI, 2018).

To achieve the structural shift away from an agriculture-based economy, the Government of Rwanda deemed it imperative to adopt a gradual, yet unrelenting reform in the current agricultural model. The revised version of the country's long term development agenda enshrined in the Blueprint of Vision 2050 envisages that by 2050, agriculture in Rwanda will be market-led and high-tech, driven by few professional farmers with large farms on irrigable lands, with an irrigation rate of 100% of irrigable land (Vision, 2050).

The use of modern inputs and technologies is expected to be scaled up to increase productivity and develop professional agriculture services with strong downstream and upstream linkages to primary agriculture. The key related services to be delivered shall include: production and distribution of fertilizers, quality seeds, irrigation technology, higher-value agricultural products for supermarkets among others, that will be needed domestically and in the region. In comparison with contemporary farming in Rwanda, farms are expected to be mechanized, fully irrigated and using high-tech inputs in greater volumes (Vision, 2050). A set of strategic actions, programmes and projects also include among others, establishing a programme to improve professionalization of livestock farmers and increase their outputs in terms of quality, quantity and productivity.

Through such main programmes as intensification of sustainable production systems in crop cultivation and animal husbandry; building the technical and organizational capacity of farmers; promoting commodity value chains and agribusiness, and strengthening the institutional framework of the sector at central and local levels, Rwanda has achieved an unprecedented increase in crop and animal production. This has resulted in a substantial increase in real national agriculture GDP, although the share of agriculture GDP has decreased mainly due to larger growths in the other sectors (Figure 1).

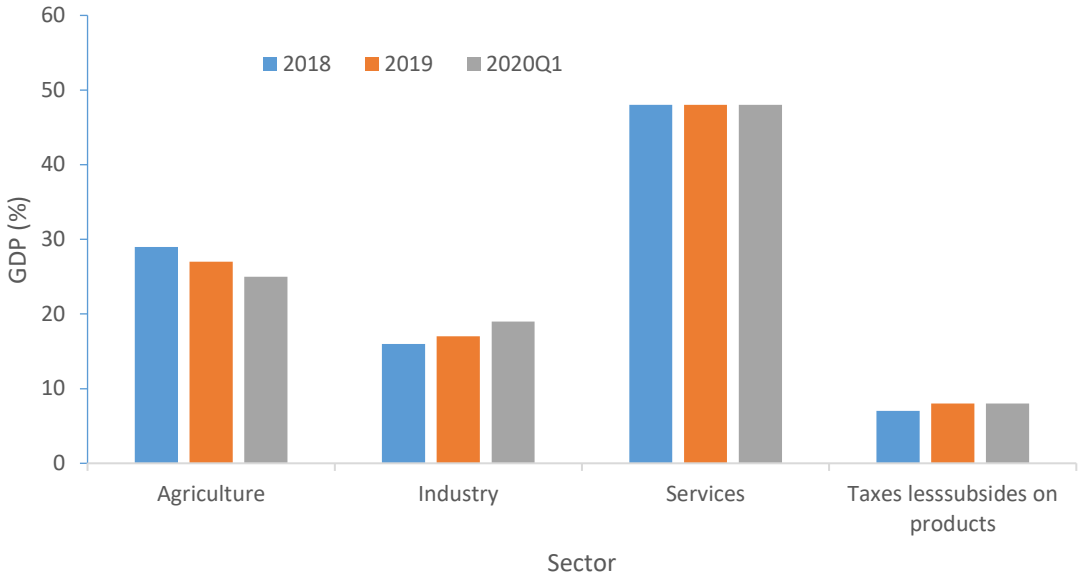

Figure 1: Contribution of agriculture to the GDP for the last three years (Source: Adapted from NISR, 2018; 2019abcd; 2020a)

1.2. The role of research in agricultural development

Demand-driven and innovative research and development (R&D) is an important public function in support of agriculture development. The Rwanda Agriculture and Animal Resources Development Board (RAB) has made significant contributions to agriculture development. It has worked to deliver on national priorities outlined in the key strategic documents (NST1, PSTA4), through development and transfer of technologies in areas of crop and animal resources improvement, sustainable agriculture and livestock intensification, postharvest management, natural resource management, land husbandry, irrigation and mechanization.

For Crop Intensification and Improvement, new varieties were developed for different crops, adapted to different agro-ecologies (high and middle altitudes) with early maturity, tolerance to drought, low nitrogen and Maize Lethal Necrosis (MLN) and, resistant to pest and diseases, tolerant to biotic and abiotic stresses with high yield and marketable traits, and c lean seeds were produced to boost the performance of agriculture sector.

For Livestock Intensification, embryo transfer was applied to local cows, semen doses were produced and processes for artificial insemination, vaccination campaigns against black Quarters, Lumpy-Skin Disease (LSD), Rift Valley Fever (RVF), Brucellosis and Foot and Mouth Disease (FMD) were conducted. Forage seed was produced to improve forage seed dissemination. Aquaculture and fisheries research produced fingerlings and research on fish feed showed increased growth with dietary protein at 25 - 35% for monosex Nile tilapia fingerlings (RAB, 2018).

For Sustainable Soil Fertility Management, progressive and radical terraces were developed across different catchments of the country to transform steep lands into low or moderate sloping cropping lands, well protected against soil erosion. In the marshland, large and small-

scale irrigation infrastructure were developed to cope with climate change and improve productivity. Research on site and crop specific fertilizer recommendations was initiated across different agro-ecological zones of the country to improve crop nutrition. Table 1 below summarises average key indicators of the agriculture sector

Table 1: Key indicators of the Agriculture sector

Indicator	2017a&b	2018a&b	2019a&b	2020a
Improved seeds used (%)				
Small scale farmers	5.8	8.2	8.5	35.2
Large scale farmers	55.8	29.6		
Land size in which improved seeds were used			8.4	34.3
Demo plots with organic fertilizer (%)				
Small scale farmers	42.3	43.4	48.3	60.7
Large scale farmers	38.1	42.4		
Demo plots with inorganic fertilizers(%)				
Small scale farmers	17.0	21.6	23.5	34.2
Large scale farmers	38.1	37.9		
Demo plots with irrigation (%)				
Small scale farmers	4.3	4.9	3.3	2.8
Large scale farmers	24.2	18.5		

Source : NISR (2017, 2018, 2019 and 2020).

1.3. Overview of RAB

RAB's vision is stated as "improved food security and livelihoods of all Rwandans by transforming agriculture from subsistence into modern farming through generating research and extension innovations that generate sustainable crop, animal husbandry and natural resource management". The vision was used in setting the organizational strategic objectives of RAB for the medium term (2020-2024) elaborated in the document.

1.3.1. RAB' Organization structure

1.3.1.1. Mission

A mission statement generally provides a succinct description of what an organization does to achieve its vision. Under the Organic Law No N°14/2017 of 14/04/2017, the general mission of RAB focuses on developing agriculture and animal resources through research, agricultural and animal resources extension in order to increase agricultural and animal productivity, as well as their derivatives.

Given the mandate of facilitating the desired agriculture transformation through research and technology transfer, RAB is therefore expected to develop and transfer appropriate technologies in agriculture and animal husbandry. Such a mission is pertinent and paramount in enabling the transformation articulated in the overarching national strategy for transformation (NST1), PSTA 4, as well as Vision 2050.

The RAB's mission also adds thrust to achieving the sustainable development goals (SDGs) in Rwanda – more specifically SDG 1 (no poverty), SDG 2 (zero hunger), SDG 5 (gender equality), SDG 12 (Responsible for consumption and production) and SDG 13 (climate action). It also complies with the principle of agriculture led growth and development envisioned under the Comprehensive African Agriculture Development Program (CAADP) initiative led by African Union (AU)/African Union Development Agency (AUDA then NEPAD). Therefore, the major responsibilities of RAB are:

1) to contribute to the development of the national policy and strategies in agriculture and animal resources;
2) to implement the national policy, laws and strategies on agriculture and animal resources;
3) to coordinate activities aimed at promoting agriculture and animal resources infrastructure;
4) to search, collect, provide and disseminate technology, services and information of agricultural and animal resources to farmers that increase the quantity and quality of agricultural and animal products;
5) to establish mechanisms to support farmers by delivering innovation packages to preserve and add value to the productivity;
6) to conduct fundamental and applied research that promotes agriculture and animal resources, as well as their derived products;
7) to conduct research on the nature of forestry and agroforestry trees, as well as tree varieties that are suitable for each area of the country;
8) to conduct research on climate change, its impact on agriculture, animal resources and forestry, as well as put in place strategies aimed at mitigating its impact;
9) to conduct research on animal diseases, put in place and implement appropriate measures to prevent and control them;
10) to conduct research on diseases and pests that attack field and stored crop products, put in place and implement appropriate control measures to prevent and control them;
11) to study soil characteristics and conduct research on appropriate fertilisers, development of new plant varieties and their suitability to each soil type;
12) to establish and manage a gene bank for storing and conserving plant and animal genetic resources, as well as any other living organisms related to agriculture and animal resources;
13) to coordinate, monitor and supervise activities of agriculture, animal resources and related research carried out by RAB or other professional actors;
14) to develop sufficient quality seeds and ensure their multiplication and distribution;
15) to develop animal breeds that are suitable for each agro-ecological zone and carry out activities meant for animal breeds' improvement and feeding;
16) to prevent, inspect, investigate and monitor the movement of animals and animal products that are not processed by industries in order to prevent the introduction and spread of animal diseases;
17) to carry out inspection and authorize the movement within and out of the country of animals and animal products that are not processed by industries;

18) to monitor the preparation, conservation, distribution and use of crop protection products;
19) to collect, at national and international level, new and required technologies and refine them for use in agriculture and animal resources;
20) to put in place programmes for sensitizing farmers to operate in cooperatives and build their technical capacity in agriculture and animal resources;
21) to establish a communication system to provide customers with information about agricultural and animal resources produce on the market;
22) to cooperate with regional and international organizations whose mission is similar to the mission of RAB.

1.3.1.2. Core Values

Values drive the organization's priorities and hence provide a framework in which decisions are made. Since research and technology transfer are the keys to success of RAB, responding to farmers' needs through reforms and modern methods serve as core values. Delivering demand-driven, market- oriented research, innovations, and extension advisory services represent RAB's main results directions. In order to achieve these results, it is mandatory to perform their functional obligations include with *Inclusivity, Accountability, Client focus, Professionalism, Sustainability, Communication, as well as Integrity*:

- *Inclusivity*: In all RAB Programs, as approach that ensures gender and farmer categories and status will be handled without any form of discrimination.
- *Accountability*: In terms of accountability, RAB programs will ensure we provide channels and means of being accountable to our stakeholders.
- *Client focus*: All RAB programs build strong customer relationships to enhance RAB's customer's satisfaction. The customer is at the centre of all RAB business development and management decisions.
- *Professionalism*: RAB is science based institution that requires qualified and dedicated staff, RAB services to customers must reflect its reliability, competence and dependability.
- *Sustainability*: RAB activities and results integrate economic, environmental and social dimensions...
- *Integrity:* RAB management and staff must display consistently and uncompromisingly adherence to strong moral and ethical principles.

Given the above core competencies, RAB requires entrepreneurship in order to translate technologies and knowledge into innovations that respond to market demands and improved livelihoods of Rwandan farmers. The strategic plan presented in this document aims at setting directions for crafting and delivering the expected innovations to the end users so as to facilitate the shift of Rwanda's farmers from subsistence to market oriented farming. This forms the goal of the strategic plan.

1.4. Rationale of the strategic plan

The strategic plan is designed to align RAB interventions and operations with the PSTA 4 which is the agriculture sector's strategic document under Rwanda's National Strategy for Transformation. It builds on the achievements and successes of the previous strategic plan of 2013-2018 and the current organizational structure, and will introduce new approaches of improving crop and animal resources productivity and production, that increase performance

of the agriculture sector and the country's economic development. While the PSTA 4 envisages a transformation of agriculture from a subsistence sector to a knowledge-based value creating sector that contributes to the national economy and ensures food and nutrition security, the RAB strategy will play a pivotal role in implementing and coordinating all agriculture development activities across different actors. The strategic plan will contribute to PSTA4 targets and achievement of the Sustainable Development Goals related to agriculture.

Since the operationalization of the previous strategic plan of 2013-2018 to date, RAB has entered into a new reform to improve its performance. The added values of the new structure include the reinstatement and operationalization of stations and recognition of research programs, as both levels entrench research and technology transfer in their delivery mandate. The new strategic plan will therefore reposition RAB in the context of the current structure.

RAB, being part of the key institutions to deliver on the priority areas of PSTA 4, is supposed to collaborate with a range of stakeholders including ministries, districts, private sector and farmers' organizations. Therefore, this strategy is essential to show the strong coordination to ensure collaboration among those actors for the successful implementation of various activities.

To this end, this strategic document reviews the achievements of the last strategic plan, analyses the current situation, proposes the strategic orientations, formulates the key strategic objectives and proposes the implementation plan.

Both primary and secondary data were needed for the situation analysis. The process of collecting these data was consultative and participatory. Secondary data included review of the international, national and regional policy documents; and past and present national strategic plans (e.g. Vision 2020, Vision 2050, National agriculture policy, RAB 2013-2018 strategic plan, NST1, PSTAs). Primary data were collected from RAB senior management and programs coordinators using a questionnaire/checklist; Stakeholder consultations were done through engagement workshops, focus group discussions while key informant interviews with various key actors at the policy and implementation levels were conducted using a checklist.

CHAPTER 2: SITUATION ANALYSIS

This section includes an analysis of RAB's performance in its last five-year strategic plan (2013–2018); an analysis of political, economic, social, technological and environmental factors affecting RAB research and technology transfer programmes; an analysis of RAB's strengths and weaknesses and, a stakeholder analysis. External and internal factors affecting the functioning of RAB are thus identified and interests, roles/responsibilities, comparative advantages and contribution of the various RAB stakeholders in the implementation of the 2020-2024 strategic plan recognized.

2.1. RAB 2013-2018 Strategic plan related achievements

A number of milestones were realised during the implementation of the RAB 2013-2018 strategic plan and these include:

A. Crop variety development

a) The maize program released 8 hybrid varieties (4 for highlands and 4 for mid-altitudes) with early maturity, drought, low N and MLN tolerance. These varieties can reach an average yield of 7 tons per hectare.
b) Wheat research breeding has developed 10 new varieties that are currently being used by farmers. These are Gihundo, Keza, Nyaruka, Rengerabana, Majyambere, Mizero, Kibatsi, Reberaho, Nyangufi and Cyumba.
c) Eleven potato varieties were developed and released. Yields of these varieties vary from 25 to 35 tons per hectare.
d) Eight cassava varieties have been informally released and are being multiplied by seed producers.
e) Six sweet potato varieties were released while 18 others were submitted for release.
f) Four bush and nine climbing bean varieties are ready to be officially released.
g) A new coffee variety named 'RAB C15' was officially released to the coffee growers, and it has proved to be the most resistant to Coffee Leaf Rust (CLR).
h) Three rice varieties were released.

B. Development of improved agronomic and post-harvest practices

a) Horticulture research developed a new approach for pest and disease management – fruit fly control using pheromone traps with methyl eugenol.
b) Optimum fertilizer rate was determined for tamarillo (200 kg NPK 17-17-17/year).
c) Stevia research developed optimized spacing and manuring.
d) Natural Resource Management research developed a blended fertilizer formula adopted for major Rwandan soil types and crops (maize, Irish potato and rice). These formulae were applied in established demonstration plots all over the country and after successful demonstration they were recommended for blending by fertilizer factories.

e) The Horticulture program developed the Thunder OD 145 to control six insects (name the insects if possible) in tomatoes; identified local beneficial nematodes and established the existence of entomopathogenic nematodes.
f) Research has identified integrated soil fertility management (ISFM) interventions, which consists of the use of travertine in combination with farmyard manure and inorganic fertilizer, and it contributed significantly to improve crop yields (2.5 t/ha of beans bush type, 4.0-7.7 t/ha of maize, 4.7t/ha of wheat and 26.0t/ha of Irish potato).
g) New fertilizer recommendations were developed for maize, rice and Irish potato.
h) New post-harvest technologies were developed, disseminated and adopted by rice cooperatives and grower's cooperatives. These technologies consist of harvesters, threshers and winnowing machines for rice and wheat plantations.

C. Development/adaptation of improved animal husbandry practices

a) Livestock research conducted embryo transfer on 51 cows, 15 from Muyira, 17 from Kibilizi and 19 from Songa with a success rate of 25.5%. Calves born from embryo transfer were four in Muyira, three in Kibilizi and six in Songa.
b) In large stocks, the efficacy and safety of 'Inkuyo plus', a new locally manufactured acaricide from Rwandan highland pyrethrum, was assessed and found to be effective in controlling major ticks parasitizing cattle.

D. Agriculture and livestock technology transfer

a) Increase marketability and revenues of production in smallholder farms increased: 20% of households engaged in market-oriented crop production.
b) Crop productivity: Maize: 3.7 Mt/ha against 5.5 Planned **(67%),** Rice: 5.6 Mt/ha against 7 Planned **(80%),** Wheat: 2.3 Mt/ha against 3.5 Planned **(66%),** Cassava: 20.7 Mt against 26.3 planned **(79%),** Irish Potato: 22 Mt/ha against 31.8 Planned **(69%)**, Bush Bean: 1.3 Mt/ha against 2.2 planned **(59%),** Climbing bean: 2.5 Mt/ha against 3.5 Planned **(71%),** Soybean: 1.4 Mt/ha against 2.5 Planned **(56%),** Banana: 19.7 Mt/ha against 19.7 Planned **(100%)**
c) Livestock Production: Milk: 847,187 Mt produced against 723,831 Mt Planned **(117%),** Meat: 162,470 Mt against 201,033 Mt planned **(80.8%),** Fish: 31,465 Mt against 112,000 Planned **(28%),** Eggs: 7,936 Mt against 14,414 Planned **(55%),** Honey: 5,200 Mt against 8,695 Mt Planned **(60%)**
d) Optimize the water use in raising the crop and animal productivity: Rwanda Irrigation Master plan was updated to 70% water use at the end of 2018 and 100% at the end of 2019- 2020 FY.
e) Reduce soil erosion and negative impacts of crop and livestock intensification on natural resources: soil conservation, for minimizing the soil erosion at the end of this strategy, 118,399 ha (71.4%) of radical terraces out of 165,596 ha planned were developed and 932,282 ha (84.1%) of progressive terraces out of 1,107,227 ha were developed (MINAGRI 2017-2018).

f) A total of 205 demonstrations and awareness campaigns were conducted to adopt Small Scale Irrigation Technology (SSIT). Land tilled using machines increased from 41,010 ha to 47,060 ha.
g) A total of 1,924 farmers and technicians were trained on the use of SSIT equipment; 2,080 farmers were trained on use of machinery in various farm operations, as well as 213 tractor operators and 180 agronomists .
h) Biotechnology: A total of 50,420 banana plantlets were produced by micro-propagation and disseminated to farmers in collaboration; 62,409 sweet potato plantlets of sweet potato planting materials using tissue culture, 76,849 plantlets of cassava planting materials using tissue culture, and 24,843 plantlets using macro-propagation were produced.
i) Eleven Irrigation Water Users Associations were created; Irrigation Steering Committees were initiated to oversee activities of irrigation schemes; members of water user organisations, cooperatives' governing bodies (Committees), and lead farmers in newly created irrigation water user organisations, were trained in operation and maintenance of irrigation infrastructure. Through the established village Mechanisation Service Centres, farmland was tilled through public-private hiring services of mechanised equipment.
j) Capacity building of farmers in post-harvest best practices (harvesting, handling, transport and storage).

E. Institutional capacity development

a) Construction of drying grounds and temporary stores in order to reduce post-harvest losses: 268 drying grounds constructed up to 2018.
b) Construction of modern storage facilities including warehouses and metallic silos: 213 warehouses and silos for 311,795 Mt capacity were constructed .
c) Key infrastructure for horticulture centre of excellence was established.
d) Acquisition of a mobile soil-testing laboratory.

F. Empowering and promoting proactive participation of all gender categories in agriculture development

a) Forty-six (46) young graduate entrepreneurs (MCCs Associates Managers) under Rwanda Youth in Agri-business (RYAF) were recruited and deployed to support operationalization of Milk Collection Centres.
b) Rwanda hosted an international conference themed 'Youth Employment in Agriculture as a Solid Solution to ending Hunger and Poverty in Africa' that took place in Kigali.
c) On June 21, 2019 in Rome, MINAGRI was awarded the Edouard Saouma Award 2019, a global prize instituted by the Food and Agriculture Organization (FAO), for outstanding efforts in involving youth in Rwanda's agriculture transformation.
d) Horticulture in Reality Corporation (HoReCo) was hired by RAB as a youth service provider to productively manage the irrigation schemes.

e) RARICO was hired by RAB as a youth service provider to provide technical services to fish farmers in Rwanda.

2.2. Analysis of Political, Economic, Social, Technological and Environmental factors (PESTE) affecting RAB's Innovation and Technology Transfer programmes

2.2.1. Policy and legal environment

Table 2 shows the policy and legal factors.

Table 2: Policy and legal factors

Factor	**Strategic implication**	**Strategic response**
Policies and legal frameworks (Rwanda constitution, Vision 2050, NST1, SPATs, NAP)	- Clear orientation in terms of Research/Innovation, Extension, production targets and sustainable natural resource management - Sound collaboration among the different stakeholders leading to high adoption of RAB's technologies and innovations. - Development of diversified demand-driven technologies	- Ensure that RAB's strategic plan reflects National strategic goals - Leveraging collaboration with stakeholders including private sector, local government, civil society, youth and women organisations, development partners, etc.
Favourable regional and international policies (FAO, WTO, FARA, AGRA ASARECA, CGIAR, CABI affiliated institutions, …)	- Great benefits from working with international and regional organizations involved in agriculture	- Mechanisms for promotion of domestic and regional platforms for improved agriculture research and technology transfer - Collaborative action research

2.2.2. Economic environment

Table 3 shows the economic factors

Table 3: Economic factors

Factor	Strategic implication	Strategic response
The National Economic growth affected significantly by COVID-19	- Decreased budget allocated to agricultural research/innovation and technology transfer for 2020-21 FY - Harnessing the use of digital applications in research, extension and technology transfer	- Prioritize areas to be covered during planning and budgeting process in line with economic recovery strategy - Set new targets and related policy actions
Rwanda Franc inflation and fluctuating exchange rates	- Increased cost of conducting research arising from increasing cost of inputs and services	- Improve RAB's staff productivity - Improve collaborative networks
Regional markets and integration	- Opportunities for partnerships and linkages - Market outlets for RAB products - Increased research opportunities within the economic blocks. - Opportunities to compete for and tap into available research funds	- Develop high quality research and products to enable RAB to exploit and benefit from offered opportunities.

2.2.3. Social factors

Table 4 shows the social factors

Table 4: Social factors

Factor	Strategic implication	Strategic response
Low rural population incomes	- Low effective demand for improved technical inputs	- Subsidy policy implementation
Rapid population growth in context of land scarcity	- Increased demand of food	- Development of crop and livestock technologies and strategies for the management of small agricultural plots. - Crop intensification program on consolidated land
Fair satisfaction of agricultural sector services delivery	- Low level of adoption of improved agricultural technologies - Need for more efficient	- Incorporate perceptions of end users in the planning process for ensuring the successful formulation and implementation of RAB's

	communication to farmers about innovations - Need for collecting more feedback from farmers	research and technology transfer programmes. - Adopt more efficient pathways of communication and feedback
Low engagement of youth in agriculture	- Low number of well-educated agro-entrepreneurs taking agriculture as a business	- Address the major blockers of youth engagement which include access to land, finance (capital), and markets for those involved in direct production and access to skills for those involved in processing and service provision along the agricultural value chains. - Put in place mechanisms to streamline and respond to the needs of youth already engaged .Need to address the major blockers of youth engagement which include, access to land, access to Comprehensive agricultural value chain analysis to identify opportunities that interests youth especially in-service provision may be needed.
Low women access to resources and opportunities	- Low agricultural land and labour productivity	- Consider issues related to the participation of women to make RAB programmes more inclusive .

2.2.4. Technological factors

Table 5 shows the technological factors

Table 5: Technological factors

Factor	**Strategic implication**	**Strategic response**
Low uptake of technology and few innovations in production, processing and value addition systems	Persistent high costs of production and processing	- Improve information delivery and expand communication on innovations. - Develop cost-efficient and beneficial technologies. - Adoption of state of the art research procedures.

2.2.5. Environmental factors

Table 6 shows the environmental factors

Table 6: Environmental factors

Factor	**Strategic implication**	**Strategic response**
Climate change and depletion of natural resources	- Low food production and availability - Reduced access to and utilization of food (Increases in crop, livestock and human pests and diseases) - Decreased crops and livestock productivity - Increased level of poverty	- Modification of inputs, varieties and species (crops, livestock) for increased resistance to heat shock and drought, flooding and salinization; - Changing fertilizer rates to maintain grain or fruit quality; - Change the amounts and timing of irrigation and other water management methods; - Altering the timing or location of cropping activities.

2.3. Analysis of Strengths, Weaknesses, Opportunities and Threats

2.3.1. Strengths

Table 7 shows the strengths

Table 7: Strengths

Strength	**Strategic implication**	**Strategic response (What needs to be done to take advantage of the identified strengths)**
Organizational structure	● There is a possibility for placing right people in the right place ● Clear chain of command and reporting system	● Effective operationalization of RAB structure through - placing right people in the right place - Compliance with laws & regulations on public service in regard to grade promotion - Elaboration and implementation of a proper staff capacity building plan ● Adoption of good governance and public finance management cycle (PFM) practices through - Joint planning, budgeting, execution, monitoring and evaluation within RAB programs - Proper flow of information and reporting channels - Strengthening social cohesion and team spirit building in RAB community
Highly skilled staff	● Good understanding of priorities and strategic vision of the institution and the agriculture sector in general	● Higher focus of RAB management of using staff competence and/or competency in a more efficient and accountable way ● Implement a rigorous staff assessment approach to ensure high performance RAB management creates an enabling environment for more efficient use of staff ● Carry out staff capacity building in identified relevant gaps
Fair infrastructure and equipment	● Improved agriculture and animal resources services	● Efficient use of available infrastructure and equipment to provide quality agriculture and animal resources services ● Acquisition of more necessary and relevant infrastructure according to identified priorities ● Staff capacity building to adequately use available infrastructure

2.3.2. Weaknesses

Table 8 shows the weaknesses

Table 8: Weaknesses

Weakness	**Strategic implication**	**Strategic response (what need to be done to mitigate identified weaknesses)**
Weak service delivery	● RAB image negatively affected ● Low adoption of improved agriculture technology ● Slow increase of agriculture and animal resources productivity and growth ● Less public trust	● Comply and mainstream the existing Service Standards and Service Charters; ● Establishment of peer review and peer learning mechanisms within RAB to speed up the pace of departments/programmes lagging behind in delivery which will lead to effective and efficient team work; ● Improve collaboration, coordination and communication with stakeholders; ● Reinforce customer friendly regulations; ● The use of ICT in service delivery ; ● Regularly assess performance and work out modalities for improvement.
Poor budget execution and procurement processes	● Under/over spending of government and donors' funds ● Consistent adverse opinion of the OAG	● RAB management to ensure - proper planning and linking planning with budget; - strong and efficient finance and procurement entities; - Digitalisation of key processes; ● Establish a strong M&E function; ● Proper management of the audit process; ● Sensitize staff on procurement and budget management and set monthly or quarterly performance targets as a way of making each accountable.
Poor human resource management	● Insufficient service delivery ● Staff demotivation ● Staff turnover	● RAB management to ensure - right people are put in right place; - mechanisms for staff replacement and promotion are created; - mechanisms for staff retention through a favourable working environment are created; - performance evaluation and feedback mechanisms are put in place ; - design mechanisms for staff reward or recognition and build team work spirit among staff.
Lack of clear institutional moral values	● lack of institutional ethical behaviour ● low sense of institutional belonging ● low motivation of staff ● low institutional ownership	● Define, mainstream and safeguard institutional moral values

2.3.3. Opportunities

Table 9 shows the opportunities

Table 9: Opportunities

Opportunities	**Strategic implication**	**Strategic response**
Committed national, regional and international stakeholders	Contribution to agriculture and animal resources sector growth	Institutionalize the stakeholder management framework for efficient decision making and implementing
Supportive Government leadership	Availability of appropriate policies and resources	Timely delivery on high level national agriculture and animal resources priorities. Regular reporting and feedback to top management on RAB progress, challenges and priorities for redress.

2.3.4. Threats

Table 10 shows the threats

Table 10: Threats

Threat	**Strategic implication**	**Strategic response**
High expectations from stakeholders	● Expectations beyond the institution mandate and resources ● Institution image negatively affected	● Hold regular consultations with stakeholders to engage them in planning and share responsibilities ● Increase outreach communication and stakeholders engagement
Climate change and degrading natural capital	● Unpredictability of farming seasons ● Potential food and nutrition insecurity ● Decreasing soil carbon and depleting soil fertility with the existing cultivation practices	● Climate change mitigation measures ● Identification of critical areas for soil resource conservation and carbon restoration research
Insufficient budget	● Risk of not achieving PSTA 4 and NST 1 planned targets	● Advocate for increased GOR budget ● Resource mobilization from external donors ● Prioritize programs

2.4. Stakeholders analysis

Table 11 shows the core operational intervention and strategy for obtaining stakeholders' support

Table 11: Stakeholder core operational intervention and strategy for obtaining support

Stakeholder	**Core areas of operational excellence in supporting agricultural research for development**	**Potential strategies for obtaining stakeholder support**
Districts, Ministries and government institutions		
LODA (Local Administrative Entities Development Agency)	● Implementation of agriculture sector development projects through decentralized entities	Engage LODA in joint planning, implementation and reporting
Meteo Rwanda	● Generation of weather and climate products ● Co-Production of climate products ● Dissemination of weather and climate products	MoU on weather and climate data and products dissemination
Private sector		
YARA (agricultural inputs company)	● Fertilizer importation ● Fertilizer distribution ● Farmers trainings ● Collaborations/partnerships with industry players in uplifting farmers status	Establishment of timely delivery services system Have a mechanism in place to strongly link farmer advisory services with input delivery Put in place feedback mechanism
National Agricultural Research System (NARS)		
Universities/RICA	● Education, applied research and extension.	MoU on research and extension Hold regular feedback meetings
Regional and International Organizations		
ICCO Cooperation	● Provide technical capacity building at producer and first aggregator level, upgraded post-harvest technology (mechanization, industrial shelling and drying, logistics and management. ● Provide improved information and data on post-harvest losses along the entirety of prioritized value chains, and improved market information to facilitate efficient trade.	Establish a collaboration framework to improve agri-value chains development.

	● Enhance producers' access to and linkages with markets (contract farming). ● Develop, implement and coordinate pluralistic extension and service delivery systems to meet needs of different actors along value chains.	
ASARECA	● Coordination and implementation of regional agricultural research projects & programs. ● Support to regional policy harmonization initiatives for collective action in R4D. ● Facilitation of technology, knowledge and information sharing across member countries. ● Support to capacity strengthening for effective research delivery with member NARIs. ● Brokering partnerships with national, regional and global actors.	Establish a collaboration framework to advance research and development
CABI	● Invasive species ● Development communication and extension ● Digital development ● Value chains and Trade ● Crosscutting (Bio service, gender and social-economics)	Establish a collaboration framework to advance research and development
Bioversity/CIAT, IITA and Africa rice	● Genetic diversity and improvement ● Sustainable productivity enhancement ● Dissemination of technologies and innovations ● Policy, innovation systems and impact assessment	Establish a collaboration framework to advance research and development

Table 12 shows RAB and its stakeholders' expectations

Table 12: Stakeholders and RAB expectations

Stakeholder	**Stakeholder expectations from RAB**	**RAB expectations**
Districts, Ministries and government institutions		
LODA	● Enhanced coordination of agriculture sector at decentralized entities; ● Easy access/ dissemination of results from agricultural research; ● Easy access of agricultural and livestock inputs ● Promotion of urban agriculture ● Encouragement and advocacy for investors in agriculture sector	● Facilitate the dissemination of key technologies ● Facilitation on detailed data collection at decentralized entities
Meteo Rwanda	● Dissemination of generated weather and climate forecasts of different time scale to farmers ● Feedback from farmers/users for forecasts improvement ● Participation in the formulation of policies for use and application of weather and climate products in	● Provide real time meteo information ● Work closely with RAB to

	agriculture ● Meteo Rwanda and RAB to work closely on weather climate products ● Meteo and RAB to anticipate, understand and adapt to the reality of long term and historical change in climate information ● Incorporate and share knowledge on local climate ● Contribute to localised downscaled weather climate information. ● Meteo, in collaboration with RAB and other agricultural entities, to engage all players in dissemination of weather/climate products to all users; ● Together, Meteo and RAB increase talk shows on national and local radios/TVs during dissemination of seasonal and other forecasts in order to help farmers and the local population understand the importance of climate information; ● Discussion on improvement of farmer friendly the dissemination tools.	translate meteo information into climate products accessible by farmers ● Hold joint farmer awareness campaigns
Private sector		
YARA	● Advocacy to competent authority for timely delivery of imported inorganic fertilizer. ● Timely payment of fertilizers distributed to farmers ● Update fertilizer recommendations ● Improve communication strategy vis-à-vis partners	● Provide timely reports on fertilizers sold/used. ● Timely supply of fertilizers
National Agricultural Research System (NARS)		
Universities/ RICA	● Engage with RAB in identifying the most critical opportunities for RICA extension programming. ● Collaborative efforts with RAB, to develop applied research projects on crop and livestock production systems. ● RAB to host RICA students for internships and field visits when needed.	● Participate/develop joint research projects ● Joint development/ improvement of agricultural extension approaches ● Involve RAB in curricula development and review
● **Regional and International Organisations**		
ICCO Cooperation	● Work with other government bodies (RDB) on legal framework for leasing products for smallholders to access farm equipment. ● Develop framework and special initiative to attract ICT in agriculture. ● Participate in the development of a framework	● Collaborate with RAB in the dissemination of technologies ● Participate in the

	contract between smallholders and market to access key services including finance. ● Participate in the establishment of a framework for business development services provision.	development/ improvement of agricultural extension approaches
ASARECA	● RAB, with support from MINAGRI, to prioritize establishment of conducive policy environment in order to easily access technologies & innovations that have proven effective in other countries; ● RAB to fully engage ASARECA where and when we can provide support; ● RAB to honour its membership contributions as a Core member of the Association and as a sign of ownership.	● Facilitate the development and dissemination of research innovations ● Regional technology transfer
CABI	● Invasive species to stand out alone rather than being submerged in crop protection as currently presented. ● Develop appropriate communication channels and promote use of digital tools.	● Sharing scientific expertise and backstopping research projects
Bioversity/CIAT, IITA and Africa rice	● Demand articulation and strategy development; ● Joint proposal development: ● Enabling environment for joint project implementation; ● Breeding for end-use traits	● Sharing scientific expertise and backstopping research projects

CHAPTER 3: KEY RESULT AREAS AND STRATEGIC OBJECTIVES

3.1. Key Results Areas

The strategic direction in research, innovation and technology transfer is guided by the PSTA 4, envisaging a transformation of agriculture from a subsistence sector to a knowledge-based value creating sector, that contributes to the national economy and ensures food and nutrition security through four priority areas: Innovation and Extension; Productivity and Resilience; Inclusive Markets and Value Addition, and Enabling Environment and Responsive Institutions. To align with PSTA 4, the RAB strategic plan is structured around 4 Key Result Areas.

Key Result Area 1: **Research, innovation, extension and advisory services**

Innovation and extension provides the knowledge base for key result areas 2 and 3. The focus is on improving agronomic knowledge and technology in terms of basic research and innovation, especially aimed at developing improved varieties and breeds and management practices. Innovative projects will be promoted through PPP and developing innovative networks and beneficial partnerships with local and international research institutions and the private sector. Such PPP are the planned tools for developing land for greenhouse testing facilities, for testing hydroponics as well as promoting private sector providers of extension services, to increase adoption of developed technologies at scale.

Key Result Area 2: Sustainable agricultural intensification and resilience

Productivity and resilience focuses on promoting sustainable and resilient production systems for crops and animal resources. This component of the strategy contains heavy investment in improving land productivity and animal production. Significant investment will go into irrigation, with plans to increase the irrigated area from 48,508 ha to 102,284 ha. Moreover, there will be a continued focus on environmental conservation such as controlling land erosion with radical terracing going from 110,906 ha to 142,500 ha and progressive terraces from 923,604 ha to 1,007,624 ha. Finally, biological soil control measures will be promoted to protect another 150,000 ha by 2024. Furthermore, fertilizer usage is planned to go from 39 kg/ha providing access to improved seed utilization to 75% of farmers. To increase animal production, there will be a focus on animal feed production through PPPs, and animal health through enhanced access to veterinary services and vaccinations. Furthermore, a national registry for livestock will be established. For fisheries and aquaculture, the focus will lie on feed and fingerlings production. To increase animal production, social security, and mitigating protein deficiency at the household level, the Girinka model will be extended to include small-stock animals: 5,400,000 chickens and 1,250,000 pigs are to be distributed alongside 189,000 cows. Finally, nutrition sensitive agriculture will be promoted through mainstreaming in programmes, as well as increasing kitchen gardens and school gardens and promoting the production and consumption of highly nutritious fruits and vegetables.

Key Result area 3: Agriculture commodity value chains and market development

Inclusive markets and value addition seeks to improve markets and linkages between production and processing. This includes key input markets such as fertilisers, insurance, and finance as well as upstream activities such as aggregation, promotion of value addition, market infrastructure and export readiness. In collaboration with the private sector through

productive alliances, this strategy envisions the establishment of hard and soft infrastructure along the value chains. This includes, for example, increasing storage facilities from 295,495 MT to 350,431 MT, establishing 240 drying grounds and 40 local cold room facilities, and promoting a fully operational cold-chain. Specifically, for dairy, the GoR envisions that fully functioning Milk Collection Centres will increase from 56 to 77 over the strategy period. Emergency food storage facilities should increase from 184,814 MT to 260,052 MT by 2024. Moreover, market information is to be endorsed through e-soko plus. Market access for farmers is to be promoted through enhanced analysis for marketing, and especially, through promotion of access to standards and SPS certification. Finally, innovative products for agricultural insurance and finance will also be supported.

Key Result Area 4: Strengthening organization capacities and resource management

This result area focuses on Strengthening RAB organizational and management capacities to deliver on the 3 previous results areas (1;2;3). This will primarily require organisational reform, to enhance the capacity to deliver on the strategy and moving the institutional focus from market actor to market enabler. The key result area also aims at increasing public private partnerships and incentives to invest in delivering the strategy. Internal capacities will also be enhanced through short term and medium training at MSc and PhD levels.

3.2. Strategic objectives

Table 13 summaries key results areas and strategic objectives

Table 13: Summaries key results areas and strategic objectives

Key result area	Strategic objectives
Research, Innovation extension and advisory services.	**1.1. Promoting demand driven research based on farms' needs and national priorities in crop production and protection, animal production and health as well as natural resources** Despite the success registered since 2009 under the crop and livestock intensification programmes, the yield gap for many commodities remains high and impedes the country's efforts to achieve food security in face of the fast growing population. Poor pre-and post-harvest handling, limited product value addition and unpredictable markets require new approaches and technologies to unlock the national and regional market potential. The depletion and unsustainable management and utilization of the natural resources exacerbated by climate change are among other concerns. This strategic objective aims at guiding RAB research towards addressing the challenges in agriculture and animal resources to generate adapted technologies and innovations that improve productivity and provide appropriate responses to Rwandan farmers and other value chain actors. In line with PSTA4, the research will focus on areas such as soil health and Integrated Soil Fertility Management, pest and disease management, development of high yielding and resistant varieties, animal genetic improvement and climate smart agriculture. The linkage between research and extension and the increasing

	involvement of the private sector will inform research on agriculture and animal resource value chain actors' needs by establishing an effective feedback mechanism that constantly guides research programs and priorities.
	1.2. **Enrich and conserve genetic resources for food, nutrition, income and environmental security** Plant and animal genetic resources are the primary biological capital for Rwanda's current and future food security and a reserve for adaptive traits needed in crop and animal improvement. In the context of increasing production and productivity, efforts have been oriented in using exotic highly productive races/varieties with the risk of threatening the extinction of domestic genetic resources, exacerbated by the climate change impact and unsustainable natural resources management. This strategic objective gives emphasis on genetic resource diversification and conservation by expanding the RAB resource base through continuous introduction of new germplasm from known institutions. Moreover, RAB will invest in collection, characterization, conservation and archiving information on indigenous and foreign germplasm. Ex-situ conservation of genetic resources including microbial species in dedicated infrastructure, such as the RAB gene bank at Rubona, will be complemented by selected in-situ conservation sites. For that purpose, RAB will rehabilitate, expand and equip its gene bank centre at Rubona, and strengthen information management of plant and animal genetic resources conserved at the national gene bank.
	1.3. **Leveraging national, regional and international research results to adapt them to country conditions** The size and limited funding of national research cannot alone respond to the fast changing needs of the market in terms of productivity and quality of products. While maintaining a long term research program, RAB will strengthen regional and international research collaboration. In that way technologies available in the region and across the world will be introduced in Rwanda through patents and licenses to support the sector.
	1.4. **Generate, disseminate and advocate socio-economic information, markets and policy options supporting agriculture product value chains** The country's prevailing socio-economic and political environment highly influences the development and adoption of agricultural technologies and knowledge. RAB will undertake market and policy research /analysis to provide evidence based advice to the Ministry of Agriculture and animal resources, in the formulation of sector policies and strategies to ensure that they are acceptable by the community, aspire the needs of gender and youth and are implementable under the existing conditions.
	1.5. Promote private sector investment in research (local, regional, and international companies) PSTA4 recognises the contribution of the private sector in supporting the growth of the agriculture sector. Private companies have already introduced new plant varieties of hybrid maize, soybean and wheat. Other private companies have obtained licences to produce some varieties belonging to some international organizations such as CIMMYT, CIAT,

	IRRI, etc. RAB will intensify its collaboration with private actors in the country and abroad to allow farmers to access high quality and productive varieties and breeds. RAB will put in place mechanisms for the private actors to access RAB developed technologies for their further dissemination and use.
	1.6. To develop, implement and coordinate the pluralistic extension and service delivery system to meet the needs of the different actors along the value chain. The Current Government NST1 (MINECOFIN 2016), the National Agriculture Policy 2018 (MINAGRI 2017), and PSTA IV (MINAGRI 2018) recognize the importance of extension in closing the gap between current productivity and potential productivity. The national agriculture policy specifically highlights the interface with farmers, mainly through the agricultural extension service, is a key priority to be addressed. The Strategic Plan for Agriculture Transformation (PSTA IV) underscores the need for a pluralistic partnership in funding and delivering extension and advisory services; commercial driven extension that involves the public, the private sector, knowledge and research institutions and farmer's community. In line with this new orientation, it is proposed to have a new customized agriculture extension system (CAES) that is efficient, more private oriented, value chain based, demand-driven and market-oriented. While, public extension will continue to support smallholder farmers in form of Twigire Muhinzi farmer to farmer extension system, extension and advisory services to commercial farmers, and other commodity value chain actors, will be ensured by trained and licensed private extension professionals. RAB will lead the development of appropriate extension packages suited to the needs of the different actors, and also ensure quality assurance in extension and advisory service delivery.
	1.7. Capacity building of public and private extension actors along the different value chain. To understand the needs in extension and advisory services of the different agriculture value chain actors, RAB will lead a needs assessment exercise. The identified needs will be translated into extension packages for the different actors. A capacity building program of both public and private extension professionals is expected to avail a critical mass of trained extension professionals across the country ready to deliver extension on a demand basis. A mechanism to incentivise front line extension agents under Twigire Muhinzi will be established, and their knowledge expanded beyond production skills to respond to farmers' needs in organization and access to markets.
	1.8. **Enhancing partnerships and constructive engagement between RAB, the private sector and higher learning institutions in**

	agricultural research and extension The RAB strategy focuses on establishing a framework for partnership between the Government (MINAGRI/RAB), the private sector and knowledge institutions (colleges and universities) in innovation and technology development, and delivery/ transfer/ dissemination. Deliberate efforts to establish collaboration between the national agriculture and livestock extension services unit and public/private sector knowledge institutions will be undertaken. The framework will enhance the synergies of the human resources in the three institutions and their commitment to support agricultural extension. This will result in the creation of joint innovation centres where researchers and experts from the different institutions join their effort and expertise towards improvement of the agriculture sector. This framework will also encourage the development of private entities in innovation and technology delivery.
Sustainable agricultural intensification and resilience	**2.1. Sustainable land husbandry and crop production intensification with judicious use of hazardous pesticides and promotion of IPM including cultural practices** Land scarcity is the key limiting factor for agriculture production, and productive use of land requires optimisation of appropriate technologies. This requires investments in infrastructure for irrigation, with an integrated water resource management system to continuously supply water, and allow several production cycles a year. Investments are needed in structure development, such as radical and progressive terraces, contour bands, check dams, etc., of catchments mostly characterised by hilly slopes, and planting agroforestry trees and grasses. Sustainable land management, with soil conservation and water management technologies, coupled with climate smart technologies, will contribute to increased productivity, while building resilience to climate variability and related risks. To increase crop production, efficient and sustainable use of inputs will be adopted, where emphasis will be put on ISFM, which encompasses optimum use of organic and inorganic fertilisers, agricultural practices, improved germplasm, and increased capacity of users on how to apply the ISFM technology package. Furthermore, promotion and dissemination of adapted machines for mechanization will reduce labour drudgery and increase agricultural productivity. This will require establishment of a centre of excellence for mechanization in the country, to help in designing prototypes of needed machines and addressing all mechanisations challenges encountered by different users, such as maintenance of machines and provision of spare parts.
	2.2. Promoting climate smart agricultural technologies This section aims to mainstream responses to climate change throughout the agriculture sector, by operationalizing climate-smart agriculture (CSA) approaches across the sector. Rwanda is currently highly vulnerable to

climate change, as it is strongly reliant on rain-fed agriculture. Historically, 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 2050. Rainfall is highly variable in Rwanda but average annual rainfall may increase by up to 20% by the 2050s.

Projections for East Africa, including Rwanda, show an increasing trend in rainfall intensity for both rainy seasons, which is likely to cause floods and storms and thus, result in landslides, crop losses, health risks and damage to infrastructure. On the other hand, temperature increase may lead to pestilence, including the spread of vector-borne diseases, air-borne and water-borne diseases, impacting on livestock and human health, and could negatively affect crop yields, food security and export earnings.

In view of the above background, the development and use of agricultural technologies, adapted to abiotic and biotic stresses, will be promoted. Promoting climate smart agriculture technologies is aligned with PSTA4, which emphasises alternative land management to complement terracing, with comprehensive climate smart soil and integrated watershed management. It also aims to introduce better weather and climate information, and early warning to ensure all investments are climate smart, and research information is developed to enable integration. Climate research and technology development and transfer will be focusing the following areas:

- Water resource development
- Promotion of innovative irrigation technologies
- Management of irrigation infrastructures
- Crop varieties
- Conservation agriculture
- Peri urban agriculture

In the field of water resource management and irrigation, innovative climate smart technologies shall be developed and promoted to increase water retention and water use efficiency, as well as minimise water losses in the agricultural farming system, both at the catchment and bottomlands. Irrigation infrastructure will be designed and established to ensure sustainability of the system. High yielding early maturing varieties, that are tolerant to biotic and abiotic stresses, will be emphasised to address weather variability and climate change effects. Conservation agriculture technologies including zero or minimum tillage, mulching, cover crop and productive intercrops, will be integrated in the farming system as constituents of climate smart agricultural technologies.

2.3. Sustainable animal production intensification

Animal resources are the major animal-agriculture sub-sector that provides food, income and draft power. Animal source food is a critical component of a balanced diet, and contributes to nutrition security, in particular for children. As a result of high population growth and diet shifts, the demand for meat and milk is rising quickly. Mixed crop-livestock systems produce 70% of the meat and 90% of the milk in Eastern Africa, including Rwanda, while also providing livelihoods for some 50 million of Africa's rural poor. At the same time, they cause

	important environmental impacts, and must thus urgently begin a process of sustainable intensification. Expected climate change impacts are multiple, with effects on animal productivity most prominently mediated through impacts on improved animal genetic resources, animal health, quantity and quality of feed resources, as well as water availability. On the other hand, livestock systems of the East African highlands are hotspots for GHG emission intensity, mainly due to low productivity. Improper management of manure generates nitrous oxide (N_2O) and methane (CH_4), while the animals themselves generate CH_4. Beef and dairy cattle production account for the majority of emissions and strong projected growth of this production will result in higher emissions and volumes over time. Building the evidence for the most appropriate mitigation methods; increasing capacity of relevant stakeholders in climate smart crop-animal techniques; and using this evidence and awareness to mainstream environmental and climate change considerations into animal development, has the potential to provide a meaningful contribution to the achievement of sustainable animal production and climate compatible growth in Rwanda. The achievements will be through investing in the following areas: ● Animal feeds, their safety and feeding, husbandry practices; ● Animal disease control and health management; ● Promotion of the use of high quality animal genetic resources; ● Fisheries and aquaculture development; ● Improving the production of commercial insects; ● Mainstreaming climate smart animal production technologies.
	2.4. Promotion of nutrition sensitive agriculture. Increasing food production is the major target in the agriculture sector. In many decades, promotion of high yielding crop varieties was the preoccupation of the majority of agricultural research and extension organisations. However, food that meets the nutritional requirements for human and animal consumption is paramount for increased food and nutrition security. Currently, improved crop varieties that meet the nutritional values to meet daily body requirements is the top priority. For example, bio-fortified bean varieties (Zn and Iron) and orange flesh sweet potatoes (Pro-vitamin A) have been promoted in African countries including Rwanda. Furthermore, cattle and milk carry a high socio-cultural value, represent a significant source of protein in the typical Rwandan diet, and make up a growing share of total agricultural production. The dairy, beef, poultry and fish sub-sectors offer a pathway out of poverty and malnutrition for large numbers of livestock-keeping households due to the high protein, energy and income the sector can yield. RAB will therefore continue to promote nutrition sensitive agriculture to increase food and nutrition security, thus contributing to eradication of malnutrition in the country. Nutrition focus will consider promotion of nutrient dense indigenous foods (e.g. leafy vegetables).
Value chain and market	**3.1. Post harvest handling, crop and animal product aggregation and**

development	**market linkage.** The agriculture sector in Rwanda remains largely fragmented, with many smallholder farmers, and weak market linkages to agribusinesses (inputs providers, processors, and traders). Market-oriented production and aggregation is weak, and producers lack basic data and market information, including standardized quality criteria required by processors and traders. Significant productivity gains can be made by addressing significant post harvest losses. Agricultural commodities vastly vary in terms of their losses ranging from beans at 15 percent, milk at 33 per cent, cassava at 43 percent, to potatoes as high as 45 percent (PSTA IV). The RAB Strategic plan will strengthen the harvesting, post- harvest handling, trade, storage, processing and marketing within the crop value chain as well as livestock in Rwanda. This strategic objective will mainly focus on the following points: ● Increase the post-harvest facilities including drying, storage, cold room, threshing and shelling ● Provide improved information and data on post-harvest losses along the entirety of prioritized value chains, and improved market information to facilitate efficient trading ● Provide technical capacity building at producer and first aggregator level, upgraded post-harvest technology (mechanization, industrial shelling and drying, logistics and management) ● Strengthen capacity for staff involved in post harvesting and marketing ● Promote innovations and technologies for value addition for agro-processing industries to produce the competitive agriculture products to markets ● Mobilize and support the private sector to invest in post-harvest technologies ● Enhance producers' access to and linkages with markets (contract farming) This strategy will be directed at improving the knowledge of farmers and agri-food processors on post-harvest treatment of agricultural products, at increasingly using food preservation techniques (drying, canning, or small-scale processing in both crops and livestock), and at building storage and cooling facilities. Agriculture accounts for 70% of the labour force and yet the sector contributes little value add to GDP. The transformation of agriculture reallocates workers from low productivity into high productivity jobs, and hence moves people out of poverty. Agri-food processing offers viable solutions for the economy of Rwanda, and needs to be strongly fostered to absorb the produce from growing agricultural productivity, and better paying-jobs.
Strengthening organization capacities and resource management	**4.1. To improve human capacity development and management** The effectiveness of the Rwanda Agriculture and Animal Resource Board hinges on availability of trained, dedicated and motivated human resources and their effective management. RAB needs to invest in skills

	audit and use that as a basis to address human capacity development. The last corporate retreat held in July 2019, identified key challenges related to staff management and made recommendations that are reflected in this strategic plan. They include (i) Elaborating and implementing a proper staff capacity building plan (ii) Improving employee planning and staff development for optimal workforce requirements and succession; (iii) Compliance with laws and regulations governing public service with regard to grade promotion; (iv) Strengthening social cohesion and team spirit building in RAB community; (v) Exploiting the new RAB organization structure to strengthen the chain of command within the institution to empower staff to perform functions, make decisions and ensure implementation in an effective, efficient and sustainable manner.
	4.2. To improve and manage RAB infrastructure for better delivery RAB will strengthen its stations situated in the different agro climatic zones to become hubs for technology development and disseminations. To achieve this, RAB will actively advocate for the rehabilitation of its infrastructure, and where needed ,avail them to public and private actors for use in activities, adding value to RAB objectives.
	4.3. To strengthen the use of ICT in RAB management and service delivery To achieve this, RAB will a) Develop and implement cohesive knowledge, information and communication technologies platform/database; b) Establish, operationalize and maintain ICT infrastructure; c) Develop and implement data integration and analytics tools; d) Establish support for knowledge and information management and transfer.
	4.4. To improve corporate affairs and communication RAB is committed to develop and implement its corporate brand as an effective institution in research, and an institution to support the transformation of Rwandan agriculture. For this purpose, RAB will redefine its motto to reflect what it is and what it is doing. RAB will improve its visibility through frequent press releases, an active and interactive website, radio, TV and social media, and engage with media specialized in agriculture. Emphasis in communication will be put in internal as well as external communication, improving customer care for RAB staff and guests, and putting in place mechanisms for effective coordination and engagement with all RAB stakeholders.

CHAPTER 4: IMPLEMENTATION, MONITORING AND EVALUATION OF THE STRATEGIC PLAN

The successful implementation of the strategic plan will largely depend on the commitment of the management and the staff dedication and having efficient monitoring and evaluation mechanisms in place. A monitoring and evaluation framework will facilitate the implementation of the strategic plan by using a logical framework, which will be developed at RAB, Division, Department and Program levels. Annual milestones, outputs and performance indicators will be developed, and progress of implementation tracked on an annual basis at RAB, Division, Department and Program levels.

4.1. Theory of change to achieve objectives of the strategic plan

The objectives of the strategic plan will be achieved, if strategic responses to mitigate identified weaknesses and threats in the SWOT analysis, are adopted and used by the RAB management and staff. Then, this will enable the aims of the NST-1 modernizing and increasing agricultural and livestock productivity to be achieved. Also, the national agriculture policy and PSTA-4 target towards development of a productive, green and market-led agriculture sector will be delivered. Under the context of rapid changes experienced in the sector and concerns including climate change, increased pressure on land, the need to feed the cities, the absorption of rural youth into urban labour market and the need to raise productivity of smallholder farmers, the PSTA IV targets wealth contribution, increased economic opportunity, improved food and nutrition security and increased resilience of the agriculture sector.

Figure 2 shows the impact pathways for theory of change.

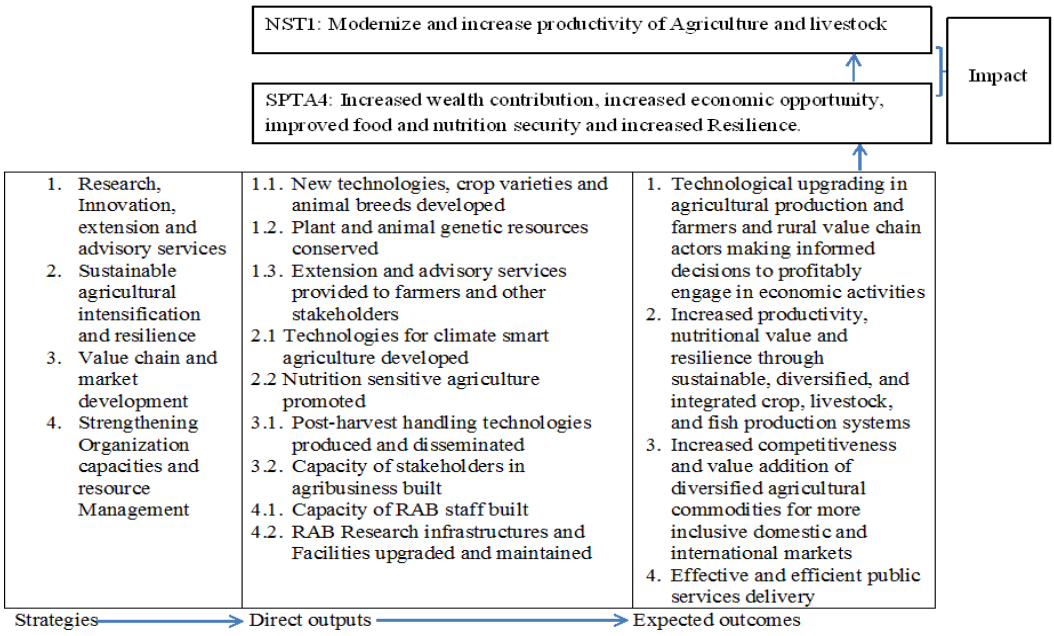

Figure 2: Impact pathways of the theory of change

4.2. Monitoring and Evaluation Mechanisms

The following M&E mechanisms will be used during the implementation of the Strategic Plan:

a) **Annual Action Plans and Performance Contracts:** The Division, Department, Program and other units will develop annual work plans based on the Strategic Plan. Implementation plans will have well defined activities, annual targets and specific timelines for implementation (Annex 2). The RAB plan will be cascaded to all Division, Department, Program and other units and staff, who will prepare annual targets that will be monitored and reported in conformity with the performance contract arrangements.

b) **Supervision:** RAB will carry out supervision of the Strategic Plan's implementation and prepare quarterly and annual reports. Findings from the supervision missions will be followed up with appropriate actions.

c*)* **Service Delivery Surveys and Field Visits:** Surveys and field visits to assess the effectiveness and quality of service delivery will be undertaken. The information from the surveys will be disseminated to all the stakeholders including the organization's management to ensure appropriate actions are taken.

d) **Annual Review Meetings (SARM):** These meetings will be held with stakeholders' representatives to track progress of the Strategic Plan's activities and outputs during implementation. The meetings will also enable the organization and stakeholders to identify and take necessary actions to address emerging challenges.

e) **Mid Term Review:** A mid-term review will be organized to assess the level of implementation of the Strategic Plan. Review meetings will be held with stakeholders' representatives and the findings will inform the need for any changes in the implementation of the Strategic Plan for the remaining period.

f) **External Programme and Management Review:** This review will be undertaken by external subject matter specialists contracted by RAB Management. The assessment will cover research activities of the organization, prevailing administrative, financial, scientific and management structures as well as processes. Special emphasis will consider the role of linkages between the various research and outreach, planning, budgeting, monitoring and reporting organs of the organization and partners.

The review will be undertaken towards the end of the Strategic Plan period so that the results can inform the development of the subsequent Strategic Planning period. The external experts will be expected to provide an unbiased review to enable management to re-focus the research programmes and corporate services to be in line with the international best practices.

g) **Internal scientific meetings:** To review the research agenda, keep track of the major research conducted at RAB, maintain scientific standards and focus on relevant priorities, internal scientific meetings will be organized for RAB scientists. A number of issues emerging inside and outside of the country will be discussed in these meetings: climate change impact resulting in appearance of new disease/pest outbreaks, system research and findings about sustainability and nutrient management, existing and emerging research gaps, the extension agenda and new approaches, use of ICT-based applications, especially those for

extension service delivery and role of RAB in the running/maintenance/repair of the new extension service delivery tool, the reasons of yield increase stagnation under CIP etc.

4.3. Reporting and Learning

Reporting the progress of implementation will be critical in adjusting strategic directions and measuring performance. There will be quarterly monitoring and evaluation reports. The reports will outline in summary form the projected targets, achievements/ milestones attained, facilitating factors and challenges. The lessons learnt will enable the management to institute appropriate remedies to overcome any challenges.

4.4. Implementation and Coordination

4.4.1. Implementation Framework

To operationalize the Strategic Plan, a detailed Implementation Framework (IF) covering the Strategy Plan period will be developed. The key activities for the implementation and coordination will include: a) Sensitizing staff on their roles in the plan implementation; b) Communicating the plan to various stakeholders; c) Assigning and communicating roles and responsibilities to different players; d) Allocating resources as per priority activities identified in the plan; e) Setting up Strategic Plan implementation committees for (1) research; (2) extension and (3) internal functioning/connections between different units inside of RAB; f) Preparing annual action plans; g) Monitoring and evaluating the implementation process; and h) Conducting a post-implementation review to bring out lessons learnt and share the results with relevant stakeholders.

4.4.2. Automation of Strategic Plan Implementation

The Strategic Plan progress will be measured by outcomes for each of the Key Result Area . Outcome categories will be labelled as indicators, and the measures for each indicator will be reported. These measures will be aligned to the mission and vision of RAB as well as the needs and expectations of internal and external stakeholders.

4.4.3. Implementation Committees for RAB Strategic Plan 2020-2024

The Director General will establish Strategic Plan implementation committees comprising members from the Secretariat and the representatives of all Divisions and Departments for (1) research, (2) extension and (3) internal links, communication flow and interactions inside RAB. The committees will be responsible for prioritizing the strategic directions identified in the process of the Strategic Plan implementation; identifying major trajectories that correspond to RAB's research vision; planning, coordination and development of efficient and effective implementation strategies of the research programmes.

4.5. Risk Management

Risk management is important to reduce the possibility of failure and ensure that the objectives are accomplished. The implementation of the Strategic Plan can be affected by various risks which are unforeseen at the time of planning. It is therefore important to identify possible risks that can have adverse impacts on the organization during the implementation of

the Strategic Plan and plan mitigation strategies to put in place to manage potential risks, as shown in Table 14.

Table 14: Potential Risks and Mitigation Strategies

No	Type of risk	Impact of risk	Mitigation strategies
1	New disease/pest outbreaks	High	• Create awareness among staff on possible outbreaks • Strengthen RAB based plant and animal health facilities to handle emergencies in more efficient manner • Train staff on disaster preparedness • Build capacity for quick response to disasters • Liaise with MIDIMAR to train staff on quick response and coping strategies Make use of ICT for fast pest outbreak reporting
2	Increased natural disasters	High	• Create awareness among staff on possible outbreaks • Strengthen RAB based plant and animal health facilities to handle emergencies in more efficient manner • Train staff on disaster preparedness • Build capacity for quick response to disasters • Liaise with MIDIMAR to train staff on quick response and coping strategies
3	Longer droughts and interrupted rain frequency	High	• Support installation of rain water harvesting technologies for farmers • Conserve water • Reserve emergency seed with RAB Seed Division • Develop drought tolerant crop varieties and livestock breeds • Promote culture of tree planting on farm and along road-sides in villages, sectors and districts
4	Cash flow problems	High	Prepare budget requests in collaboration with the concerned units to avoid situations where one unit receives funds and the fund for another unit was planned and approved but not requested for a specific quarter.
5	Financial dependence on external funds	High	Carry out high level lobbying to increase the proportion of national budget allocated to agriculture.
6	Negative reports in media	High	Increase media coverage on innovations and their scaling out. – implement communication strategy Need to have communication/information staff
7	Environmental health hazards	Medium	Prepare contracts with the existing incinerators for disposal of dangerous expired chemicals from RAB

			laboratories.
8	Delay in developing quality standards and management packages for new crops	High	Work closely with NAEB and focus research on the current export crops (e.g. pepper) to develop quality standards and management packages.
9	Challenge in coping with rapidly emerging new technologies	Medium	Prepare budgets and contracts with application developers to develop new, and maintain the existing smartphone applications, dealing with delivery of various extension messages (info on diseases/pests and reports on incidence; fertilizer and seed orders; etc.)
10	Inability to respond to changing demand for technologies (seeds for new export crops)	Medium	Develop products using participatory methods. Ensure products are widely promoted through demonstrations, trade fairs and marketing advertisements in media and other channels.
11	Delay in developing quality seeds for new crops	High	Assist private seed producers for new export crops in terms of capacity, quality standards for seeds and procedures for seed acquisition.
12	Poor communication and interactions between different units at RAB	High	Assign the responsibilities and staff for each contract management, create a communication framework for main messages between units (e.g. program leaders to be involved/informed about budget requests prepared and funds arrived).
13	Poor record keeping	High	Develop internal record keeping system (online information management system) and record monitoring schedule; assign staff to check if records are kept; identify type of reports to be kept and appropriate details of record keeping (e.g. not number of fertilizer 50 kg bags, but NPK 17-17-17, number of 50kg bags)

Annex 1: MONITORING AND EVALUATION FRAMEWORK FOR RAB STRATEGIC PLAN 2020-24

Strategic Objectives	Activities	Cost Per Activity(Frw)	Indicators	Baseline	Targets 2020/21	Targets 2021/22	Targets 2022/23	Targets 2023/2024	Responsible	Means of Verification	Assumptions
KEY RESULTS AREA 1: Research, Innovation, extension and advisory services											
OUTCOME 1: Technological upgrading and capacitated farmers and rural value chain actors who make informed decisions and profitably engage in off farm activities											
1.1 Promoting demand driven research based on farm's need and national priorities in crop production and protection, animal production and health as well as natural resources	Develop new technologies and crop varieties and breeds	66,017,646,877	Number of new technologies, crop varieties and breed developed	72	20	20	20	20		RAB Report	
	Establish screen house facilities	720,000,000	Number of screen house facilities established	47 screen houses	4	4	4	4	RAB seed programme and private partners	RAB Report	
	Update the soil fertility map	360,000,000	Number of soil fertility maps produced at country level and by region	2	1	2	2	2		RAB Report	
	Developing and promoting bio-fertilizer technologies (Vermi-composting, enriched compost)	240,000,000	Number of bio-fertilizer technologies developed and promoted	-	1	2	2	2		RAB annual report	

	Developing site specific fertilizer recommendations	4,000,000,000	Number of fertilizer recommendations developed and promoted	Blanket	6	2	4	4		RAB annual report	
	Developing Integrated Soil Fertility Management (ISFM) technologies	240,000,000	Number of integrated soil fertility technologies developed and promoted	1	2	4	4	4		RAB annual report	
	Developing lime recommendations for different soil acidity levels	200,000,000	Number lime recommendations developed for different soil acidity levels	Blanket	1	3	3	3		RAB annual report	
	Upgrading and maintaining soil research Infrastructures and Facilities	500,000,000	Number of soil laboratory, drying facilities established and maintained	1 wet based soil and plant laboratory operational	1 dry based soil laboratory established	1 soil drying facility constructed	1 soil physical laboratory equiped			Physical observations and RAB annual report	
	Update the soil fertility map	400,000,000	Ha of land surveyed and tested	15,000	30,750	45,750				RAB Report	
	Conduct Limnology studies	1,446,919,794	Number of study done	2	2	2	2	2		RAB R400eport	

1.2. Capacity building of public and private extension actors along the different value chain	Provide Extension and/or advisory services to farmers and capacity building to Extension agents	109,677,418,725	Percentage of farmers who received extension and/or advisory services including climate-smart and nutrition-sensitive agriculture		76	78	80	82		EICV	Timely availability of financial resources and increased FTE
			Number of FFS facilitators trained on crops	2500	2500	2500	2500	2500			
			Number of farmer promotors trained on crops	14,200	14,200	14,200	14,200	14,200		RAB Report	
			Number of Master trainers (Training of trainers) for livestock trained	40			50	40		RAB Report	
			Number of farmer promotors trained on Livestock		1000	1000	1000	700		RAB Report	
			Number of farmer promoters trained on improving veterinary extension services		2000	3000	3000	3000		RAB Report	
			Number of facilitators trained on improving fisheries and aquaculture extension services		50	50				RAB Report	

			Number of promotors trained on improving fisheries and aquaculture extension services		150	150				RAB Report	
KEY RESULT AREA II: Sustainable agricultural intensification and resilience											
OUTCOME 2: Increased productivity, nutritional value and resilience through sustainable, diversified, and integrated crop, livestock, and fish production systems											
2.1. Sustainable land husbandry and crop production intensification	Improve land productivity and production	150,944,946,979	Yield of priority crops(MT/Ha)								Inputs timely provided to farmers; package of supports adapted to farmers' needs and options and Farmers are willing to consolidate their land
			Maize	1.4(2019)	2.34	2.76	2.85	2.94		SAS	
			Paddy rice	4.02(2019)	4.05	4.08	4.11	4.14			
			Wheat	1.2(2019)	1.29	1.44	1.6	1.77			
			Cassava	14.4(2019)	3.2	3.77	4.45	5.25			
			Irish Potatoes	9.3(2019)	11.6	13.5	13.76	14.23			
			Beans	0.85(2019)	1.69	1.86	2.04	2.22			
			Soya beans	0.530(2019)	0.84	0.97	1.11	1.28			
			Vegetables	10.56(2019)	11.82	12.53	13.28	14.08			
			Banana	11.7(2019)	3.89	4.08	4.29	4.5			
			Ha of Land	76511	877703	980000	980000	980000			

			consolidation	0							
			Quantity of fertilizers per ha (Kg/Ha)	50	51	60	65	75		RAB,NAEB	
			Quantity of subsidized seeds distributed to farmers	6665.1	6410	6410	6410	6410		RAB/MINAGRI	
	Radical terracing	52,746,236,889	Radical terraces	127,613	130,349	132,849	135,349	142,500		RAB; MIS	
			Progressive terraces	959,182	969,558	979,604	993,604	1,007,624		RAB; MIS	
	Biological soil conservation practices	2,009,108,249	Biological soil conservation practices development		75,000	100,000	125,000	150,000		RAB; MIS	
	Professionalize cooperatives in multiplying seeds	4,773,344,587	Percentage of farmers use quality seeds: on consolidated sites/large-scale farmers) (disaggregated by gender)		63	67	71	75		RAB	
			Percentage of farmers use quality seeds/ non-consolidated sites	16.2	30	36	43	50		SAS	
	Promotion of integrated plant protection and pest management	8,038,443,300	Percentage of farmers who practice integrated pest management		5	7	9	11		RAB	

	Promote mechaanization	1,266,767,530	Percentage of mechanized farm operations	26(2019)	37	41	45	50		RAB	
2.2. Promoting climate smart agricultural technologies	Develop effective and efficient Irrigation systems	450,433,757,823	Ha of irrigation developed within an Integrated Water Resources Management Framework (cum.):	58,432	77,084	85,484	93,884	102,284		RAB	Funds for Irrigation infrastructures development is available
			a. Hillside (medium-large scale)	8,780	15,989	18,389	20,789	23,189		RAB	
			b. Marshland medium-large scale)	37,273	45,521	48,521	51,521	54,521		RAB	
			c. Small-scale hillside	12,379	15,574	18,574	21,574	24,574		RAB/MIS	
	Put in place mechanisms for increasing climate resilience	8,038,443,300	Percentage of farmers receiving weather and climate information products/services		15	20	30	50			
			Number of vulnerable farmers who have benefitted from asset building programmes		68,000	93,000	103,000	110,000		RAB, Districts, MIS, surveys	

2.3. Sustainable animal production intensification	Improve animal resources (Including fisheries) production systems	450,433,757,823	Percentage of farmers using improved feed/ fodder and technologies (hay, silage, improved pasture) (disaggregated by gender)		13.5	15	16.5	18		RAB	
			Percentage of livestock owners accessing animal health services (disaggregated by gender)		96	97	98	100		RAB	
			Number of fingerlings production(*1000)	21.4	30,000	60,000	100,000	180,000		RAB	
			Number of bovine Artificial Insemination	105,964	130,000	120,000	110,000	100,000			
			Improved local breed as a percentage of local breeds (by livestock type)		41	42	43	44		RAB, Districts	
			Animal products produced(*1000 MT)								

			Milk	847(2019)	850	875	900	925		RAB/MINAGRI	Private investment will complement public investment
			Meat	162.5(2019)	146	187	207	215			
			Honey	5.2(2019)	7	7	8	8			
			Eggs	7.9(2019)	9	9.5	10.2	11.2			
			Fish	35	65	90	100	112			
2.4.Promotion of nutrition sensitive agriculture	Enhance nutrition sensitive agriculture	29,125,646,462	Number of Chicken distributed (Cumul)	156,800	800,000	1,000,000	1,200,000	1,400,000		RAB	
		20,096,108,249	Number of pigs distributed	8,755	200,000	250,000	300,000	350,000		RAB	
		58,816,226,113	Number of cows distributed	25,499	31,000	32,000	32,500	33,000		RAB	
KEY RESULT AREA III: Value chain and market development											
OUTCOME 3:Improved productivity and inclusiveness of agricultural market systems and increased value addition and competitiveness of diversified agricultural commodities											
3.1 Post harvest handling, crop and animal product aggregation and market linkage	Strengthen post-harvest handling, aggregation, and pre-processing	4,099,606,082	Number of beneficiaries trained on Reduction of post-harvest losses		360	360	360	360		360	
		4,019,221,650	Number of post-harvest handling technologies produced and			100	100	100		100	

			disseminated								
		1,004,805,412	Number of cooperatives trained on marketing and aggregation services			500	500	500		500	
		1,507,208,119	Number of cooperatives trained on improved standards, grading and technology			500	500	500		500	
KEY RESULT AREA IV: Strengthening Organization capacities and resource Management											
OUTCOME 4: Effective and efficient public and private sector services in the agriculture sector delivered to all sector stakeholders.											
4.1. Improve human capacity development and management	Increase capacity of RAB Staff	11,173,714,197	Number of staff trained for professional courses, For MS and PhD degrees (In different domain)	5		6					
4.2. To mobilize and manage efficiently financial resources	Manage efficiently financial Resources		Financial statements done and validated		1	1	1	1		1	
4.3. To improve and manage RAB infrastructure for better delivery	To rehabilitate RAB Research Stations		RAB Research stations rehabilitated and maintained		13	13	13	13		13	

4.4. To Strengthen the use of ICT in RAB management and service delivery	To maintain Installed Video Conference		RAB Research stations and HQ equipped with Video conferences	13	13	13	13	13		13	
	To install internet connectivity in all RAB Stations		RAB Research stations and HQ equipped with Internet Connectivity	13	13	13	13	13		13	

REFERENCES

MIDIMAR (Ministry of Disaster Management and Refugee Affairs) of Rwanda, 2016. National Disaster Contingency Matrix Plan, Kigali, Rwanda

MINAGRI, 2018. Strategic plan for agriculture transformation 2018-24. MINAGRI, Kigali, Rwanda, 235 p.

MR (Meteo Rwanda), 2016. Post El Niño Analysis of Meteo Rwanda, Kigali.

NISR (National Institute of Statistics of Rwanda) 2020a. Gross domestic product first quarter 2020. Kigali, Rwanda, 12p.

NISR, 2018. The fifth integrated household living conditions survey EICV5 - 2016/2017. Rwanda poverty report, Kigali, 66p.

NISR, 2019a. Gross domestic product first quarter 2019. Kigali, Rwanda, 12p.

NISR, 2019b. Gross domestic product second quarter 2019, 13 p.

NISR, 2019c. Gross domestic product and its structure. Third quarter 2019, 11p.

NISR, 2019d. Gross domestic product – fourth quarter 2019, 11 p.

REMA, 2011. Green Growth and Climate Resilience National Strategy for Climate Change and Low Carbon Development. Kigali, Rwanda.

Vision 2050. Future Drivers of Growth in Rwanda: Innovation, Integration, Agglomeration, and Competition, doi: 10.1596/978-1-4648-1280-4. KIGALI, 49P.