NARO

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2023-2024



National Agricultural Research Organisation (NARO)

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List of Acronyms

AEZ	Agro-Ecological Zones
AJOL	African Journals Online
ARA	Agricultural Research Activity
ARDC	Agricultural Research Development Center
ARIPO	African Regional Intellectual Property Organisation
ASF	African Swine Fever
BCTB	Black Coffee Twig Borer
BMAU	Budget Monitoring and Accountability Unit
CAADP	Comprehensive African Agricultural Development Programme
CABI	Centre for Agriculture and Bioscience International
CAII	Centre for Agricultural Inputs International
CAL	Catalyst Africa Limited
CBSD	Cassava Brown Streak Disease
CDSC	Country Development Cooperation Strategy
CGIAR	Consultative Group on International Agricultural Research
CMD	Cassava Mosaic Disease
CoC	Certificate of Compliance
COMESA	Common Market for Eastern and Southern Africa
CPA	Certified Public Accountant
CWD	Coffee Wilt Disease
DATP	Directorate of Agricultural Technology Promotion
DDG-R	Deputy Director General Research
DLG	District Local Governments
DITRA	Defence Threat Reduction Agency
DO	Development Objective
DUS	Distinctiveness, Uniformity and Stability

EGS	Early Generation Seed
EO	Earth Observation
EOC	Equal opportunities commission
FBI	Food Bio sciences
FMD	Foot and Mouth Disease
FY	Financial Year
GIS	Geographic Information System
GAPs	Good Agricultural Practices
HACCP	Hazard Analysis Critical Control Points
IACUC	Institutional Animal Care and Use Committee
IAG	Internal Auditor General
IBC	Institutional Biosafety Committee
IECs	Information Education and Communication
IP	Intellectual Property
IPM	Integrated pest management
IPMC	Intellectual Property Management Committee
ISSD	Integrated Seed and Sector Development Uganda
KaZARDI	Kachewkano Zonal Agricultural Research and Development Institute
KM	Knowldege Management
LSBs	Local Seed Businesses
MAAIF	Ministry of Agriculture Animal Industry and Fisheries
MbaZARDI	Mbarara Zonal Agricultural Research and Development Institute
MDAs	Ministries, Departments and Agencies
MoFPED	Ministry of Finance Planning and Economic Development
MoLG	Ministry of Local Government
MoPS	Ministry of Public Service

MoU	Memorandum of Understanding
MoWE	Ministry of Water and Environment
MP	Member of Parliament
MSIPs	Multi Stakeholder Innovation Platforms
NARL	National Agricultural Research Laboratories
NaSARRI	National Semi-Arid Resources Research Institute
NHL	NARO Holdings Limited
NPA	National Planning Authority
NaCOFE	NARO Coffee
NaCORI	National Coffee Research Institute
NaCRRI	National Crops Resources Research Institute
NaFIRRI	National Fisheries Resources Research Institute
NaFORRI	National Forestry Resources Research Institute
NaLIRRI	National Livestock Resources Research Institute
NARIs	National Agricultural Research Institutes
NARO	National Agricultural Research Organisation
NDP	National Development Plan
NPK	Nitrogen Phosphorus and Potassium
OAG	Office of the Auditor General
OPM	Office of the Prime Minister
OPVs	Open Pollinated Varieties
OWC	Operation Wealth Creation
PARI	Public Agricultural Research Institute
PFM	Planning Finance Management
PFM	Public Finance Management Act

PIAPs	Programme Implementation Action Plans
PMB	Papaya Mealy Bug
PMIS	Partnership Information Management System
PSST	Permanent Secretary/ Secretary to Treasury
PVP	Plant Variety Protection
QDS	Quality Declared Seed
RCC	Resident City Commissioner
RDP	Regional Development Programme
R&D	Research and Development
RTUs	Remote Telemetry Units
SDG	Sustainable Development Goals
SLM	Sustainable Land Management
SMEs	Small and Medium Enterprises
STI-OP	Science Technology and Innovation
STR	Striga Resistance
TIMPs	Technologies, Innovations and Management Practices
TPM	Top Policy Management
UCDA	Uganda Coffee Development Authority
UG	Uganda
UJAS	Uganda Journal of Agricultural Sciences
UNFFE	Uganda National Farmers Federation
UNCST	Uganda National Council of Science and Technology
UPDF	Uganda Peoples Defence Forces
URBS	Uganda Registration Bureau Services
ZARDIs	Zonal Agricultural Research and Development Institute



Message from the Chairman, NARO Governing Council

On behalf of the Governing Council of the National Agricultural Research Organization (NARO), it is my distinct honor to share my reflections on the achievements and progress made during fy 2023/2024 documented in this report. This year, NARO has once again demonstrated its pivotal role in advancing agricultural research and development, contributing significantly to the sustainable growth of our agricultural sector.

Our achievements are a testament to the dedication and expertise of both our staff and partners. During this year, we ushered in a new breed of top policy management leaders including the Deputy Director General in charge of Research coordination (Dr. Mugerwa Swidiq), the Director of Finance (CPA Tegiike Mununuzi), Corporate Services (Dr. Stevens Kisaka) and Human Resource (Mr. Mark Serembe). At the institute level, the National Livestock Resources Research Institute (NaLIRRI), Kachwekano and Buginyanya ZARDIs also got substantive leadership from Prof. Majalija Samuel, Dr. Jerome Kubiriba and Dr. Nasser Kasozi, respectively.

We also have a host of new crop varieties designed to improve crop resilience, enhance food security, and boost agricultural productivity.

They further address challenges faced by farmers and contribute to the sector's overall sustainability. Guided by the strategic plan, NARO released new varieties to ensure that farmers have access to crops that are

more resilient to pests, diseases, and climate change, thereby securing a more reliable and productive food supply for the nation.

Ticks have long been a major problem for farmers in Uganda, leading to significant economic losses due to decreased livestock health and productivity. The development and upcoming mass production of the anti-tick vaccine is a groundbreaking achievement for NARO. This vaccine is capable of providing cross-protective immunity against multiple tick species, and is expected to save farmers substantial costs related to tick infestations.

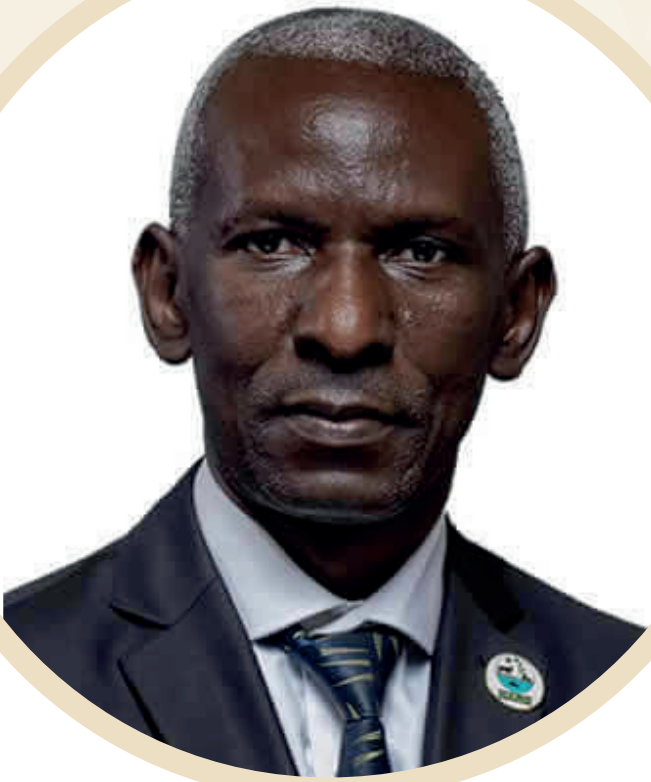
This vaccine will boost agricultural productivity and have a profound economic impact on the country by improving livestock health and reducing the need for chemical acaricides. The construction of the largest anti-tick vaccine production facility in sub-Saharan Africa underscores our commitment to addressing livestock health challenges head-on and solidifies NARO's position at the forefront of recombinant vaccine technology.

As we reflect on these accomplishments, I extend my deepest appreciation to the NARO team, our partners, and stakeholders. Your unwavering support and collaboration have been instrumental in achieving these milestones. Together, we will continue to drive forward the frontiers of agricultural research, ensuring a prosperous and sustainable future for our agricultural sector and the communities we serve.

Thank you.



Dr. William Olaho Mukani
Chairman NARO Governing Council



Foreword by the Director General

I am honored to present the highlights of our key achievements for the Financial Year 2023-2024. This year has been marked by substantial achievements across various sub-sectors, underscoring our commitment to advancing agricultural research and innovation for the benefit of our nation and beyond.

In the past year, NARO has strengthened the required institutional capacity to deliver its mandate. In terms of human resources, we attracted new and talented staff with the required skill set and also improved the operation environment as well for staff motivation. We also started implementing the Public Service-approved staffing structure to deliver better on our mandate. We continued to complement government funding with additional resources from partners to strengthen human capacity and the required competencies in market-let and climate-oriented research. We engaged and increased efforts to build sustainable funding, innovation and scaling partnerships between NARO and one CGIAR.

Our efforts in the Crop sub-sector have been particularly noteworthy. We successfully released twelve new crop varieties, including sweet potatoes, rice, groundnuts, maize, beans, and lablab. These varieties promise to enhance food security and agricultural productivity. Additionally, we developed four plant-specific NPK fertilizer formulations tailored for coffee and beans, which will help reduce fertilizer costs and improve crop yields. Our ongoing work on updating the Jinja soil sheet and developing Striga-tolerant maize and high-oil groundnut varieties will further support sustainable agriculture.

In the Livestock sub sector, NARO made groundbreaking advances with the development of an anti-tick vaccine. This vaccine, which provides cross-protective immunity

against three tick species, positions us as a global leader in recombinant vaccine production. Our facility, capable of producing over 20 million doses annually, is set to be the largest of its kind in sub-Saharan Africa. Furthermore, our innovative model for predicting Foot-and-Mouth Disease (FMD) occurrences using AI and Machine Learning has set a new benchmark in disease forecasting with a sensitivity of 98.3%.

The development and release of a maiden lablab variety released as NARO LABLAB 1 is a game changer for the livestock industry as it offers a cheaper source of high-quality protein in smallholder production systems and is expected to reduce on ratio and/or replace soybean that has been depended on as main ingredient of livestock feed yet costly.

The Forestry and Fisheries sub-sector also saw significant advancements. We identified genes responsible for shea butter oil biosynthesis, paving the way for improved shea nut varieties, and developed a grafting protocol for jackfruit to reduce fruiting time. In fisheries, genomic characterization of Nile tilapia and African catfish, along with new protocols for labeo species under captivity, are poised to enhance aquaculture diversity and productivity.

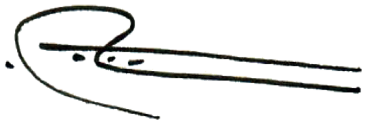
Compliance with international research standards and facilitating germplasm exchange remain key priorities. Our accreditation by UNCST and efforts to develop comprehensive research guidelines reflect our dedication to maintaining high standards.

We have also made strides in research planning, reporting, and publications, with over 200 publications this year, including a standout paper in Nature Biotechnology. Our competitive grant scheme, environmental and social safeguards initiatives, and the establishment of new research platforms further illustrate our unwavering commitment to excellence.

As NARO, we understand that we can achieve more through strategic partnerships and collaborations. We have thus worked hard to sustain and form new partnerships not only in government but also with civil society, the donor community, cultural institutions, the private sector and industry.

NARO continues to streamline and professionalize the allocation of varieties to private seed companies, and last year, we signed plant variety licensing agreements with ten new companies to commercialize NARO crop varieties.

As we move into a new year, I extend my heartfelt gratitude to our dedicated staff, partners, and stakeholders for their unwavering support. Together, we will continue to drive agricultural innovation, ensuring progressive agriculture and prosperity for all.



Dr. Yona Baguma
Director General

SECTOR POLITICAL LEADERSHIP



Hon. Frank K. Tumwebaze
Minister of Agriculture, Animal Industry and Fisheries



Hon. Bwino Fred Kyakulaga
Minister of State for Agriculture



Hon. Bright Rwamirama
Minister of State for Animal Industry



Hon. Hellen Adoa
Minister of State for Fisheries

THE 5TH NARO GOVERNING COUNCIL



Dr. William Olaho Mukani
Chairperson NARO Governing Council



Rev. Dr. Susan Awino
Chairperson, Users Committee



Ms. Nankunda Olivia Mpuuga
Chairperson, Audit and Risk Committee



Mr. Katungisa Kenneth
Chairperson, Finance and Human Resources Committee



Dr. John Wasige
Chairperson, Science Committee



Ms. Masika Kateeba Jolly
Member, UC



Prof. James M. Kajete
Member, UC/SC



Ms. Nanvuma Rehema Wandera
Member, FHRC



Dr. Martin Patrick Ongol
ED, UNCST Member, SC



Ms. Akullo Sharon Atoo
Member, UC/SC



Dr. Sylvester Dickson Baguma
Member, SC



Dr. Ramathan Goobi
PSST, MoFPED
Member, FHRC



Maj. Gen. David Kasura-Kyomukama
PS, MAAIF
Member, FHRC



Dr. Samuel Mugasi
Executive Director, NAADS
Member, FHRC & UC



Dr. Yona Baguma
Director General, NARO
Member, FHRC & SC

NARO TOP MANAGEMENT



Dr. Ambrose Agona
Director General – NARO



Dr. Swidiq Mugerwa
Deputy Director General, Research Coordination



Dr. Sadik Kassim
Deputy Director General, Technology Promotion



CPA Tegiike Julius Mununuzi
Director, Finance



Mr. Mark Serembe
Director, Human Resources



Mr. Denis Owor
Director, Internal Audit



Dr. Stevens Kisaka
Director, Corporate Services

DIRECTORS OF PUBLIC AGRICULTURAL RESEARCH INSTITUTES



Dr. Godfrey Asea
National Crop Resources Research Institute (NaCRRI)



Dr. Geoffrey Arinaitwe
National Coffee Research Institute (NaCORI)



Dr. Winnie Nkalubo
National Fisheries Resources Research institute (NaFIRRI)



Dr. Hillary Agaba
National Forestry Resources Research Institute (NaFORRI)



Dr. Robooni Tumuhimbiise
National Agricultural Research Laboratories (NARL)



Prof. Samuel Majalija
National Livestock Resources Research Institute (NaLIRRI)



Dr. Michael Ugen
National Semi Arid Resources Research Institute (NaSARRI)



Dr. Nasser Kasozi
Buginyanya ZARDI



Dr. John Walakira
Abi ZARDI



Dr. Sylvester Dickson Baguma
Bulindi ZARDI



Dr. Halid Kirunda
Mbarara ZARDI



Dr. Barbara Zawedde
Mukono ZARDI



Dr. Laban Turyagyenda
Ngetta ZARDI



Dr. Titus Alicai
Rwebitaba ZARDI



Dr. Jerome Kubiriba
Kachwekano ZARDI



Dr. Paul Okullo
Nabuin ZARDI

NARO Performance Summary FY 2023/2024

NARO contributes to NDP III programs particularly the Agro-industrialization program and other government frameworks including Presidential strategic guidelines and directives. It primarily develops and promotes appropriate technologies, innovations and management practices aimed at increasing productivity and production for improved livelihoods and economic development.

In addition to coordination of agricultural research in the country, NARO undertakes agricultural research through her 16 PARIs in all aspects of agriculture including crops, livestock, fisheries, forestry and cross-cutting areas. In the FY 2023/2024, NARO scored highly in technology generation, technology promotion, Agricultural research strengthening and, governance and management surpassing most of the physical performance targets in light of the key indicators:

Technology Generation

12	Varieties released: Two (2) sweet potatoes; Two (2) rice; Three (3) groundnuts: Two (2) maize, Two (2) beans and One (1) lablab.
1	Determined the safety, efficacy and effectiveness of anti-tick vaccine via field-based trial.
1	A model (AI&Machine Learning) for accurate prediction of FMD occurrences in Uganda developed.
2	FMD candidate vaccines developed waiting for Biosafety Lab level 3-testing.
1	Genomic characterization of Nile tilapia and African cat fish was conducted to inform suitable strains for selective breeding process
7	Identified seven (7) genes that condition shea butter oil biosynthesis. With this knowledge, improving shea nut varieties for oil will be eased. It sets the foundation for breeding shea nut varieties with high oil content. It also diversifies the oil industry from depending on sun flower, soya bean and palm oil. This presents another product for the oil industry and provides a cash crop for areas where it is grown.
1	A protocol for grafting Jackfruit tree was developed
30%	Survival of high value species (labeo and labeobarbus) was increased by 30% through improving breeding and weaning protocols



1	Institutional Biosafety Committee (IBC) accreditated to regulate and oversee compliance of biosafety related research in NARO
1	Application for accreditation of Institutional Animal Care and Use Committee (IACUC)submitted and a provisional lincence was secured for operations.
1,600	The Access Benefit Sharing committee facilitated exchange of over 1600 germplasm samples.
20	Proposals developed and submitted over the year, 3 of which have been awarded to a tune of USD 6.4M
200	Over 200 scientific articles published
2,000	Over 2000 trees planted under the NARO Go Green initiative across 3 PRIs. (NaliRRI, KaZARDI and Buginyanya) and rasing over 5,028 seedings at NaFORRI.
311	311 scientists across 16 PARIs trained in gender and equity. 131 of these were male ans 180 females
	Established a Mycotoxin platform at NaLIRRI
320	Drought screening platform at NaCORRI established - over 320 accessions
1	Established Tea analytical platform at Rwebitaba
1	Sequencing platform at NaCRRI established
1	Sorghum impact study conducted
1	Supported three laboratories FBI, Nutrition and DITRA towards recognition at Kawanda, Namulonge and Nakyesasa respectively
1	Supported designation of molecular lab at NaCRRI as COMESA reference laboratory

Technology Dissemination

	A comprehensive Technology and Innovation Dissemination Strategy was developed and approved by the NARO Governing Council to guide the enhancement of access and utilisation of agricultural research results.
9	Nine (9) demonstrations were established and maintained at the ZARDIs on various commodities to expose and train farmers and extension workers on newly released and candidate varieties of priority commodities of the zones.
	Assorted seeds of maize, beans, soybean, sorghum, potato, and other vegetatively propagated crops were produced and distributed to seed companies, community seed producer groups, and individual farmers.
	Four technology up-scaling demonstrations were jointly established and maintained in partnership with cultural institutions (Bunyoro Kingdom - 1 on coffee; and Buganda Kingdom - 3 mainly on urban farming). Preparation meetings were held with Tooro, Rwenzururu, and Busoga kingdom teams.
3,260	Three farm clinics were organized in partnership with Monitor Publications Ltd in which a total of 3,260 participants were trained (at NACORRI – 1,500, Abi ZARDI - 400, and Ngetta ZARDI – 1,360).
4	Four (4) trademarks (Banana starch, Banana fibre, Coffee yogurt, and Cocoa wine) were developed and registered.

45	Over 45 technologies were exhibited and more than 60,000 participants trained and or exposed to NARO technologies in 6 major events (National Agricultural Show 2023, World Food Day 2023, regional farmer mobilization campaigns led by the Office of Prime Minister, Eastern Agricultural Show at Awoja Riverside in Soroti, International Labor Day celebrations in Fort Portal City and Harvest Money Expo 2024 at Kololo).
2	Two (2) patents (Banana starch and Cocoa fermentation box) were developed and filed for protection.
446	Revenue of over UGX 446 million was collected in royalties from licensed seed companies.
10	Ten (10) new licensing agreements with seed companies were signed bringing the total of licensed seed companies to 23 and the varieties licensed to 84.
	Several MoUs were signed with industry players for market testing and commercialization of product prototypes (e.g., coffee body and facial scrub).
2	Two (2) NARO Institutes (Bulindi and Mukono ZARDIs) are accredited by the Directorate of Industrial Training.
30	Over 30 content packages and over 5,000 digitized information materials were indexed and uploaded on the NARO Information Hub.
3	User requirements for three modules were compiled which informed the latest upgrades on the infohub (http://NAROinfohub.NARO.go.ug).
1	Knowledge Management (KM) Guidelines were developed to operationalize the NARO KM Policy 2021.
2	Two volumes of UJAS (Volume 21 issues 1 & 2 and Volume 22 issue 1) were published online and can be accessed via the African Journals Online (AJOL) link https://bit.ly/3EfuabN or internally on NARO servers.
10	A 10-year UJAS strategic plan was developed and approved by the NARO Governing Council to guide its investments and developmental activities.
1	A Partnership Information Management System (PIMS) was designed and developed to improve partnership management (by enhancing the storage and retrieval of information) in NARO.
23	Twenty-three (23) new partnerships were initiated bringing the cumulative number of partnerships at different levels of development and implementation to 34.



Agricultural Research Strengthening

Human Resources Development

- Sixty-nine staff were trained (52 PhD and 17 Masters). Eight (08) staff on PhD completed, 5 at Master's level and 2 at Bachelors level completed their studies.
- The overall staff performance stood at 78%
- Overall staffing levels stood at 995 compared to 1180, presenting 67% implementation of the NARO establishment.

Financial Resources Mobilization

- Annual budget for FY 2023/24 increased to UGX 164,487 billion compared to 117,926 billion in 2022/23
- Off-budget project grants amounted to 33,247 bn
- The overall absorption for NARO was 99.97%

Infrastructure Development

- Aflatoxin mitigant research and production facility 95% completion
- Industrial Vaccine Production facility 90% completion: (plate 11)
- The calf and heifer research platform at Nakyesasa is 95% completed;
- The goat research facility at Maruzi is 80% completed;
- Vegetable research and seed production facilities completed
- The biosecurity gate at Nakyesasa was completed.
- 5 laboratories of strategic importance notably anti-tick vaccine seed, mycotoxins research, tea research, Biosciences laboratories, and fish floating feed facility at NaLIRRI Nakyesasa, Rwebitaba, NaCRRI, and NaFIRRI-ARDC respectively were equipped.
- 1 Drought screening platform for Coffee established

Governance and Management

- Provided strategic guidance on: (a) management and securing agricultural research land (b) management of human resources and filling critical positions in light of establishment of a new structure.
- Approved the plan for implementation of the new organizational structure and staff establishment.
- Appointed program leaders (39) and over 20 new staff including Directors (7), Scientists (7), and support staff (12) to fill vacant positions.
- Promoted over 50 staff to fill vacant positions
- Renewed contracts of Directors (2) and other staff.
- Approved the following guidelines to enhance the dissemination of technologies:
- Strategy for Dissemination of NARO research results
- Knowledge Management Guidelines
- UJAS (Uganda Journal of Agricultural Sciences) Strategic Plan 2023-2028
- Approved the revised duty facilitation rates
- The council reviewed audit reports and provided advice on internal controls and measures to mitigate identified risks.


NEWLY
RELEASED
MAIZE
VARIETY
NARO-maize-64-StR
Resistant to Striga weed
High-yielding- 7.3t/ha
Maturity period – 110 Days
High milling percentage (60% flour)
Tolerant to common foliar diseases
NARO-maize-63-VitA
High Vitamin-A content
High yielding: 7.7t/ha
Drought tolerant

CHAPTER 1

Introduction

1.1 Background

The National Agricultural Research Organisation (NARO) is a semi-autonomous corporate agency under the Ministry of Agriculture, Animal Industry and Fisheries (MAAIF). NARO was first established by a Statute of Parliament in 1992 and later reformed by the National Agricultural Research (NAR) Act of 2005 as a body corporate with the mandate to coordinate, oversee and guide agricultural research in Uganda. NARO comprises a Governing Council, a Secretariat and 16 Public Agricultural Research Institutes (PARIs).

The PARIs consist of 7 National Agricultural Research Institutes (NARIs) conducting research of national and strategic importance and 9 Zonal Agricultural Research and Development Institutes (ZARDIs) serving specific research needs of our diverse agroecological zones. NARO conducts research in all aspects of agriculture including crops, livestock, fisheries, forestry and cross-cutting areas

NARO contributes to Cluster 1 of Value Addition and specifically to Programme 1 Agro-industrialization under NDP III. Under the Agro-industrialization Programme, NARO contributes to six objectives namely: (i) increased production and productivity, (ii) improved post-harvest handling and storage of agricultural products, (iii) increased agro-processing of the priority products, (iv) increased market access and competitiveness of agricultural products in domestic and international markets, (v) increased mobilization, equitable access and utilization of Agricultural Finance, and (vi) strengthen institutional coordination for improved service delivery.

NARO further contributes to three other NDP III Programmes: (i) Regional Development Programme, (ii) Natural Resources, Environment and Climate Change, Land and Water Management Programme; (iii) Innovation, Technology Development and Transfer Programme.



1.2 Mandate, Vision, Mission, Goal and Objectives

Mandate: Coordinating, Overseeing and Guiding Agricultural Research in Uganda.

Vision: A competitive society supported by a dynamic agricultural research innovation system.

Mission: To innovate for sustainable agricultural transformation.

Goal: To increase total factor productivity and access to agricultural research products and services for inclusive growth.

Values: NARO commits to uphold values of inclusivity, subsidiarity, transparency, accountability and excellence along the agricultural research and development continuum.

Objectives: NARO is primarily financed by the government through vote 142 with the following strategic objectives:

i) Develop and promote demand-driven technologies, innovations and management practices that respond to target clientele demands.
ii) Increase research products and services suited for vertical integration into industries.
iii) Improve access and sustainable utilization of improved agricultural technologies and innovations by communities.
iv) Increase Total Factor Productivity to accelerate community institutional orientation to agricultural transformation.
v) To improve farmers' Allocative Efficiency to ensure optimal productivity at minimal cost.



1.3 Alignment of the research agenda

NARO adopted the current Strategic Plan (2020/21 – 2024/25) which focuses on research and innovation geared towards increased development and utilization of research products and services suited for the market and industry. The Strategic Plan is well aligned to the National Agriculture Policy (2015).

Currently, NARO mainly contributes to the NDP III programme on Agro-industrialization whose objectives include:

i) Increased production and productivity,
ii) Improved post-harvest handling and storage of agricultural products,
iii) Increased agro-processing of the priority products,
iv) Increased market access and competitiveness of agricultural products in domestic and international markets,
v) Increased mobilization, equitable access and utilization of agricultural finance, and
vi) Strengthen institutional coordination for improved service delivery.

NARO also contributes to three other NDP III programs:

i) Regional development,
ii) Environment and Natural resources;
iii) Innovation, Technology development and Transfer.

In pursuit of the national aspirations, NARO's research agenda is equally well aligned to regional, continental and global commitments (R&D guiding policies and planning frameworks) especially the Comprehensive African Agricultural Development Programme (CAADP) and Malabo declaration on accelerated agricultural growth and transformation, African Union Agenda 2063 on inclusive and sustainable socio-economic development and Sustainable Development Goals especially SDG 1 (No poverty), 2 (No hunger), 3 (Good health), 12 (Responsible Consumption), 13 (Climate action), 14 (Life below water).



1.4 Interventions during the FY 2023/2024

In the FY 2023/2024, NARO developed and disseminated several technologies, innovations and management practices (TIMPs) with a goal of increasing agricultural productivity and production, contributing to food and nutrition security, economic growth and agro-industrialization. The interventions focused on developing and dissemination of disease and pest-resistant, climate resilient and nutrient-rich crop varieties; Improving livestock productivity through sustainable solutions; innovations towards improving the fisheries sector both capture fisheries and aquaculture; Innovations in forestry and sustainable natural resources management; and cross-cutting interventions in agro-machinery and socioeconomics. This report presents progress recorded against those interventions under four broad sections of technology generation, technology promotion, agricultural research strengthening and, governance and management in line with her key performance indicators. The report is organized into 6 chapters including the introductory chapter and profiles of selected projects.



CHAPTER 2

Technology Generation

NARO generates technologies in all aspects of agriculture including crops, livestock, fisheries, forestry, and cross-cutting areas such as agricultural engineering and social economics with a goal to enhance agricultural production and productivity in the country.

2.1 Development and dissemination of disease and pest-resistant, climate-resilient and nutrient-rich crop technologies

During the FY 2023/2024, NARO generated various crop technologies addressing production, productivity and food nutrition challenges. These include:

Twelve (12) NARO crop varieties with desirable attributes were released. The released varieties include; two (2) maize (NARO MAIZE 63 Vita & NARO MAIZE 64STR), two (2) rice (WDR 73 & KF 20039), two (2) sweet potato (NARO SPOT 6 & NAROSPOT), two (2) bean (NABE 12CR and NABE 14 R) and three (3) groundnuts (NARO-NUT 3R and 4R). Additionally, one (1) livestock forage variety (NARO LABLAB 1) was released.

The released varieties notably maize and sweet potato are suited to be grown in all parts of the country to boost food and nutrition security of men, women, children, youths, elderly persons, and people with HIV/AIDS.

NARO maize 63 Vita is high in protein with a provitamin A content 12.2 µg/g. It has a grain yield of 7.0 – 7.8 t/ha with a milling percentage ≥60% flour. It matures in about 120 days and is tolerant to drought and foliar diseases, and performs well in mid-altitude regions. In addition, NARO maize 63 Vita is an orange maize by color, the first of its kind in the maize portfolio produced in the country and rich in vitamin A. Sweet potato variety NARO SPOT 7 is also rich in Provitamin A. Once consumed, provitamin A enables the synthesis of vitamin A in a human or animal body. Once synthesized, Vitamin A improves eye vision, boosts the body's immune system, supports reproduction in men and women; and enhances growth and development in children.

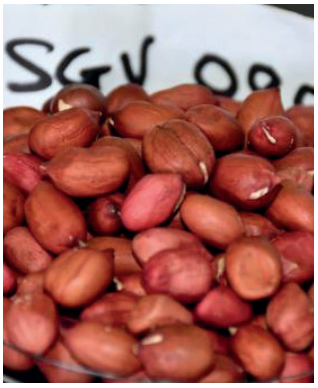
On the other hand, NARO MAIZE 64STR is resistant to Striga, high-yielding (6.5 – 7.5t/ha) and 3.5 – 4.0 t/ha under Striga free and Striga conditions, respectively. It has a high milling percentage ≥60%. It is tolerant to foliar diseases and adapted to mid-altitude regions.

Groundnut varieties NARO-NUT 3R, 4R and 5R are high-yielding, tolerant to common pests and diseases. Specifically, NARO-NUT 3R is red-seeded, small-medium size with 2 seeds per pod, matures within 90 days with a sweet taste: NARO-NUT 3R has a nutrition content of up to 25.55(g/100g of protein, 43.38 Oil, 22.4 (mg/kg) Iron and 34.9 (mg/kg) Zinc. It is resistant to stresses, Rosette, Leaf Spots, drought and tolerant to cold with a yield potential of 2-3.0t/ha. This variety can be grown in all agro-ecologies.

NARO-NUT 4R is red seeded, has 2 seeds per pod, matures within 110 days and has a sweet taste. Its nutrition content is 24.43(g/100g Protein, 43.14 Oil, 21.2 (mg/kg) Iron and 24.4 (mg/kg) Zinc. Just like NARO-NUT 3R, it is resistant to stresses: Rosette, Leaf Spots, drought, cold tolerant and can be grown nationwide. It yields upto 3.0 - 3.5t/ha. NARO-NUT 5R is also red-seeded, small-medium size, with 3 seeds per pod.

It matures within 90 days, has a sweet taste, protein – 24.57(g/100g), Oil (45.4), Iron – 19.2 (mg/kg), and Zinc- 27.8 (mg/kg) nutrition content**.** It is resistant to stresses such as Rosette, Leaf Spots, drought and tolerant to cold. It performs well in all agro-ecologies and yields unto 2-2.5t/ha

NARO-NUT 5R




NARO-NUT 4R




NARO-NUT 3R



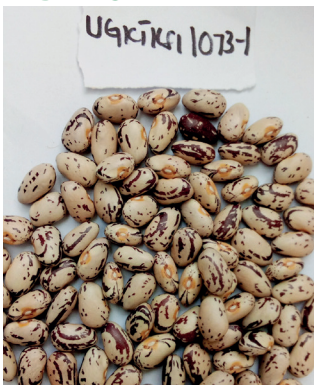

NABE 14R is high-yielding (2700 kg/ha) and matures within 76-94 days. It is a bush type (determinate bush), medium seeded, with market-class quality targeting the Red Kidney Bean market. NABE 14R has been improved for Anthracnose resistance and bean root rot. This variety is best suited for Mid-highland altitude areas and is highly palatable.

NABE 12CR is a **c**limber, medium seeded, improved for root rot resistance energy efficient with short cooking time. It is early maturing (94 - 105 days) with a potential yield of 3800 kg/ha. It has market-class quality (targeted for fresh pods market), highly palatable and is best suited for mid-high altitude area.

NABE 14R




NABE 12CR





Development and release of the first forage variety

NARO has successfully developed and released the first forage variety registered on the National Cultivar

List of Uganda. This ground-breaking achievement indicates a significant advancement in forage improvement and improvement programs under the National Livestock Resources Research Institute.



Developed under code T16 and released as NARO LABLAB 1, this maiden variety exhibits an outstanding performance with a seed yield of 2.33 tons per acre of staked lablab; high crude protein content of 26.63%; excellent protein digestibility of over 88%; and good ensiling attributes.

The variety is a perennial climbing cultivar with ability to climb up to 2 meters when staked. It therefore provides opportunities for utilization of vertical space, making it a suitable forage for resource-constrained smallholder farmers who are often constrained by land. Lablab being a semi-perennial crop, the farmer is able to harvest grain and forage for two seasons before replanting the crop. This saves the farmer money which would have been invested in seasonal land preparation and sowing operations. Consequently, lablab emerges as a cheaper source of high-quality protein in smallholder production systems and is expected to reduce on ratio and/or replace soybean that has been depended on as main ingredient of livestock feed yet costly.

Other crop technologies at various stages of development

Ten (10) promising drought tolerant clones have been identified and are being prepared for on-farm yield performance evaluation. Drought screening platform with capacity of 300 genotypes in two batches per year was established at National Coffee Research Institute (NaCORI).



Rootstock varieties using the grafting technique are being developed for; adapting current varieties to drought prone areas using Liberica coffee (Kisansa) rootstock, accelerating variety replacement and rehabilitation through top-working of old coffee trees (as rootstock) with new improved varieties. And raising the possibility of revitalizing the availability of high-yielding old clones and seed varieties supported on CWD resistant Liberica or NARO KR varieties.

Five (5) trials of rootstock varieties have been set-up along a drought gradient in Kituza, Nakaseke, Sembabule and Ntungamo.



Coffee seedling production

- 100,000-130,000 CWD-r clones can be generated for weaning per year.
- 30,000 plantlets are currently weaned from the Tissue Culture Lab per year.





Coffee variety multiplication through Tissue Culture

i) 223,656 clonal plantlets of NARO KR varieties were generated, of which 110,119 cuttings were distributed to farmers and private nurseries in FY 2023/2024.

ii) 2,000 new mother bushes of NARO KR varieties planted in FY 2023/2024 for expanding production:

- 1,000 in Abim district, Karamoja.
- 1,000 at Mbarara Zonal Agricultural Research and Development Institute (MbaZARDI).



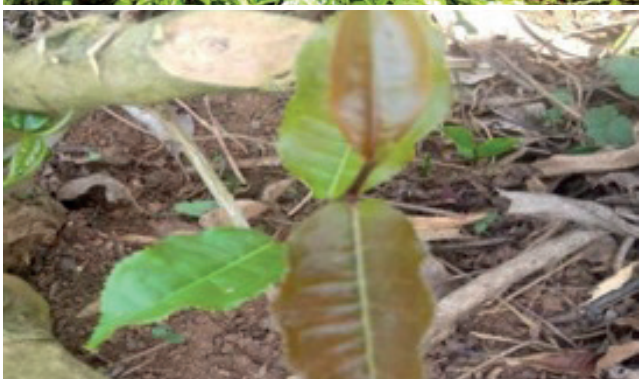


Clonal coffee multiplication through mini-cuttings and convention approach

In support of the industrialization drive, NARO developed a prototype of Coffee Facial Scrub and availed it to the private sector, specifically Movit Products Limited, for commercialization. In addition, NARO registered a Trademark (UG/T/2022/75655) for a unique and specialized coffee powder branded as NaCOFE. Other industrial prototypes developed from coffee include; a body cream, lotions and yogurt. Additionally, prototypes for the NARO Black Coffee Twig Borer (BCTB) trap have been developed and are currently under evaluation.

In an effort to increase the productivity and competitiveness of Ugandan tea, 6 tea clones (2 for specialty tea including the world-popular purple tea and green tea) were developed and selected based on their yield and quality attributes for advancement into late-stage breeding evaluation. These were identified as best performing based on their fermentability and physiochemical components (polyphenols, catechins) attributes. Additionally, one tea biofertilizer (BioNiKPhos) from NARO Holdings Limited was identified for use after it was established to increase yield. When applied at a rate of 200 mls per 20 litres of water, it gives the highest number of pluckable shoots per tea bush, and also highest wet weight of 0.083kg per bush.





16 crop varieties submitted to the National Variety Release Committee of MAAIF

A total of 16 crop varieties were submitted to the National Variety Release Committee of MAAIF. These were: five (5) sorghum varieties, three (3) finger millet, three (3) pearl millet, three (3) wheat and two (2) of barley.

The sorghum varieties yield between 1,500 to 4,000t/ha, are tolerant to common pests and diseases, and have desirable traits for wide industrial use ranging from food, malt (for beer) and forage.

The Cassava varieties are highly resistant to Cassava Mosaic Disease (CMD) and Cassava Brown Streak Disease (CBSD). They have a yield potential of 13t/ha and 5t/ha for fresh root yield and dry yield respectively. It also has good industrial processing properties.

The wheat varieties are rich in Zinc and Iron, yield beteween 2.5-4.0t/ha, are tolerant to common wheat diseases, early maturing (90-100 days) and have good industrial processing properties.

Similarly, the Barley varieties yield between 3-5 t/ha, are good for brewing, resistant to net blotch and `barley scald disease. They are adapted to highland areas (>1800 metres above see level) where they mature in 100-110 days.

The variety attribute–s incorporated take into consideration the need for reduced workloads and costs of production, increased food and nutritional security, increased seed access, favorable market access and incomes for women and youth. The sorghum and cassava varieties are also suitable for industrial use in the manufacture of products such as beer, confectionery, starch and ethanol. Additionally, groundnuts are rich in oils that have health benefits. All these varieties are under Distinctiveness, Uniformity and Stability (DUS) trials.

2.2 Improvement of livestock productivity through development and dissemination of sustainable technologies

Livestock technologies have been developed under thematic research areas of vaccine research and development; forage improvement, agronomy and conservation; dairy research; beef and meat research; and harnessing insects for food and feed.

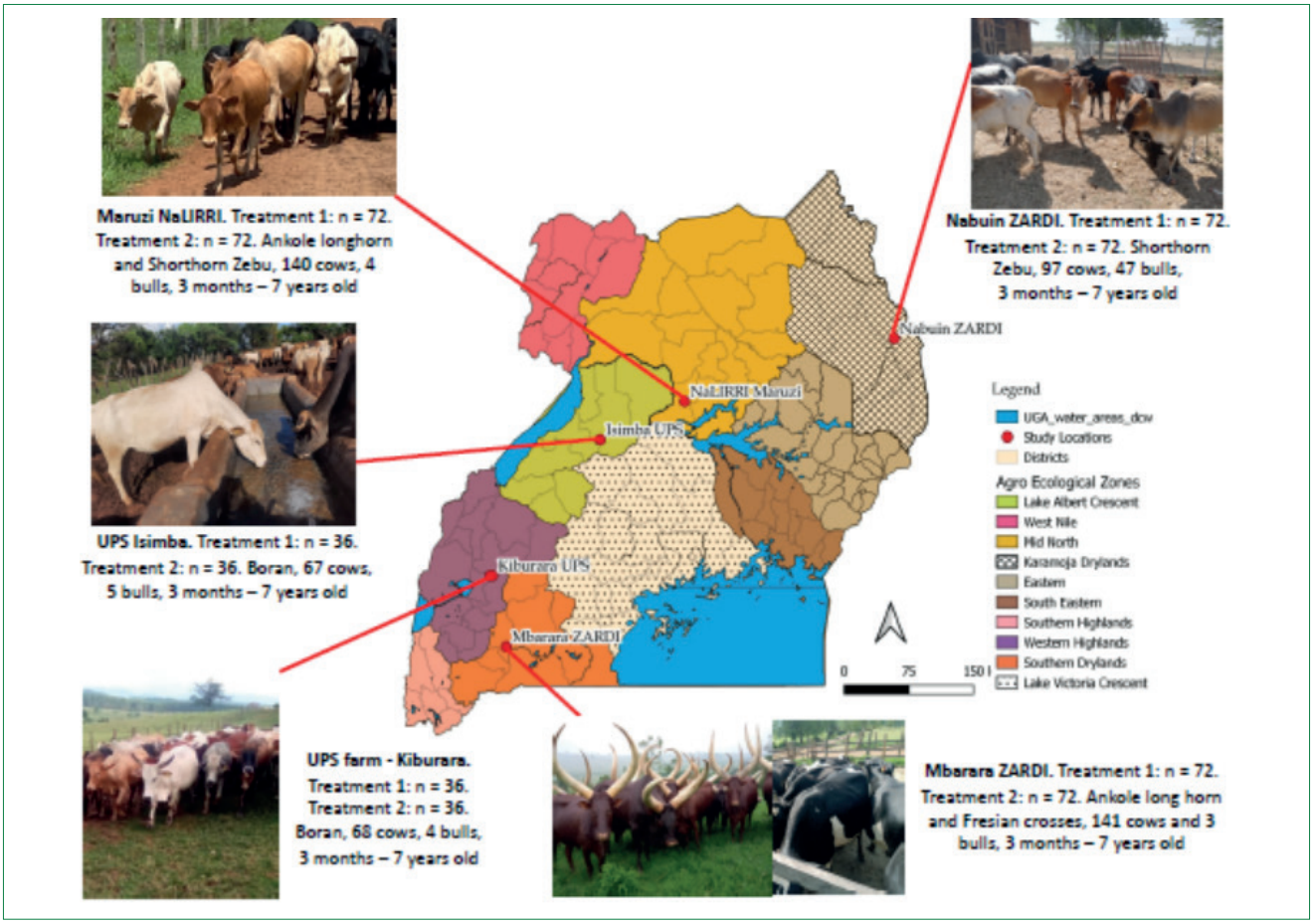
a) Development of safe and efficacious vaccines against livestock pathogens and vectors

Vaccine research focused on the development of efficacious, safe and affordable livestock vaccines against ticks, Foot and Mouth Disease (FMD) and African swine fever (ASF) viruses.

Anti-Tick Vaccine: Field-based trials determined the safety, efficacy, and effectiveness at **93.2%**. A facility with a capacity to produce over 20 million doses annually is being assembled. The quantities are sufficient to cover the demand of both the country and region in control of ticks. This is the largest recombinant vaccine production facility globally, positioning NARO as a global reference center in recombinant vaccine production. It is the only facility in sub-Saharan Africa and the second in the world, after Cuba. The vaccine provides cross-protective immunity against three tick species (Brown ear, Bont-logged and Blue tick).

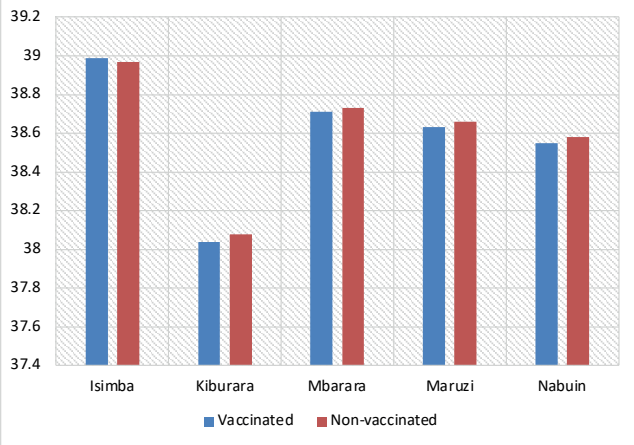


The vaccine saves the farmer UGX: 188,000 per head of cattle per year incurred in use of acaricide to manage ticks. From the results of the trials, the administration of the anti-tick vaccine has not caused negative effects



on the body functionality of vaccinated cattle and the food safety analysis revealed that the protein used in the constitution of the anti-tick vaccine is not associated with negative physiological reactions in human beings. At the national level, the vaccine will save the country from the annual integrated economic loss of 3.7 trillion UGX due to ticks and tick-borne diseases, such as, cattle mortalities, cost of acaricides, reduced milk and meat production, as well as labour costs involved in the management of ticks and tick-borne diseases

FMD Candidate Vaccines and modeling - Two FMD candidate vaccines for O and A strains have been developed, awaiting trials in a Biosafety Lab level 3 facility. In addition, an Artificial Intelligence and Machine Learning model with a sensitivity of 98.3% for accurate prediction of FMD occurrences in Uganda has been developed. This model happens to be the first on the continent, published in the AI journal of Frontiers and Springer Nature. In addition to this, a patent application has been filed to protect the predictive model.



Plant-specific NPK fertilizer formulations developed - The development of crop-specific fertilizers is expected to reduce costs per kilogram and will aid manufacturers in producing targeted fertilizers. Coffee has two (2) formulations (20:20:18 to 20:18:20; 20:16:22), while beans have four (4) formulations.

2.3 Improvement of fish conservation and sustainable harvests and aquaculture productivity

In fisheries, research has been undertaken to improve technologies both capture fisheries and aquaculture.

a. Improvement of aquaculture production and productivity

During the reporting period of 2023/2024, research in aquaculture focused on improving fish production and productivity with emphasis on ....

b. Innovations in Capture fisheries biodiversity conservation

Three information dissemination materials were produced: postcards, a freshwater biodiversity portal for Uganda, and an atlas of fishes in the Lake Edward system, along with a policy brief on the status of fish stocks in Lakes Edward and George.

In a bid to address water pollution, the impact of heavy metals and organochlorides on mukene was assessed by season and geographical location. Additionally, a fishing rig was partially developed to optimize fish harvesting procedures.

To advance capture fisheries research, NARO-NaFIRRI acquired a cutting-edge research vessel to enhance monitoring of the aquatic ecosystem in Lake Albert.

c. Aquaculture Research and Development Centre Kajjansi (ARDC)

Improved fish seed

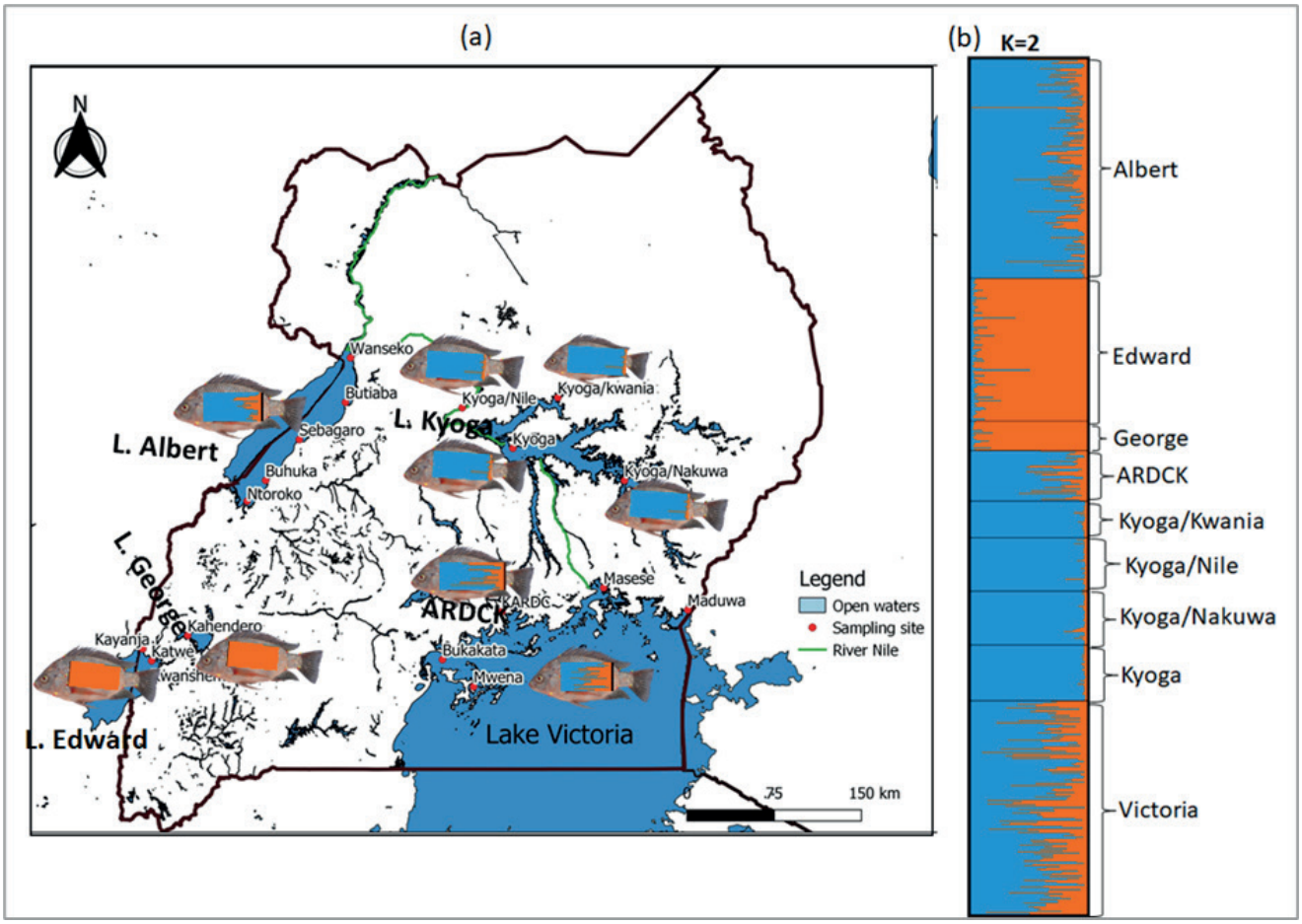
To tackle the challenges of fish seed quality, high throughput sequencing of Nile tilapia and African catfish fish populations in Uganda for enhanced aquaculture production and productivity was undertaken through PESCA project support. In these studies, robust genetic markers, SSR-genotyping by sequencing-NGS and mtDNA D-loop were utilized to characterize Nile tilapia and African catfish

species respectively. This was key to inform the base populations suitable for selective breeding programs at ARDC and the country at large. This information was also important in guiding aquatic biodiversity conservation strategies for sustainable aquaculture in East Africa particularly focussing on wild Tilapia and African catfish which are continuously used for aquaculture production. From genomic sequencing information, it is possible to culture known Nile tilapia and African catfish genotypes and subsequently identify candidate genes for growth. This is vital for propelling and enhancing aquaculture productivity in Uganda.

Figure showing the Bayesian clustering for genetic assignments of Nile tilapia populations between the major water bodies in Uganda based on STRUCTURE. (a) represent the map of Uganda major water bodies, (b) Nile tilapia genetic structure. The various rectangular color shapes embedded in Nile tilapia digital images in Figure 2.1a depict the species' genetic structure reference map/distribution in Uganda's major water bodies (Tibihika et al 2024).

Similarly, high-throughput sequencing tools to expound the genetic structure of tilapiines in the East African Lake Victoria Basin based on Single Nucleotide Polymorphism (SNP) genotyping was conducted by a consortium of researchers from ARDC-NARO, Kenya Marine Fisheries Research Institute (KMFRI), Tanzania Fisheries Research Institute (TAFIRI), Earlham Institute UK, and WorldFish under the TRUEFISH project.

This work provides the necessary foundational data, tools, and resources to contribute to the



sustainable management of the fisheries resources in the Lake Victoria Basin. Additionally, the study unveils the risks to biodiversity as well as reliable base broodstocks for quality seed generation in the EAC. This study clearly showed the status of tilapia genetic resources in the Lake Victoria basin and provided a basis for addressing the key questions of managing the risk to biodiversity and developing a viable aquaculture industry in the region.

Specifically, the study generated information on the spatial distribution of different species and genotypes of tilapiines in the Lake Victoria basin thus, enabling the identification of risks to biodiversity potentially due to aquaculture as a consequence of genetic admixture and introgressive hybridization.

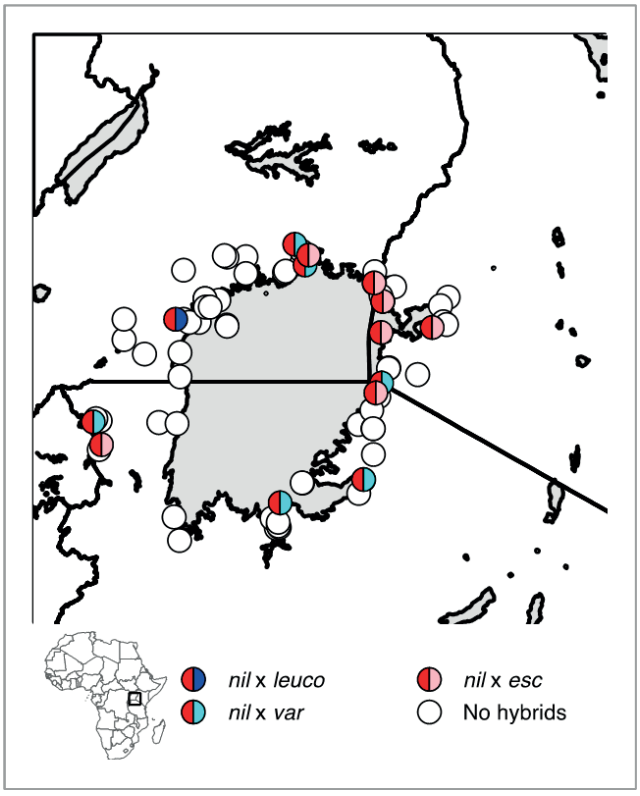


Figure of the Lake Victoria basin, showing all sampling sites and colored according to species combinations of hybrids located in the sites. Nil=Nile tilapia, leuco=*Oreochromis leucostictus* (blue-spotted tilapia), var=*Oreochromis variabilis* (Lake Victoria tilapia), esc=*Oreochromis esculentus* (Ngege).

A total of 2,600 Nile tilapia, sourced from four distinct local populations, were collected to develop strains of Nile tilapia that exhibit enhanced growth rates and greater tolerance to temperature fluctuations.

A protocol for the preservation of African catfish milt was developed, incorporating the supplementation of Vitamin E at a dosage of 10 international units (IU). This approach aims to improve the viability and longevity of the milt during storage, ensuring better quality for future fertilization processes.

Enhancements in the breeding and nursing protocols for *Labeo victorianus* and *Barbus altianalis* were made, particularly emphasizing the use of African catfish pituitary glands as an effective hormonal inducing agent.

Additionally, there was a focus on formulating locally produced larval feeds to optimize the nursing phase, ensuring better growth and survival rates for these fish species.











Figure showing the process of improving breeding protocol for *Labeo victorinus (Nungu);* The latest picture shows a mature Ningu.

In the area of capacity building, 19 fingerling fatteners and 28 seed producers, along with two extension staff members, were comprehensively trained in effective breeding techniques and best hatchery management practices thus equipping them with knowledge and skills to enhance their operations and improve overall seed productivity.

A total of 113,905 Nile tilapia, 5,966 African catfish, and 13,050 mirror Carps improved seed were produced and availed to 68 farmers including 07 women from 16 districts (Kasese, Wakiso, Luwero,Mityana, Mbarara, Hoima, Kampala, Masaka, Koboko, Kikube, Mitooma, Ntugamo, Gulu, Moroto, Kanungu and Namutumba) of Uganda to support fish farming in the country.

A fish molecular and genetics analysis laboratory has been established at the Aquatic Research and Development Center (ARDC). This facility was equipped with tools for genetic studies on various fish species, aiming to improve breeding programs and support sustainable aquaculture.

Fish feeds

As a way of tackling the fish feed quality challenge, four fish feed formulae for juvenile and grow-out fish were developed. Eleven (11) local crop varieties appropriate for use in fish feed production based on their nutritional composition, effect on enhancing fish performance, and producing cost-effective fish feed were identified. The crop varieties included Maize (Long 5D, Long 5 OPM, and Bazooka), Sunflower (AGSUN, Sunfola), Cotton (BPA2015 A, BPA 2022), Soya (Maksoy 3N, Maksoy 6N), Simsim (Sesame 2, Sesame 3). Four feed formulations for Nile tilapia and African catfish were developed using these local crop varieties and black soldier fly larval meal (BSFLM) for upscaling quality and cost-effective fish feed production in Uganda. BSFLM was used to substitute Mukene at 0, 25, 50 and 75% of animal protein source, respectively. Four fish feeds with 25%, 75%, and 50% BSFLM were found to be the most effective in enhancing fish growth and cost effectiveness. The best feed conversion ratios of 1.6, 1.7, 1.5, and 1.4, respectively, were achieved for Nile tilapia juveniles, Nile tilapia grow-out, African catfish juveniles and African catfish grow-out fish. The average FCR for all the feeds was 1.55. This is very important for aquaculture production and productivity.

A novel approach has also been developed to reduce heat-stable antinutritional factors found in fish feed ingredients by employing a commercial multienzyme complex. This complex is included at a concentration of 0.5% in the feed formulation. The application of this enzymatic solution aims to enhance the digestion and overall utilization of plant-based feed ingredients by fish, ultimately improving their growth and health.

Established comprehensive standards for fish feed to ensure the effective production and utilization of fish feeds throughout the country. These guidelines will enhance the quality and safety of fish feeds, promoting sustainable practices in the aquaculture industry.



A section of the newly installed floating fish feed production line at ARDC Kajjansi with the capacity to generate 2 tons of feeds per hour

Production systems design

A total of 13 high-potential aquaculture zones have been mapped across 6 agro-ecological zones (AEZs). These maps provide valuable information to policymakers regarding potential locations for local aquaculture parks. They also offer guidance to prospective investors looking to establish production facilities within the aquaculture industry.

An integrated living laboratory for fish and crop production has been established to evaluate and test an Agroecology (AE) decision-support tool. The lab will serve as an experimental hub where various

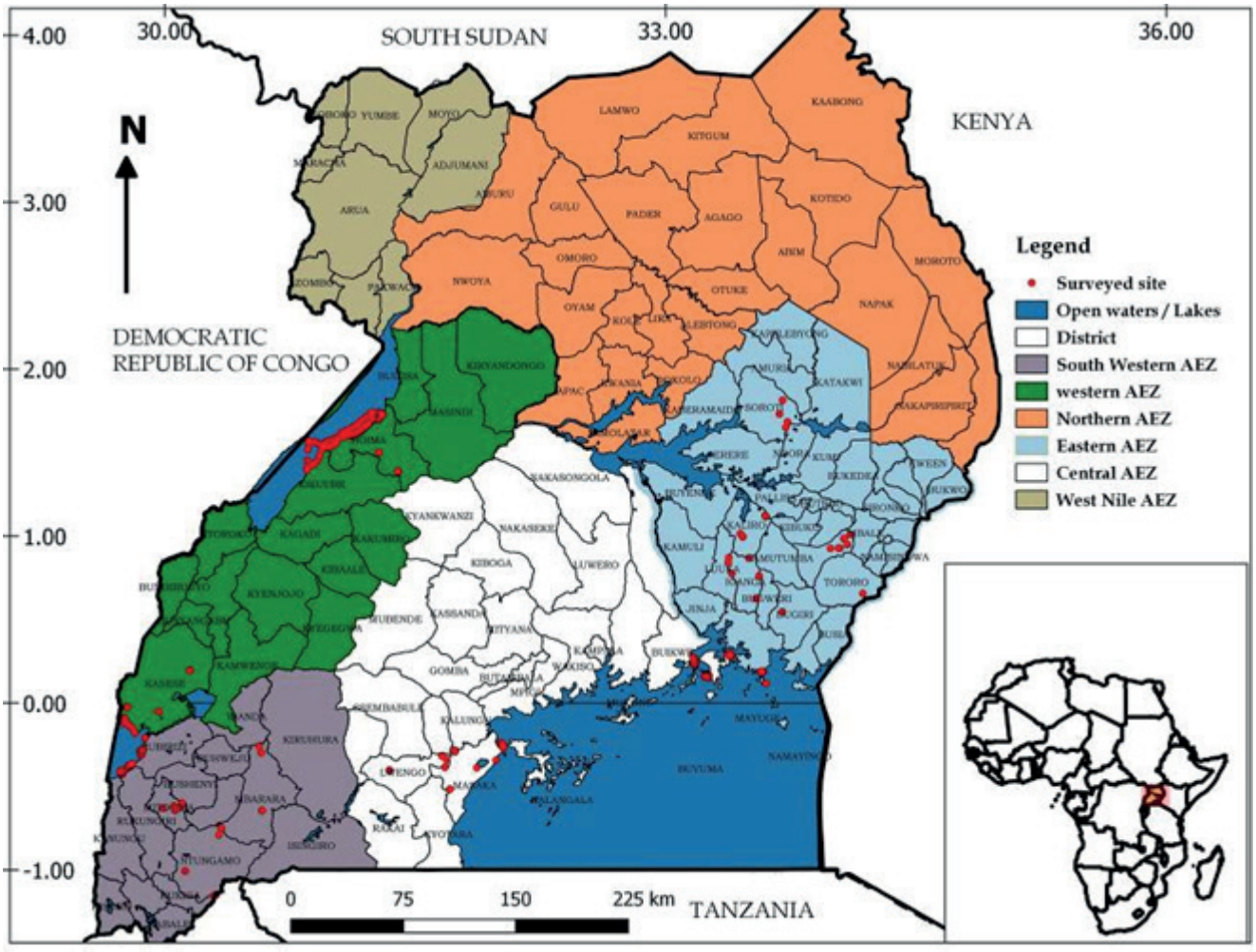


Figure showing various potential high-value land and lake locations for aquaculture in different zones of the country.

methods, including the nutrient film technologies (NFT), media bed cultures (MBC), and Deep-water cultures (DWC), are being explored to optimize the synergy between aquaculture and agriculture, enhancing sustainability and productivity in both sectors. The structure has been completed and initial products (Fish and Vegetables) are being tested to acclimatise the system to its perfection before experiments begin. We plan to develop and promote integrated fish and vegetable farming techniques to enhance agricultural productivity. We shall provide hands-on demonstrations and support at least 400 farmers, helping them implement these practices on their farms to improve food security and livelihoods.

Aquatic health management

Disease surveillance was conducted across five fish hatcheries in Wakiso District to assess parasitic infections and their impact on fish health. The findings revealed a high prevalence of ciliates (81%), monogeneans (40%) and myxozoan (21%) among the examined fish. Mortality rates ranged from 70% to 100%, primarily attributed to parasite infestations.

Additionally, in collaboration with students of Makerere and Ghent universities, their studies evaluated the efficacy of locally isolated probiotics and plant extracts as biocontrol agents against Aeromonas hydrophila, a bacterial pathogen. Laboratory trials demonstrated the effectiveness of both probiotics



Figure showing constructed aquaponics unit at ARDC, encompassing fish culture and plant/vegetable growing. The system is currently under test for subsequent dissemination.

(Lysinibacillus fusiformis and Priestia megaterium) and plant extracts in inhibiting A. hydrophila, crucial for disease management in aquaculture.

To strengthen disease control capacity, training was provided to 208 farmers, 10 extension officers, and 16 students at diploma, BSc, MSc, and PhD levels on best management practices (BMPs) for disease prevention and sustainable fish farming. Information materials covering biosecurity, early disease detection, and responsible antimicrobial use were distributed to participants to improve farm-level disease control measures.

Furthermore, a fish health staff participated in an advanced training program on aquatic animal health management for maritime countries in China from July 26 to August 15, 2023 and received further training on risk analysis in the aquaculture value chain, with a focus on biosecurity, through the FAO-True Fish project

Value addition

Under the Foodland Project ARDC has been working in collaboration with NaRL (National Research Laboratories) to improve protocols for development of biodegradable packaging materials made from cassava, and also improving shelf life of smoked and filleted fish products.



Figure showing preparation and coating of the smoked fish products with biodegradable material to prolong the shelf life of the smoked fish

2.4 Innovations in Forestry and Natural Resource management

Shea Butter Oil Biosynthesis

NARO has potentially made groundbreaking discovery in Uganda by identifying genes which could enhance the production of bio-based oils in Shea nut trees. This discovery is expected to go a long way in directing the breeding of Shea trees in Uganda for high oil yield and developing a seed multiplication system for Shea trees, thus maximally exploiting the commercial potential of the legendary tree.

Jackfruit Grafting Protocol

In response to the increasing economic value of jackfruits, NARO has developed a protocol for grafting Jackfruit, reducing the fruiting time from 5 to 2 years.

Biodiversity conservation

NARO has continued its efforts to preserve Uganda's biodiversity at the Plant Genetic Resources Centre in Entebbe. Mass propagation of *Dendrocalamus asper* bamboo species and *Mondia whitei* (Mulondo), which are valuable for environmental conservation and medicinal product development, respectively.

The production of avocado and other tree planting materials was also supported by use of screen houses.



Focus on Bamboo

Additionally, various bamboo-derived products, such as charcoal, biochar, vinegar, and tar, are being explored. A pyrolysis prototype for carbonizing bamboo is in development, with the cyclone and condenser already fabricated and the pyrolysis reactor's fabrication in progress.

Tapping into the pharmaceutical potential of woody plants in Uganda

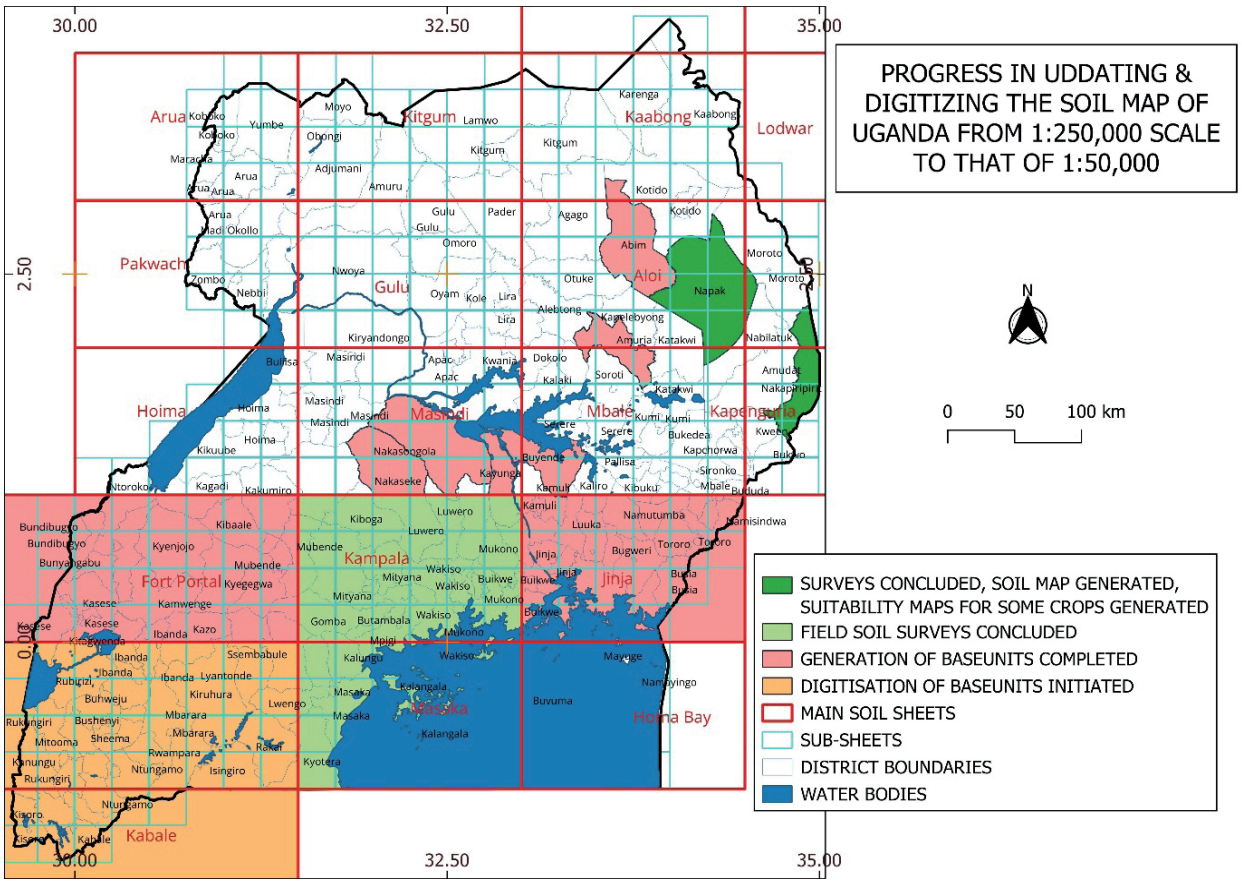
NARO investigated the pharmaceutical potential of Uganda's woody plants in promoting healthy livelihoods to emphasize their conservation value. This research led to the development of an antidiabetic drug, KAV 400, which has been published and is currently undergoing registration with the National Drug Authority. Additionally, a handbook on antidiabetic woody plants in Uganda has been produced to educate Ugandans on the health benefits of these plants. This handbook will serve as a resource for students, researchers, and practitioners in ethnobotany and ethnomedicine. In total, 50 medicinal woody plants have been documented, highlighting their properties for treating diabetes, including antidiabetic, anticancer, anti-inflammatory, antioxidant, antiproliferative, antimicrobial, anti-ulcerative, antigenotoxic, antifungal, and antimicrobial effects.

Money from wood waste products

To maximize the utilization of wood-based resources, a technology was developed to convert commonly discarded carpentry waste, such as sawdust and wood shavings, into useful products that enhance safety and environmental protection.

Digitizing the soil map of Uganda

Digitization and generation of base units as well as field surveys have been completed for the Kampala main sheet, covering over 10 districts (Kampala, Wakiso, Mukono, Buikwe, Nakaseke, Luweero, Mityana, Mubende, Kiboga, Butambala, Gomba and Mpigi). Updating the Jinja soil sheet is also in advanced stages.



2.5 Innovations in cross-cutting areas

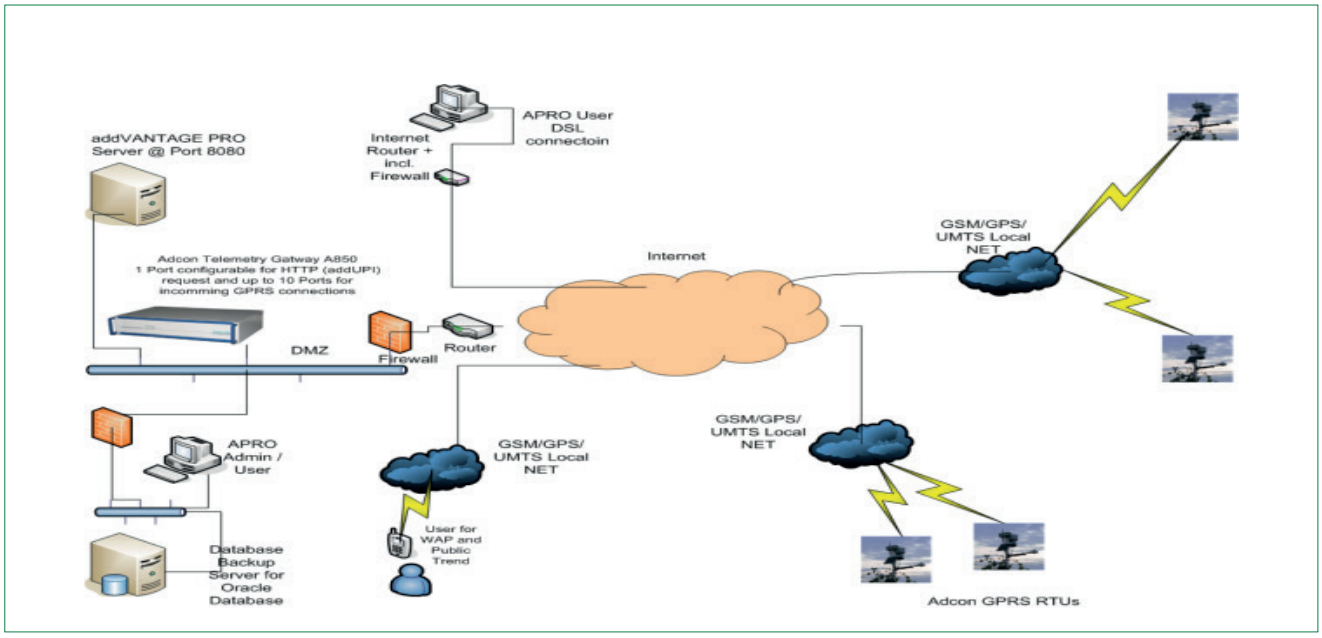
This section highlights progress and achievements in areas such as social safeguards, climate change,

Environment and Social Safeguards

NARO has made significant strides in environmental and social safeguards through developing the NARO Greening initiative. The initiative focuses on planting trees along NARO land boundaries, roads, and forest leisure parks. This initiative, led by Dr. Hilary Agaba, aims to enhance biodiversity, improve landscapes, and contribute to environmental sustainability. Additionally, NARO supported training programs focused on gender and equity, ensuring that our research and development efforts are inclusive and considerate of social dimensions.

Climate Change Mitigation and Adaptation Performance

To provide accurate and real-time climate advisory data for climate change adaptation in agriculture, NARO, in partnership with development organizations, has installed Remote Telemetry Units (RTUs). These units collect temperature, rainfall, wind speed, and evaporation data to support mitigation and adaptation efforts across Uganda. Using mobile technology, the RTUs allow researchers to access real-time weather data remotely via the internet. Currently, this data is available in five Agro-Ecological Zones (AEZ) of Uganda: South Western AEZ (Mbarara-ZARDI station), West Nile AEZ (Abi-ZARDI station), South Western Highlands AEZ (Kachwekano-ZARDI station), Eastern AEZ (Serere station), and Lake Victoria Crescent AEZ (Jinja, Namulonge, Kamenyamiggo, and Kawanda stations).





Current seasonal forecast provides general information in the form of Normal, below Normal, or above Normal. Such information is so general and cannot be used to guide farm level agricultural agronomic decision making. In the effort to bridge this gap, NARO in collaboration with development partners developed a computer-based application known as ***the seasonal characteristics tool*** that generates seasonal characteristics on rainfall onset, length of the growing season and end of rains. This tool therefore supports farmers to make accurate decisions on the timeliness of land preparations and planting operations; crop and variety selection; and post-harvest handling operations.

a) Innovations and technologies for Post-harvest handling, Quality and Safety enhancement

During the FY 2023/2024, NARO released a cocoa fermentation box technology and filed an application for its patent with the Uganda Registration Bureau Services (URBS). The fermentation box improves cocoa bean quality and labor productivity during fermentation.

b) Value added prototypes

Nine value-added product prototypes from tea and apples were developed for industrialization (6 tea, 3 apple). The prototypes from tea include; one green tea, one tea oil and four ready-to-drink green tea beverages. From apples, three types of wines, purees and concentrates were developed.

c. Why Purple Tea?

Tea prices have faced a significant decline in the global market due to reduced demand. As such, Ugandan tea farmers have felt the impact, with many growing increasingly frustrated with what was once considered a "cash crop." Consumers worldwide are shifting from tea to other beverages, including coffee. However, there is still hope for the tea industry in the realm of specialty tea production and blending, particularly with purple tea.

The NARO-Rwebitaba Agricultural Research and Development Institute, responsible for developing and disseminating tea technologies in Uganda, has focused on creating market-oriented tea products, specifically purple and green tea. Both varieties are unique and of higher quality, aimed at niche markets.

While green tea has long been celebrated for its health and wellness benefits, purple tea offers even greater advantages. The global demand for purple tea is rising, promising better incomes for farmers.

Purple tea made from rare purple leaves, boasts numerous health benefits, including anti-inflammatory, antiviral, anti-aging, and antioxidant properties. Its vibrant purple color is due to high levels of antioxidants, anthocyanins, and polyphenols, and it contains much less caffeine compared to other popular teas. Anthocyanins, which give purple tea its color, are also found in various colorful foods such as blueberries, raspberries, blackberries, purple carrots, and purple cabbage. These compounds are known for their exceptional health benefits, including cardiovascular protection, anti-diabetic and anti-obesity effects, and defense against numerous illnesses and diseases.







Value added fish products

To enhance value addition in fish, bio-based packaging materials were produced and characterized for fish products. Four samples of these materials were evaluated, and sensory and shelf-life profiles for smoked, salted, sundried, and fermented farmed fish products were established.

Primary and secondary fish products from Barbus, Labeo, Nile tilapia, and African catfish were produced and analyzed for various macro and micronutrients. In collaboration with Foodland/Food Systems Africa, a fish business hub was established in Masaka, equipped with a smoking kiln, a storage room, and 15 assorted items for the primary and secondary processing of fish products.

Gender and Equity consideration (Hidden hunger, nutrition and drudgery)

Gender and Equity Considerations in the Commercialization and Incubation of Agricultural Research Products with SMEs

Fish smoking, typically performed by women at landing sites and markets using firewood, is a labor-intensive process associated with health risks from inhaling smoke particles that contain carcinogenic compounds. This contamination leads to fish products with unsafe levels of these compounds. The NARO Smoking Fish Kiln was innovatively designed to filter out smoke and eliminate carcinogenic compounds, producing high-quality smoked fish with undetectable levels of these harmful substances.

This technology not only reduces the health risks and physical strain associated with traditional smoking methods but also makes the process more enjoyable and safer for women, who are the primary fish smokers. Additionally, the composite flours developed offer enhanced nutritional benefits for infants, children, youth, the elderly, and individuals living with HIV/AIDS.


INLET

CHAPTER 3

Technology Promotion

The Directorate of Agricultural Technology Promotion (DATP) coordinates promotion of Agricultural research products and services through two major routes; public and commercial routes. Under the public route, a number of innovative approaches are used to disseminate and upscale technologies through the ZARDIs and extension service providers. The commercial route is linked to NARO holdings Ltd and focuses on IP management, Technology incubation, skilling, engagement of seed companies and other industry players.

Research generates valuable knowledge and information that is disseminated to end users through various channels. Notable avenues include scholarly publications, such as the Uganda Journal of Agricultural Sciences (UJAS), as well as non-scholarly Information, Education, and Communication (IEC) materials.

3.0 Introduction

The Directorate of Agricultural Technology Promotion (DATP) is mandated to coordinate promotion of Agricultural research products and services. It promotes Technologies, Innovations and Management Practices (TIMPS) targeting various end users including but not limited to farmers and industry. This function is guided by NARO's strategic plan and other policy frameworks including NARO outreach strategy, Commercialisation policy, Intellectual Property policy and Knowledge management policy that are all aligned to the agricultural sector and other national policies. The focus is to have NARO technologies, products and services reach farmers and other end users in a sustainable manner through two major routes; public and commercial routes.

Under the public route, several innovative approaches are undertaken to disseminate and upscale agricultural technologies and innovations. These include:

i) **Adaptive trials and demonstrations:** These initiatives expose farmers, extension workers, and other stakeholders to candidate lines, released technologies, and best practices.

ii) **Community seed production:** This approach ensures greater access to improved varieties for farmers.

iii) **Multi-Stakeholder Innovation Platforms (MSIPs)**: These platforms are designed to strengthen commodity value chains and enhance market linkages.

iv) **Joint Technology Upscaling Demonstrations:** These demonstrations aim to boost the uptake of new technologies.

v) **Field days and technology Fairs:** These events showcase various technologies and provide training for participants along commodity value chains.

vi) **Farm clinics:** These clinics raise awareness, facilitate connections between end users and commodity value chain actors, and offer opportunities for instant feedback, thereby promoting the adoption of improved technologies.

vii) **Technology exhibitions and showcasing events:** These events are organized to promote the uptake of technologies.

The commercial route is closely linked to NARO holdings

Ltd and focuses on Intellectual Property Management, Technology Incubation and Skilling, Engagement of seed companies and Engagement of industry players. Meanwhile, other Knowledge and information generated by research is managed in different ways and disseminated to end users through scholarly journals both international and local e.g., Uganda Journal of Agricultural Sciences (UJAS) and non-scholarly Information, Education and Communication materials (IECs).

This report provides progress on dissemination & commercialization of improved technologies, products and services and released varieties between July 2023 – June 2024.

3.1 Technology Dissemination and Commercialization

3.1.1 Technology Dissemination

Technology dissemination involves the systematic distribution and integration of agricultural technologies, ensuring that advancements reach end-users, including farmers, businesses, and industries, to enhance productivity, efficiency, and overall development. During the reporting period, NARO developed a comprehensive Technology and Innovation Dissemination Strategy. The main purpose of the strategy is to enhance access and utilisation of agricultural research results from NARO and other agricultural research institutions. The strategy was approved by NARO governing council and submitted to the Minister of Agriculture, Animal Industry and Fisheries. The implementation of the strategy is expected to enhance adoption of improved agricultural technologies and consequently increase production and productivity in the country.

3.1.2 Adaptive trials and demonstrations

Adaptive trials and demonstrations are intended to expose farmers, extension workers and other stakeholders to candidate lines, released technologies and best practices so as to accelerate release and uptake of farmer preferred varieties suitable for specific agro-ecological zones. During the reporting period, the 9 ZARDIs were supported to establish and maintain demonstrations on different commodities to expose and train farmers as well as extension workers on newly released and candidate varieties of the priority commodities for the zones focusing on traits like high yield, water use efficiency, tolerance to drought, resistance to diseases, early maturity and nutrient content. Sustainable Land Management (SLM) and other climate smart agriculture practices were integrated and demonstrated. The specific outputs are being compiled and will be reported in the NARO Corporate Annual report 2023/2024.

3.1.3 Community Seed production

One hindrance to adoption of improved varieties has been limited access to quality seed by farmers. To address this constraint, ZARDIs were supported to: 1) increase production of basic/foundation seed and other types of seed on station and 2) build capacity of community-based seed producers to enhance production of Quality Declared Seed (QDS). The institutes especially ZARDIs produced assorted seed of OPV maize, beans, soybean, sorghum, potato and other vegetatively propagated crops in season 2023B and season 2024A. The specific outputs are being compiled and will be reported in the Annual corporate report.

3.1.4 Joint Technology up-scaling demonstrations in partnership with cultural Institutions

NARO in partnership with cultural institutions engaged in differed technology promotion activities:

a) **Bunyoro Kitara Kingdom** - through Bulindi ZARDI launched and established a new coffee demonstration site at Musaijamukuru village in Kikuube District. The purpose of the site is to promote 6 KR varieties and showcase good agronomic practices to farmers.

b) **Buganda Kingdom** - through Mukono ZARDI established and maintained three demonstration

gardens mainly on urban farming.

c) While for **Tooro, Rwenzururu** and **Busoga** kingdoms, implementation meetings have been held.

These joint demonstrations are aimed to enhance production capacity of farmers and improve the livelihoods of those communities and beyond.

3.1.5 Farm Clinics

During this reporting period, NARO in partnership with Monitor Publications Ltd organized three farm clinics:

i) **On 30th July 2023 at NaCORI, Kituza** focusing on coffee, cocoa, and banana value chains. Technologies exhibited included varieties, disease and pest management options, good husbandry practices and value-added products. Leveraging on the synergy between NaCORI and UCDA, this clinic attracted over 1500 participants who were trained on the various aspects. High-profile personalities from Operation Wealth Creation and UPDF attended. The invited Chief Guest, General Salim Saleh was represented by Hon Sarah Kataike. The NARO Council Chairperson and Board Chairperson UCDA graced the event as well as the Chair User Committee, Chair Science Committee and some Council members participated. The key concern raised was the need to accelerate delivery of research products and services to end users.

ii) **On 26th August 2023 at Abi ZARDI, Arua** focusing on cassava, dairy, fish, soya bean and rice. Technologies exhibited included varieties, breeds, good husbandry practices and value-added products. The clinic attracted over 400 participants who were trained on the various aspects. It was graced by Resident City Commissioner (RCC) and the Area Member of Parliament (MP) among other dignitaries. Other entities that participated in the farm clinic included Bank of Uganda and Stanbic bank. Similarly, the key concern was on the need to increase demonstration and learning platforms in the zone to enhance technology adoption.

iii) **On 29th June 2024 at Ngetta ZARDI, Lira** covering dairy, fish, rice, soybean, cassava and maize production among others. The training which involved practical field demonstrations and exhibitions along the value chains of the different commodities, was attended by over 1360 participants including farmers, extension workers, politicians and other value chain actors. Present were officials from Bank of Uganda, Jubilee Insurance, Stanbic Bank and Heifer International that trained farmers on financial and other business tips.



The next farm clinics are planned to take place in KaZARDI and BugiZARDI.

These events have strengthened partnerships, increased awareness of the masses on improved technologies and the overall visibility of NARO.

3.1.6 Technology exhibition and showcasing at different events to enhance uptake

During the reporting period, there were several significant events at which NARO had the opportunity to showcase its technologies:

i) **National Agricultural show 2023 -** The 28th Source of the Nile Agricultural and Trade show at Jinja was organized by the Uganda National Farmers Federation (UNFEE) in collaboration with NARO and other partners from public, private sector and civil society organizations dealing in agricultural value chain. The National Agricultural Show ran from 5th-14th August 2023 under the theme'' Fostering Resilient Agricultural Vale Chains to drive Agro-Industrialization and Wealth Creation''. It was preceded by the National Agricultural Education Show from 10th-15th July 2023 under the theme 'Empowering Young Agriprenuers''. NARO participated in both activities to show-case her technologies for increased dissemination, appreciation and adoption by different end users. NARO demonstrated commodities in the field including drought resistant and early maturing varieties of Maize, Beans, Coffee, and Cocoa, Cassava, Bananas, Rice, Sunflower, Vegetables, Sweet Potatoes, Barley, Wheat, Millet, Sorghum, Oil crops, Pasture and Fruits. The demonstrations were well labelled with key information on variety names, agronomic details and use among others. Commodity samples and value-added products for horticulture, cassava, banana, fish etc. and agro-machinery as well as related literature information (posters, brochures, factsheets and technical guides) were exhibited. Different categories of people including high rank government officials, the Minister of State for Agriculture, Hon. Fredrick Bwino Kyakulaga and the Chairman NARO Governing Council among others visited the NARO exhibitions. In his opening speech, the Minister of Agriculture appreciated NARO and other exhibitors for participation at the organised Agricultural show. He appreciated the fact that NARO research is generating climate smart technologies that are in line with the show-theme such as drought resistant and early maturing varieties. Despite the good job done by the team, there were gaps mainly attributed to limited resources to enable full participation and adequate maintenance the demonstrations. For NARO to excel on relevant, well-coordinated and impactful exhibitions during agricultural shows there is need for adequate publicity of her technologies in the demonstration village before, during and after the event.

ii) **World Food Day Celebrations –** NARO hosted the 44th World Food Day 2023 at the National Coffee Research Institute (NaCORI). The theme for the celebrations is "Water is life. Water is food. Leave no one behind". Over 1000 participants attended.

iii) **Regional farmer mobilization campaign launched by the Prime Minister** - NARO was well represented at the events that took place in the central region under commendable leadership of Dr. Barbara Zawedde, Director of Research Mukono ZARDI. The team was joined by NaCRRI, NARL, NaCORI, NALRRI and NHL exhibited technologies along 10 commodities of maize, bean, soy bean, banana, coffee, fruits, vegetables, pastures, dairy, fish and agro machinery to over 12,200 participants (6500 in Mityana –Kiboga trip and 5757 in Nakaseke-Luwero trip) and sold over 8 tons of maize and other assorted seed and products. There was overwhelming demand for NARO

agro-machinery and seed especially for maize. Livestock technologies were not adequately demonstrated especially dry season feeding and milk quality technologies in Nakasongola and Nakaseke due resources constraints. NARO was appreciated by stakeholders especially by the Rt. Honourable Prime Minister, Minister of State for Agriculture and other dignitaries; a number of NARO technologies and products were disseminated to the masses; and there was increased publicity of NARO that are favourable for technology uptake, resource mobilization and other opportunities.

iv) **Eastern Agricultural show at Awoja Riverside in Soroti** - Three (3) institutes participated including NaCRRI, NARL and NaSARRI. NARO team showcased technologies and trained over 1703 participants on 28 commodities including cassava, maize, citrus, fish, millet, bees, rice, wheat, ground nuts, Food Biosciences and Agribusiness Program and soil and land management.

v) **International Labor Day celebrations in Fort Portal City** - NARO showcased transformative agricultural technologies with potential to uplift Ugandans from poverty to over 5,000 participants. Among the products were value added products from coffee, including facial cream, body cream, face and body scrub, lotion and oil, banana fibre-based hair extension, green banana resistant starch and banana dyes; tea-green tea beverage and oil extracted from tea.

vi) **Harvest Money Expo 2024 (23rd - 25th February 2024) at Kololo independence grounds** - Six (6) institutes including NaCRRI, NaLIRRI, NaSARRI, NaFORRI, NARL, and RwebitabaZARDI participated in the event and exhibited technologies along commodities that included; improved pastures & seed, rice, beans, tea, maize, banana, cassava, sweet potatoes, sorghum, millet, Macademia, hass avocado, citrus, mangoes, alongside value added products. The Expo attracted participation from over 150 exhibitors from all key agriculture sectors with over 40,000 show goers who streamed in from early morning(s) to late evening(s) on each of the three (3) days and most of these numbers reached the NARO stall and attended the trainings conducted by the NARO team.

3.1.7 Multi Stakeholder Innovation Platforms

MSIPs are important in strengthening commodity value chains and market linkages. Over time NARO has formed 78 MSIPs for various commodities across the country. These MSIPs have been supported in governance and technical skills (group dynamics, business plan development, post-harvest handling and value addition, marketing and quality assurance, climate change and adaptation, improved husbandry and management practices). The target for this period was to profile and assess their functionality for targeted support. However, due to resource constrains, the activity has been moved forward to FY 2024/25.

3.2. Technology Commercialization

3.2.1 Intellectual Property Management

During the period, two (2) trademark applications were developed and registered and one (1) patent for the banana starch developed and filed for protection. NARO continued to safeguard her outputs of research (technologies) through timely intellectual property identification and protection at different levels and review of Memorandum of understandings, research collaboration agreements and material requests and transfer agreements to prevent misappropriation. A response in relation to the search report for the patent application for the cocoa fermentation box by the African Regional Intellectual Property Organisation (ARIPO) and submitted to the National IP Office and one (1) utility model application has been made for the cocoa

fermentation box. Two trademark applications, *Cherry delight* for the coffee yogurt and *Forest charm* for the cocoa wine were filed for protection with the National IP office. NARO has continued to raising a conscious IP community through weekly virtual IP advisory services held every Tuesday of the week on the zoom platform. A total of 40 sessions have been held and cumulatively attended by 300 participants including scientists, academia and private sector players.

3.2.2 Technology Incubation and Skilling

Efforts to refine NARO prototypes are ongoing with a focus on supporting product development teams at PARIs in trademark development and product standardization.

The directorate of ATP has supported the banana program of NARL in the development of two trademarks for the banana fibre hair product and the banana starch, this geared towards ensuring that the products attain standardization at an appropriate time. NARO is increasing efforts to support other institutions in establishing and strengthening their own incubation hubs and centres to boost innovation. The directorate of ATP has hosted Uganda Christian University, Kabale University and Lira University in their benchmarking visits to the NARO incubation centres and offers technical support in their incubation and IP management endeavors.

The directorate has supported NaCORI in the development of two trademarks for the coffee yogurt and the cocoa wine, this geared towards ensuring that the products attain standardization at an appropriate time. DATP has initiated strategic engagements with the Starthub with the goal of entering into a partnership to catalyze significant advancements in agricultural technology and innovation. By combining NARO's research capabilities with Starthub's entrepreneurial acumen and market insights, this collaboration will enhance product development and commercialization, ultimately benefiting the broader agricultural community and contributing to national growth.

3.2.3 Licensing of NARO plant varieties to Seed Companies

NARO continued to streamline access and licensing of plant varieties to foster quality assurance, product stewardship, timely delivery of Early Generation Seed (EGS) to seed producers and benefits sharing. To increase the compliance of seed companies to NARO's access and licensing framework for the commercialization of her varieties, NARO through a team comprising of the Intellectual Property Management Committee (IPMC), Early Generation Seed Working Group, Ministry of Agriculture and Animal Industry (MAAIF) Police, the National Seeds Certification Services and the IP and Commercialization office, interfaced with non-licensed seed companies to discuss implications of their continued use of NARO plant varieties without a formal license. A total of eight (8) un-licensed seed companies were visited including: Crown Seeds, Rhino Seeds, Savana Seeds, Select Seeds, Masindi Seeds, Supa Seeds, Green Firm Africa and Centre for Agricultural Inputs International (CAII). As a result, eight new seed companies signed licensing agreements with NARO to commercialize her varieties, they include: Supa Seeds, Rhino Seeds, Golden Bull Africa, BRAC Seeds, Okeba Seeds, Century seeds, Green Firm Africa and Savana Seeds.

In a significant milestone, DATP successfully collected over **UGX. 446,120,555** (Four hundred forty six thousand one hundred twenty thousand five hundred fifty five shillings) in royalties from licensed seed companies (Details are in Annex 1) and **UGX. 34,867,750** (Thirty-Four Million Eight Hundred Sixty-Seven Thousand Seven Hundred Fifty Shillings) for foundation seed for session 2024 A (Details in annex 2). This achievement not only underscores the value of NARO's intellectual property but also reflects the practical impact of the research outputs in the agricultural sector. Collecting royalties is crucial as

it provides a sustainable funding stream, enabling reinvestment in ongoing research and development. This ensures that NARO can continue to innovate and offer scientifically advanced solutions to farmers and the agricultural industry.

In the efforts to commercialize NARO plant varieties, the DATP coordinated the signing of ten (10) licensing agreements with seed companies bringing the total of licensed seed companies to 23 and the varieties licensed to 84. The 10 seed companies include; Rhino Seeds, Savana Seeds, BRAC seeds, Masindi Seeds, Supa Seeds, Green Firm Africa, Century Seeds, Golden Bull, Okeba Seeds and Premier Seeds.

In season 2024A, DATP coordinated the production of 73% of the foundation seed required by seed companies and produced and processed by NHL. The coordination involved collecting the foundation seed demand a season in advance from seed companies, ensuring that the demand is effective, passing on the demand schedule to NHL and communicating to seed companies when and where to collect their seed from.

3.2.4 Engagement of Industry Players

NARO continues to strengthen Research-Industry collaboration for uptake of her technologies and informing research on the industry needs. NARO has engaged Movit Products Limited on issues related to the commercialization of the coffee body and facial scrub. An MoU to enable Movit Products Limited to conduct market testing has been drafted. The market testing is expected to catalyse the commercialization of the coffee scrub by Movit Products Limited. DATP continues to engage Movit Products Limited on issues related to market testing of the coffee body and facial scrub.

3.2.5 Business and commercialization plans

In accordance with the NARO commercialization policy, DATP has coordinated the development of the commercialization model/plan for the commercialization of NaFIRRI's Feed mill and the commercialization strategy for the tick vaccine. The commercialization model for the feed mill ensures optimization in production, distribution, and marketing strategies in alignment with private sector efficiency and public sector goals. Developing robust commercialization models and plans is crucial for successfully launching and scaling ventures.

3.2.6 Technology Valuation studies

The directorate of technology promotion conducted a study which focused on an interaction with agro-input dealers to assess the demand and explore preferences of NARO varieties in the market. The study addressed four specific objectives including; 1. Determining the demand of NARO plant varieties in terms of popularity and acceptance; 2. Evaluating market preference for available plant varieties in the market; 3. Evaluating the competitiveness of seed companies dealing in released NARO plant varieties and; 4. Establishing the prevailing demand and supply trends in the seed market. The results from the study revealed that across regions, maize was the highest traded and preferred seed type followed by beans. NARO plant varieties, UH 5354 popularly referred to as Bazooka and Longe10H are the most traded varieties across the regions mostly due to the massive promotion campaigns and a wide distribution network by NASECO. Longe 5 is also popular on the market owing to the low cost of the seed. However, these face stiff competition from imported hybrids from Kenya such as DK series owing to the consistence of quality standards, innovative marketing strategies employed by the agents of imported seeds including offering seed to input dealers on credit and delivering to their premises in addition to conducting massive awareness campaigns. The results further revealed that NASECO dominates as a supplier of seed in all the regions due to the popularity of Longe 10H and UH 5354 (Bazooka). Syova Limited formerly East Africa seeds was also found to be a key source of seed mainly due to their distribution across the four regions.

Based on the findings, the study recommended that: the NARO commercialization office regularly engages licensed seed companies to identify and co-create solutions to the challenges that are limiting the commercialization of already licensed varieties including intensifying demonstrations and promotions and should profile and engage the unlicensed seed companies to formalize their access to NARO plant varieties. The Directors of Research should popularize the NARO policies relating to access and commercialization of plant varieties and the repercussions of not adhering to them to stop the unauthorized trade in NARO varieties. Furthermore, MAAIF as a regulator should consider not issuing seed certification clearances and labels to seed companies commercializing NARO varieties without proof of license certificate and foundation seed source.

3.3 Knowledge and Information Management

3.3.1 Generation of content for Information hub

In order to increase reliability and improve usage of the NARO Information Hub, regular updates and upgrades are conducted. These are both technical in terms of navigation and interface as well as content uploads. During this period, over 30 content packages have been indexed and uploaded on the information hub. User requirement for three modules have been compiled which informed the latest upgrades. (http://NAROinfohub.NARO.go.ug)

The Information-Hub (Info-Hub) has recently been consistently updated with new content, providing users with the latest agricultural information, resources, and insights. The addition of updated materials also enhances the overall value of the Info-Hub, making it a more comprehensive and reliable source of information for researchers, practitioners, and other stakeholders.

In addition to the new content, significant upgrades have been initiated to increase the functionality of the Info-Hub. These upgrades include the ability to track traffic, which will provide valuable insights into user engagement and content popularity, helping to tailor future updates more effectively. Furthermore, the new functionality allows for the uploading of audio and video files, enriching the user experience by offering diverse formats for information consumption. These enhancements make the Info-Hub a more versatile and powerful tool for information dissemination and knowledge sharing, catering to the evolving needs of its users.

3.3.2 Development of Knowledge Management guidelines

The KM guidelines have been developed and will help to operationalize the KM policy by promoting consistency in the general application as well as uniformity in policy interpretation, for effective and efficient utilization of generated knowledge. The document is ready for presentation to Top Policy Management, User committee and subsequent approval stages.

3.3.3 Uganda Journal of Agricultural Sciences

UJAS publishes two issues each calendar year. Two volumes; volume 21 issue two and volume 22 issue one with a total of eleven papers were published in this reporting period. Nine of which were from NARO institutes including AbiZARDI, NaCORI, NaCRRI, NaFORRI, NaLIRRI, NaFIRRI and MuZARDI. Ten of these were from Uganda while one was from Nigeria. The titles of the respective papers belonged to broad displines in plant health, livestock health, and socio-economics. These can be accessed via African Journals online (AJOL) https://bit.ly/3EfuabN and https://bit.ly/3TFrhqg. The same link provides access to other publications made over the years.

Online submission functionality on the portal was operationalized and all current submissions are made via the portal.

The journal joined the social media space to increase its visibility. Currently journal products and updates can be accessed on Twitter and LinkedIn. Further efforts to increase its visibility through indexing by CABI have been initiated.

The UJAS 10-year strategic plan was developed and approved by the NARO governing Council. The strategic plan is specifically designed to guide UJAS's investments and developmental activities over the next ten years. The strategies outlined in the plan include enhancing research dissemination, increasing collaboration with international researchers, and improving the accessibility and quality of published research.

In a bid to increase UJAS's visibility, efforts towards enrolling it onto editorial manager were initiated too. An agreement was signed between NARO and Aries (Editorial Manager) to formalise the working relationship between the two entities. This will increase the number of submissions, improve the quality of the publications and shorten the turNAROund time for the peer review process hence increasing the visibility and popularity amongst target audience.

3.3.4 Annual Corporate Reports

In adherence to a practice of transparency and accountability NARO publishes detailed annual corporate reports. These reports are compiled following the organization's annual performance reports, which detail the progress and outcomes of its various initiatives throughout the year. The NARO Corporate Report for the fiscal year 2022/2023 was completed. In an effort to balance accessibility with environmental considerations, a limited number of physical copies have been printed. To ensure that all stakeholders and the general public have easy access to this important document, digital versions of the report have been made available on NARO's official website.

3.3.5 Digitization of documents

In a significant advancement for agricultural research accessibility, the Information Management (former "ARIS") staff is undertaking comprehensive digitalization initiative. A total of 255 publications, comprising 236 theses and 19 program reports, were meticulously scanned, cleaned, and indexed. Additionally, 201 theses were digitised too. The fully digitised documents were uploaded into the e-repository of the NARO Information Hub. This initiative is aimed at enhancing the availability of valuable research information materials for scholars, policymakers, and practitioners at various levels. Furthermore, 10,123 documents in 546 personnel files at NaCRRI were digitised and uploaded on their internal Online File Station. Personnel files, by their nature, cannot be uploaded onto the NARO Information Hub

3.3.6 Data Base Management and Development of Systems

Through www.NAROinfohub.NARO.go.ug, NARO consistently provides valuable information and resources to farmers and stakeholders, covering agriculture best practices, pest and disease management, post-harvest handling, technological innovations, and collaboration opportunities. During the reporting period, the platform was enhanced by updating key modules like the home page, pests and diseases, post-harvest handling, and good agricultural practices, ensuring a more impactful and user-friendly resource for our agricultural community. The design and development of a Partnership Information Management System (PIMS) to optimize collaboration and project oversight at NARO has been completed. The implemented PIMS consolidates partnership details, project data, and communication channels, facilitating streamlined collaboration and effective project management. The PIMS serves as a centralized database for all partnership-related information, ensuring that data is easily accessible and up-to-date. PIMS will enable efficient tracking of collaborative

project progress, milestones, and outcomes, facilitating better oversight and management. PIMS is comprehensive and includes details of all current and past partnerships, including contact information, project details, and collaboration history.

3.4 Development and maintenance of partnerships

NARO works closely with a number of strategic partners to achieve various outputs along the technology generation and promotion chains. These include; Ministries, Departments and Agencies (MDAs), District Local Governments (DLGs), Farmer Organisations, Research institutions, Academia, International Development Partners, Private sector players, Cultural and Religious Institutions. To ensure sustainable development and maintenance of partnerships, NARO developed a Partnership Policy in 2021 in line with the Public Private Partnerships Act, 2015. In pursuance of NARO's Partnership Policy and strategic Plan 2018/19-2027/28 that emphasizes strengthened private sector partnerships and collaboration to enhance technology transfer, upscaling uptake, adoption and promotion of NARO's technologies to the end users, the following have been achieved in this period.

3.4.1 Development of NARO partnership guidelines

Guidelines have been developed to operationalise the NARO Partnership Policy 2021 and have been submitted to the Policy Management Review Committee for scrutiny. Partnership profiles and monitoring tools for the completed projects/ended partnerships, running partnerships and potential partners have been developed and submitted alongside the guidelines to the Policy Management Review Committee.

3.4.2 Status of partnership development and implementation

During the period under review, 23 new partnerships were initiated of which 15 are formalized while the remaining 8 are at different levels of MoU development. Cumulatively there are 34 partnerships at different levels of development and implementation as detailed in Table 1.

Table 1. Cumulative R&D partnerships developed and their status as of June 2024.

Partnership	Areas of collaborations	Status/Progress
Rural Initiatives for Poverty Alleviation (RIPA)	• Promotion of modern, sustainable, environmentally friendly, and profitable livestock and crop technologies that increase production and productivity of small holder farmers and household incomes.	• MoU Developed, submitted to DDG - R and DoR NaLIRRI for final review.
Catalyst Africa Limited (CAL)	• Expert handling of satellite data and Geographic Information System (GIS); Use of Earth Observation (EO), Remote sensing and Artificial Intelligence (AI) solutions in Agriculture and Ecosystems monitoring including: crop health monitoring, pest and disease monitoring, developing yield prediction models, land use mapping, monitoring and management, soil suitability mapping and soil moisture monitoring. • Support NARO in the dissemination of results and information. • Provisioning of additional data layers over Uganda (or relevant regions) and customized ICT solutions.	• MoU fully developed and ready for signing.
Victoria University	• Joint research and capacity building/ Training programs; Community outreaches and joint resource mobilization for research and technology development	• MoU Drafted, and being reviewed by the parties. Expected to be signed in July, 2024
MUTESA I Royal University	• Capacity Building – Training programs, Joint resource mobilization, joint community empowerment programs, Joint research.	• MoU Signed, at planning and resource mobilization stage.
Start Hub Africa	• Joint research and product development; catalyze commercialization of NARO technologies through enhancing linkages and networks with private sector players; Joint resource mobilization for commercialization activities.	• MoU developed, reviewed and submitted for legal perusal and clearance. Expected to be signed in July, 2024
Monitor Publications Limited	• Technology promotion and dissemination through Farm Clinics, NARO visibility.	• Cooperation Agreement reviewed and formalized, 3 Farm clinics planned for 2024 starting with that of Ngetta ZARDI on 29th July, 2024.
Digimark Comms	• Market testing of green banana resistant starch.	• MoU signed, market testing tools developed and market testing has commenced through the Banana Program at NARL, Kawanda.

Partnership	Areas of collaborations	Status/Progress
Techno Serve	• It focused on improved food security, nutrition, increased household income, and a vibrant private sector for job creation.	• MoU signed in April, 2024. Joint planning meetings held and implementation has commenced through KaZARDI.
Psalms Foods Limited (SUMZ)	• Development of potato and Groundnut value chains that meet their production requirements.	• 6 candidate potato lines and 2 groundnut varieties were tested by Psalms Foods. The groundnuts were found to be suitable for their use. Based on this finding the NaSARRI team is currently multiplying the seed. Meanwhile the results on potato lines did not meet their requirements. The KaZARDI team is working towards developing varieties with the required attributes.
Rwenzururu Kingdom	• Food and market commodities and tree planting prioritized.	• Partnership launched and MoU signed. Planning meeting scheduled
Buganda Kingdom	• Technology promotion, adoption, dissemination through establishment of demonstrations, exhibitions/shows, outreach programs.	• MoU signed on 5th October, 2023. 3 demonstration sites established and being maintained at Bulange, Mengo and Lubiri High SS through Mukono ZARDI.
Bunyoro Kitara Kingdom	• Technology promotion, dissemination, Expositions	• Demonstration for 6 Rubusta coffee varieties established and being maintained at Mussaija Mukuru village in Kikube District through Bulindi ZARDI.
Busoga Kingdom	• Food, nutrition and income security interventions with focus on Technology promotion and dissemination.	• Partnership was launched and MoU signed on 17th May 2024 at Lukiiko Hall in Bugembe, Jinja City. The inception and joint planning meeting for the implementation has been conducted through Buginyanya ZARDI. • 28 acres of land have been ear marked at Buyende by the Kingdom's Prime Minister for demonstration and seed multiplication.
Tooro Kingdom	• Technology Promotion, adoption, dissemination through establishment of demonstrations, exhibitions/shows and outreach programs	• MoU drafted, scheduled to be signed in July 2024
MEFARMS	• Development of goat breeds, goat management practices, feed formulation and digital data management that satisfies standards for goat exportation.	• MoU signed and joint planning meeting for implementation has been scheduled for July 2024.
Movit Products Limited	• Market testing of the coffee facial scrub, product development of cosmetics and beauty products.	• MoU signed; Market testing of the facial and body scrub conducted by Movit Products Limited. The market testing report has been expected since February 2024.

Partnership	Areas of collaborations	Status/Progress
Coca – Cola/ Kike Tropical Fruits Limited/ Grain Pulse Limited	• Introduction of preferred mango varieties from Eastern Kenya and Tanzania into Uganda, • Multiplication of Kakule mango variety planting material for adaptation trials and scaling to other zones from Eastern Uganda, post-harvest handling of cereal grains.	• MoU signed with Coca - Cola. Coca-Cola subcontracted Kike Tropical Fruits and Grain Pulse Limited, a fruit pulp/puree processing plant and grain handling respectively to work with NARO in the establishment of demonstrations in different agro-ecological zones. Consultative meetings held; MoU being drafted. Expected to be signed in early July, 2024
Rewa Grains	• Technology promotion and dissemination - Seed management: sorting, packing, provision of outlet for NARO technologies. Seeds multiplication, establishment of demonstrations.	• Partnership formalized, operational especially in the foundation seed handling.
Amafh Farm Limited	• Development of Macadamia varieties and value chains improved, Multi location trials, Joint training (Amafh Farm intends to establish a training institute for Macadamia)	• MoU drafted and ready for signing in June 2024
NHL & FELITAI	• Pasture establishment and management, animal health, agribusiness management.	• MoU submitted for clearance. Meanwhile NHL, FELITAI and NaLIRRI have already started establishing forage gardens and training of community-based groups on pasture and animal health management in Eastern Uganda.
RUFORUM, ICBA	• Capacity building –skills enhancement and knowledge transfer, collaborative research.	• MoU development is at final stages of clearance.
Care International	• To promote and foster research and development especially joint generation, evaluation, validation, promotion, dissemination and transfer of agricultural technologies, products, services, extension models, etc., seed production (fish, apiary, livestock pasture) and feed production.	• MoU development in progresss.
Church of Uganda Family TV	• Enhancing visibility, sharing information on NARO's technologies, products and services with stakeholders through documentaries, Talk shows, live coverage of agricultural events.	• MoU signed. At planning and resources mobilization levels.
Busoga Consortium for Development (BCD)	• Food security and nutrition intervention in Busoga sub-region - promotion of cassava, maize, rice and beans to complement sugar cane growing.	• MoU drafted, ready for signing. Budget for establishment of cassava multiplication field developed by Ikulwe satellite centre.

Partnership	Areas of collaborations	Status/Progress
Farm Radio International	• Technology promotion, information dissemination on NARO technologies, products and services. Development of joint programs.	• MoU signed. At planning and resources mobilization levels.
COFIA Uganda	• Technology promotion and dissemination through demonstrations and annual agricultural exhibitions.	• Partnership formalized and operational since 2022. Annual show and demonstration gardens on various commodities have been organized and established respectively.
Nile Breweries Limited	• Joint research and development	• 3 trial sites established (Gulu, Lira and Kumi) on three cassava varieties for brewing traits. Two harvests and laboratory tests conducted. The results revealed that 2 candidate lines are meeting the required brewing parameters - starch content, cyanide levels. The last harvest and test will be conducted in October 2024 and will determine the variety that will be commercialized.
Uganda Breweries Limited	• Enhancing production of quality apples as a raw material for brewing apple cider beer brand at UBL. • Evaluate and release two barley varieties (Aliciana and Grace)	• The two varieties were evaluated and submitted to the Variety Release Committee for consideration for release. • 3Aapple cooperatives supported with demonstration gardens established in the districts of Rubanda, Rukiga and Rukungiri. • Capacity of over 150 Farmers built in apple production (agronomic practices, standards management, pest and disease management).
Doctor's Choice	• Designing, branding and packaging of resistant starch from green banana as a nutraceutical product.	• Designing, branding and packaging of prototype is complete. Arrangements for market testing is being done.
Church of Uganda Province	• Food security and nutrition interventions, Technology dissemination and promotion through demonstrations for adoption.	• MoU signed. At planning and resource mobilization at Provincial and Diocesan levels. Eg. Kigezi Diocese has engaged KaZARDI and are planning together.
Nature Fusions Limited (Afros &Mo)	• Branding and Market testing of hair extension from banana	• MoU developed, submitted to NARO legal Unit for clearance. Market testing plan and budget drafted and ready for execution as soon as the MoU is signed.
Awoja Riverside Farm	• Technology promotion, dissemination, adoption and visibility of NARO through regional annual shows in Eastern Uganda, establishment of demonstration gardens at Awoja Riverside farm	• Formalized, operational. Regional show organized, demonstrations established in March 2023 and March 2024.

Partnership	Areas of collaborations	Status/Progress
Rewa Animal Genetics Services	• Promotion and dissemination of animal breeds through establishment of embryo storage facility, training center for Artificial Insemination and provision of improved animal health management services for easy access by farmers.	• MoU ready for signing
NUTREAL Limited	• Continuous product improvement of the super kawomera composite flour.	• Profit sharing agreement developed, being reviewed by the parties.

Challenges

Below are some of the challenges that the Directorate of Agricultural Technology Promotion has faced in delivering her mandate in the report period:

i) Resource limitations which have restricted the scope of promotional activities, outreach programs, and the ability to conduct comprehensive training for end-users; Inadequate transport facilities and facilitation for technology promotion against overwhelming demand from both public and private sector for NARO to participate in emerging events.

ii) Limitations in coordination and collaboration among various stakeholders, including government agencies, non-governmental organizations, private sector partners, and international development partners.

iii) The absence of supportive regulatory frameworks for example the PVP regulations has impeded the commercialization of NARO plant varieties as enforcement of the IP rights is not possible.

iv) Difficulties in establishing robust monitoring and evaluation systems to assess the success of technology promotion initiatives and identify areas that need adjustment or additional support.

v) The effects of climate change, such as unpredictable weather patterns and increased frequency of extreme events, can complicate the promotion of agricultural technologies.

vi) Ensuring the protection and management of intellectual property rights is crucial for incentivizing innovation and safeguarding the interests of researchers and developers. However, navigating the complexities of intellectual property law and ensuring compliance is challenging, particularly in a developing nation such as Uganda.

Recommendations

DATP makes the following recommendations:

i) Enhance funding and resource allocation to promote, disseminate and commercialise agricultural technologies at scale.

ii) There is need to acquire specialised vehicles (conditioned NARO technology van)to facilitate movement of technologies for exhibition.

iii) There is need to continue prioritizing investments in irrigation facilities across institutes.

iv) NARO should continue to advocate for the creation and implementation of the PVP regulations.

v) NARO should move to establish a comprehensive monitoring and evaluation systems to track the impact and effectiveness of technology promotion efforts. These systems should provide valuable feedback and data to guide future initiatives and ensure continuous improvement.

vi) Strengthen intellectual property management to protect and incentivize innovation. This includes providing support for international patent applications, ensuring compliance with IP laws, building capacity in IP valuation and regularly raising awareness about the importance of intellectual property rights among researchers.


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Sentinel GOLD
ESCO Class II Biological Safety Cabinet
1 Start Up
2 Work surface decontamination
3 Material placement, drain valve & purging
4 Ergonomics: adjust seat height & pad to ensure
7 Shut down

CHAPTER 4

Agricultural Research Strengthening

The focus in agricultural research institutional strengthening has been on human resource development, financial resource mobilization, infrastructure development and securing land for agricultural research.

Human Resources Development

The directorate is mandated to initiate human resource plans, programs, policies and approaches which ensure that the entity is staffed with the requisite human resources that work towards achievement of its strategy. In this year, the salary for scientists from Principal Research Officer to Research Officer ranks was enhanced as shown in the table below.

Table 2: Enhanced salaries of Principal Research Officer to Research Officers

TITLE	GRADE	OLD SALARY	NEW SALARY
Principal Research Officer	UR3 RS	7,500,000	8,500,000
Senior Research Officer	UR4 RS	6,500,000	7,500,000
Research Officer	UR 5 (i) RS	4,800,000	6,000,000
Senior Principal Technician	UR 4 RT	5,600,000	5,600,000
Principal Technician	UR 5 (i) RT	4,000,000	4,500,000
Senior Technician	UR 5 (ii) RT	3,000,000	3,600,000
Technician	UR 6 RT	2,300,000	2,600,000

g) **NARO staff structure:** During the period, NARO in collaboration with Ministry of Public Service (MoPS) developed a new staff structure with a total establishment of 1180, from 995 numbers. Ten (10) new positions were created, and seven (7) positions were abolished. The structure therefore required several actions that ranged from re-designations, change of nomenclature and salary adjustments to de-risk staff from job loss. The total of 61 members of staff were redesignated as per the new structure into new roles, these were mainly in the category of Accountants, Administrative Assistants, Procurement Officers and Auditors. In addition, salary adjustments were made for positions whose salary moved from one category to another.

h) **Recruitments:** Fifteen (15) new directors were recruited following the expiry of contracts of the former office holders, 18 scientists recruited, 11 administrative and support staff.

i) **Appointment of Programme Leaders and Heads of Satellite Stations:** Research undertakings in NARO are programme led, therefore, new

programme leaders were appointed for all the 57 programs with clear duties, responsibilities and renumeration. All the programs have got leadership.

j) **Retention of Research Scientists:** During the period under review, NARO retained five (5) experienced high caliber scientists who had completed their term of office as Directors of research from various Public Agricultural Research Institutes. This achievement is noble because it enhances our pool of supervisors, mentors and coaches.

k) **Staff Separation:** Forty-five (45) staff who left service through mandatory retirement, resignation, terminated/ abscondment and death were paid their terminal benefits.

l) **Staff Welfare:** NARO provided medical insurance and incapacity benefits to all staff with minimal interruptions for improved research stability.

m) **Training and Capacity Development:** NARO supported staff on Long term training for improved research stability where fifty two (52) on PhD (34 male and 18 female), 17 on Masters (13 male and 4 female).

n) **Completion status for staff on long term training:** During the FY 2023-2024 eight (08) staff on PhD completed, 5 at master's level and 2 at Bachelors level completed their courses and continued working with NARO which strengthened NARO's stalk of qualified human capital.

o) **Performance management:** During the period under review, NARO undertook performance management measures for the entire staff of NARO to ensure improved service delivery. The overall staff performance stood at 78% of the developed performance plans and which were effectively assessed.

p) **Contract Renewal:** During the period under review, 168 staff contracts were renewed upon satisfaction of the minimum requirements for contract renewal as provided for under the NARO human resource mannual.

q) **Staffing levels:** At the end of the financial year 2023-2024, the overall staffing levels stood at 995 compared to 1180. This staffing level therefore, presents 67% implementation of the NARO establishment.

4.2 Financial Resource Mobilisation and Management

The 3 major sources of funds for NARO are the Government of Uganda through budget allocation to her vote 142, non-tax revenue and off-budget projects. NARO's annual budget for FY 2023/2024 stood at UGX 166,487 billion funded through the Government of Uganda (GoU development, GoU recurrent). The total cumulative release was UGX 164,487 billion representing 98.79% release against approved budget. The overall absorption for NARO was 99.97%

Table 3: NARO Annual financial performance for FY2023/2024 (UGX Billions) as at 30 th June 2024

Category	Annual Budget (UGX Bn)	Cumulative Releases	Amount Spent (UGX Bn)	Percentage Release Vs Budget	Percentage Spent Vs Release
Recurrent- Wage	43,462	43,462	43,462	100%	100%
Gratuity	10,866	10,866	10,866	100%	100%
Recurrent-Non- Wage	31,189	31,189	31,145	100%	99.86%
Total Recurrent	85,517	85,517	85,473	100%	99.95%
Gou- Development					
Project 1560 Relocation of NaLIRRI to Maruzi	21,000	21,000	20,998	100%	99.99%
Project 1619 Retooling NARO	59,970	57,970	57,969	96.66%	99.99%
Total Development	80,970	78,970	78,967	97.53%	99.996%
GRAND TOTAL	166,487	164,487	164,440	98.80%	99.97%

Table 4: Summary of the Non-Tax Revenue Performance FY 2023/2024

S/N	INSTITUTE	BUDGET 2023/2024 (UGX)	Actual 2023/2024 (UGX)	FY 2023/2024 % Performance
1	NaCRRI	569,043,335	315,391,619	55%
2	NaFIRRI	321,336,208	567116378	209%
4	NaFORRI	136,469,139	187,812,522	138%
5	NaLIRRI	187,851,846	132,413,740	70%
6	NaSARRI	276,423,408	158,937,181	57%
7	NaCORI	197,644,761	230,446,837	117%
8	NARL	553,497,029	858,660,525	155%
9	ABI	175,683,839	97,756,202	56%
10	BULINDI	151,703,678	202,275,165	133%
11	MUZARDI	386,165,022	456,930,808	118%
12	KACHWEKANO	178,584,486	106,562,222	60%
13	NGETTA	127,343,189	168,969,500	133%
14	NABUIN	97,367,004	44,977,120	46%
15	MBARARA	86,558,563	141,869,991	164%
16	BUGINYANYA	68,066,666	74,312,730	109%
17	RWEBITABA	107,909,827	69,488,868	64%
18	NAROSEC	28,352,000	704,598,375	2485%
	Grand Total	3,650,000,000	4,518,519,783	

Table 5: Summary of Off budget projects Performance for FY 2023/2024

S/N	Project Title	BUDGET FOR 2023-2024 FY	Balance as at 1ST JULY 2023	Disburse-ments for the Quarter	Payments for the Quarter	Balance as per 3OTH SEPTEMBER 2023
01	NARL	11,976,144,342	4,219,411,883	1,908,381,990	3,183,816,576	2,943,977,297
02	AEATREC	185,000,000	-	-	-	-
03	PGRC	255,375,000	38,315,124	-	12,830,071	25,485,053
04	NaSARRI	227,203,988	891,198,211	133,348,755	536,970,433	487,576,533
05	NaFIRRI	3,078,054,500	627,919,190	1,540,359,732	889,661,838	1,278,617,084
06	KACHWEKANO ZARDI	407,993,313	193,524,278	-	83,573,621	109,950,657
07	BUGINYANYA ZARDI	2,255,260,030	33,008,342	83,480,469	1,291,301	65,197,510
08	NGETTA ZARDI	-	130,582,871	12,100,000	56,092,102	86,590,769
09	NaCORI	2,963,729,789	980,845,054	935,445,518	1,022,473,158	893,817,414
10	NaCRRI	8,000,502,000	2,138,395,725	644,461,161	1,191,229,450	1,591,627,437
11	ABI ZARDI	374,395,000	-	-	-	-
12	NaFORRI		62,825,478	614,843,607	420,928,647	256,740,438
13	NABUIN ZARDI	1,000,000,000	977,998,600	-	748,757,081	
14	BULINDI ZARDI	55,500,000	47,582,708	-	21,389,513	26,193,195
15	MBARARA ZARDI	267,104,300	14,086,595	119,677,462	1,212,000	132,552,057
16	MUKONO ZARDI	-	457,516	3,000,000	2,887,700	569,816
17	RWEBITABA ZARDI	86,086,800	9,425,675	37,457,855	24,398,103	61,690,720
18	NaLIRRI	2,115,215,116	418,633,687	774,053,299	190,666,432	1,002,020,554
GRAND TOTAL		33,247,564,178	10,784,210,937	6,806,609,848	8,438,178,026	9,191,848,053

Internal Audit

Internal Audit Mandate

In line with Section 48 of the Public Finance Management Act (PFM Act) 2015, NARO's Internal Audit function is tasked with appraising the soundness of accounting, functional, and operational controls, evaluating and improving risk management processes, and preparing an annual work plan based on the fiscal risks of the vote.

Risk Management Practice and Internal Control

During FY 2023/2024, NARO maintained a strong system of internal control, designed to ensure compliance with relevant laws, accurate financial reporting, and the detection and correction of any misstatements. The Internal Audit function played a crucial role in assessing these controls and contributing to the enhancement of risk management processes across the organization.

Audit Scope and Achievements

The audit activities for the year were extensive, covering high risk areas such as off-budget projects, information technology, procurement, non-tax

revenue, governance, asset management, and financial compliance. The Internal Audit also followed up on the implementation of recommendations from previous audits, ensuring that management took corrective actions where necessary.

The key audit findings and recommendations from these audits were communicated to management and closely monitored, leading to improved internal controls, better resource management, and strengthened governance structures.

Strengthening Audit Governance

Finalization of key governance documents such as the draft Audit Manual, Audit Charter, and Audit Committee Charter aligned to the 2024 Global Internal Audit Standards marks a significant step in formalizing internal audit functions. These are awaiting review and approval by the Audit and Risk Committee.

Achievements of the Audit Committee and Internal Audit

The Audit Committee, meeting quarterly, provided essential oversight, ensuring that risks were effectively managed and that internal controls remained robust. The proactive efforts of both the Audit Committee and the Internal Audit function contributed significantly to enhancing NARO's governance framework and compliance with statutory requirements.

In conclusion, NARO's internal audit and risk management practices for the FY 2023/2024 were effective in safeguarding NARO's assets, ensuring financial integrity, and maintaining strong governance and risk management practices in alignment with the PFM Act.

Compliance and mitigation of risks

NARO sought to implement a transparent research management system, to strengthen an independent audit system in risk detection and management and compliance to ensure value for money. NARO as an agency of Government of Uganda has instituted an internal audit function, compliant with the standard and necessary practices in fiduciary management and prudent resource management. Internal auditing is an independent, objective assurance and consulting activity designed to add value and improve an organization's operations. Internal Audit assessments were conducted on a number of NARO entities, reports compiled and presented to Management. The entities included: NARO Holdings Limited, assessments regarding emerging issues NaFIRRI Jinja and Kajjansi ARDC, assessments on on-going Civil works conducted at Kigumba, Maruzi and Nakyessasa.

A Special audit of ICT at NARO Secretariat and to some selected institutes (NaRL, NaCRRI, NaLIRRI and MUZARDI) conducted, ICT infrastructure and IFMS assessed for their functionality in supporting agricultural research and data backup facilities.

An assessment was conducted on the status of implementation of key audit issues reported for FY2022/2023 conducted at NaRL, NaCRRI, NaFORRI and then Mbarara, Kachwekano, Rwebitaba, Bulindi, Mukono (Ntawo and Kamenyamiggo), and Ngetta ZARDIs. Implementation status reviewed and corrective actions ascertained. The verified status report was submitted to the Permanent Secretary/ Secretary to Treasury (PSST), Internal Auditor General (IAG), Accountant General and Auditor General. Tracker of management actions for FY2022/2023 were updated. There were other audit assessments which were conducted on Governance, procurement, Non-Tax Revenue management, on environmental and Social Safeguards, on progress of efficacy evaluation for the Anti Tick vaccine clinical trial conducted at Maruzi, Nabuin ZARDI, and Isimba Government prisons. The NARO internal audit was strengthened with the compilation of the final draft Audit Manual, audit charter, and Audit Committee charter produced. Draft awaiting review by the Audit and Risk Committee.

NARO incorporates risk management in the operations of the organization. NARO seeks to analyze, evaluate, and treat loss exposures and monitor risk control and financial resources to mitigate the adverse effects of loss. NARO undertook three risk sensitization management meetings conducted at NaRL, NaCORI, and NaLIRRI staff sensitized on risk management.

A risk management report was compiled and produced showing risk trends in the quarter, as desk review and discussed with Management, Audit and Risk Committee, and NARO Governing Council

4.4 Infrastructure Development

In order to create an enabling environment for conducting cutting edge science and transformative agricultural research, there is need to establish state of the art agricultural research infrastructure. Accordingly, NARO supported twenty two civil works projects during FY2023-2024. Examples of supported research infrastructure include: Aflatoxin mitigation research and production facility (95% completion); Industrial Vaccine Production facility (90% completion: (plate 11); Calf and heifer research platform at Nakyesasa (95% completion) ; Goat research facility at Maruzi (80% completion); Vegetable research and seed production facilities (100% completion); and Biosecurity gate at Nakyesasa (100% completion among others.

Equip agricultural research laboratories

Towards creating enabling environment of agricultural research, to develop requisite research products for food, nutrition and industry, NARO equipped 5 laboratories of strategic importance notably anti-tick vaccine seed laboratory (bio-reactors, centrifuge, steam generator, biosafety cabinets, bottling, filling and capping machines) mycotoxins research laboratory (evidence investigator, biosafety cabinets, freezers, High performance liquid chromatography) at NaLIRRI Nakyesasa (plates 14 and 16) tea research laboratory at Rwebitaba, Biosciences laboratory (anthocyanin extractor) at NaCRRI and fish floating feed faculty with assorted equipment at NaFIRRI-ARDC

New Research Platforms

In the effort to improve agricultural research efficiency in NARO, 5 research platforms of strategic importance were established notably: tea research analytical platform at Rwebitaba, Sequencing platform at NaCRRI, Vegetable research and seed production platform at NaCRRI, Mycotoxin analytical platform at Nakyesasa (Plate 19) and drought screening platform for coffee at NaCORI as indicated.

Drought screening platform for Coffee at NaCORI

During FY2023-2024, NARO established a drought screen platform for coffee to facilitate development of drought resilient coffee varieties in Uganda (Plate 17). The drought screening platform at NaCORI has capacity to accommodate 300 genotypes in two batches per year. The facility is equipped with temperature/humidity data loggers and key equipment for measuring photosynthetic capacity and water potential. Furthermore, the platform is the largest effort globally towards identification of drought tolerant coffee varieties. Ten (10) promising drought tolerant clones have been identified and prepared for on-farm trial.

Accreditation of NARO Laboratories

NARO is in the process of both recognizing and accrediting its national laboratories. A baseline survey has been conducted to assess the laboratory infrastructure across all sixteen institutes, including personnel and equipment. Gap analyses have been completed for eight laboratories: the Food Biosciences and Agribusiness Centre, Biotechnology Laboratory at Kawanda, Bioscience Nutrition Facility at NaCCRI, Biotechnology Facility at NaCRRI, Livestock Nutrition Laboratory at NaLIRRI, Ditra Laboratory at NaLIRRI, Seed Laboratory at NaSARRI, and Seed Laboratory at

Ngetta ZARDI. Facility upgrades, including painting and new fittings, are underway at NaLIRRI and the Food Biosciences Centre. Repairs to key equipment such as fume hoods, generators, refrigerators, and mineral analyzers are also being carried out to meet the minimum requirements for recognition. Additional training is being arranged to ensure the laboratories meet the standards required for accreditation.

Accreditation of Laboratories

NARO has made significant progress in the accreditation of our laboratories. Three laboratories—FBI, Nutrition, and DITRA—were supported towards achieving recognition and enhancing their capacity to conduct high-quality research. Additionally, we played a crucial role in the designation of the molecular lab at NaCRRI as a COMESA reference laboratory. This accreditation underscores our commitment to maintaining high standards in our research facilities and contributing to regional and international scientific collaborations.

4.5 Securing Agricultural Research Land

NARO focused on protection of land through opening boundaries, surveying, development of deed plans, titling, fencing and mutual partnerships that promote secure land use. During the year, 1,442 hectares were surveyed and titled in Nabuin, Nyamigogo (1.7ha), Maziba (1.7ha), Kalengyere, Amuria (12.5ha), Kumi and Pallisa (8.7ha). Land measuring up to 30 hectares was surveyed, titled and fenced in Aduku-kwania (23.49) and Katakwi (4.98). At Serere, 690.2 ha were surveyed, Kaberamaido (18.6ha), and Bukedea (5.3ha) surveyed and titled. Nyabwishenya- Kisoro (157.2ha), and Kibibimbiri-Kisoro (33.8ha) surveyed.





CHAPTER 5

Governance and Management

NARO is governed by a Council while her PARIs are directly guided by Advisory Committees. Regarding management, NARO is managed by Top Policy Management (TPM) comprising mainly the Directors at secretariat and Directors of Research, Programme Learders and other senior staff at the PARI level. Both Council and Management made enormous achivements during the FY 2023/2024.

5.1 Council Achievements

During the first half of FY2023/2024, in execution of its role in providing oversight of implementation of the organizational mandate and strategic plan, the Council registered a number of achievements that include:

i) New members of Top Policy Management were inaugurated and inducted.

ii) Approved NARO plan for strategic interventions to boost food and animal feed security in the country and conducted supervisory monitoring visits to establish progress made in implementing the plan at the various PARIs of this special intervention to respond to the prevailing food and animal feed shortages in the country.

During the FY2023/2024, the NARO Governing Council, in execution of its role in providing oversight of implementation of the organizational mandate and strategic plan, registered the following achievements:

i) Approved the Budget Framework Paper and contribution to the draft Ministerial Policy Statement for FY 2024/25.

ii) Provided strategic guidance on: (a) management and securing agricultural research land (b) management of human resource and filling critical positions in light of establishment of a new structure.

iii) Approved the plan for implementation of the new organisational structure and staff establishment.

iv) Guided recruitment and promotion of qualified and talented staff for critical positions in NARO:

- Appointed program leaders (39) and over 20 new staff including Directors (7), Scientists (7) and support staff (12) to fill vacant positions.
- Promoted over 50 staff to fill vacant positions
- Renewed contracts of Directors (2) and other staff.

v) Reviewed and approved operational framework i.e. the NARO Work Plan & Budget for FY 2024/25) and salary structure for FY 2024/25.

vi) Approved the following guidelines to enhance the dissemination of technologies:

- Strategy for Dissemination of NARO research results
- Knowledge Management Guidelines
- UJAS (Uganda Journal of Agricultural Sciences) Strategic plan 2023-2028

vii) Approved Revised Duty Facilitation rates

viii) Reviewed audit reports and provided advice on internal controls and measures to mitigate identified risks.

ix) Oversight of NAROs research functions: The Audit & Risk Committee of Council conducted

supervisory visit to institutes including Maruzi, NaSARRI, Nabuin ZARDI and NaFIRRI.

x) Identified areas for improvement of research management at PARIs (NaFORRI, NaCRRI and NaFIRRI) and made appropriate recommendations.

Advisory committees Achievements

PARI Advisory Committees are mandated to provide technical guidance in the technology generation and promotion process. They were able to register a number of achievements:

i) Provided independent expert advice to their institutes in identifying and prioritizing research issues and, contributed to the quality of the research process and the research findings, regularly reviewed work plans and progress reports and made recommendations on technologies that would enhance productivity in the zone.

ii) Advised PARIs on emerging research ideas & opportunities and the research implications of a range of strategic research management and policy issues (e.g., collaborations with farmers; creation of synergies with extension; scaling out partnerships with more farmers to produce certified seed and build their capacity through training; strengthen partnerships with NGOs, Universities and other organizations involved in Agriculture.

Management Achievements

In execution of the management role with support of the Council and cooperation/participation of the PARIs, NARO Management achieved the following:

In the FY 2023/2024, Management supported development and implementation of the operational plans to guide the organisation to achieve its objectives. It coordinated and implemented the programs and activities of the organisation. To streamline operations of some Management Committees, the following guidelines were developed and adopted during the year: NARO Institutional Biosafety Committee Standard Operating Procedures. Management also conducted supervisory visits to institutes (Buginyanya ZARDI, NaLIRRI (Maruzi), NARL, NaCORI) to assess progress of implementation of work plans and made recommendations for improved management of research. Furthermore, management negotiated for additional resources for agricultural research through engagement with key stakeholders.

NARO is regularly assessed by Government of Uganda ministries and agencies including the Office of the Prime Minister (OPM), Ministry of Finance Planning and Economic Development (MoFPED), National Planning Authority (NPA), Equal opportunities commission (EOC), Office of the Auditor General and the Ministry of Agriculture, Animal Industry and Fisheries (MAAIF). Below is the rating for NARO by each of these supervisory bodies.

Office of the Prime Minister (OPM) Assessment

In FY 2022-2023, OPM undertook the Annual Performance Assessment on the Performance of Government MDAs. The GAPR was published in 2024. NARO was rated to have achieved 75%, on programme output performance score-card. NARO under the agro-Industrialisation programme was assessed to have achieved the second highest score by MDAs under the AGI programme after the MbaZARDIFY 2023/2024, not yet.

Budget Monitoring and Accountability Unit (BMAU) of MoFPED

NARO contributes to the sub-programme of Agricultural production and productivity. In FY 2023/2024, Budget Monitoring and Accountability Unit (BMAU) rated NAROs contribution as an entity at 73%, while in FY 2024/25, NARO was rated at 100%. The best in the country. The

Budget Monitoring and Accountability Unit was established in July 2008 to enhance monitoring efforts geared towards effective implementation of government programs and projects. Starting FY 2021/22, the Budget Monitoring and Accountability Unit commenced Programme-Based Monitoring to assess performance against targets and outcomes in the Programme Implementation Action Plans (PIAPs) and Ministerial Policy Statements (MPSs)

National Planning Authority (NPA)

NPA issues a Certificate of Compliance (CoC) each FY to ensure that the National Budget comprising the programme, MDA and Local Government (LG) budgets focus on implementation of the National Development Plans (NDPs) that are aimed at achieving Vision 2040 and the programme/MDA specific interventions are aligned with the NDP targets and results. NPA rated NARO's alignment with the National Development Agenda at 70% (moderately satisfactory complaint) for the strategic plan and 74.1% for annual workplan and budget which were well above the compliance thresholds.

Assessment based on PIAPs and MPS

NARO contributes to this sub-programme. Under an intervention of Research and administrative infrastructure constructed, rehabilitated and maintained, NARO attained a good performance (73.57%). This was realized in the construction, rehabilitation and equipping of infrastructure for agricultural research mostly works were implemented at the National Livestock Resources Research Institute (NaLIRRI) stations at Nakyesesa and Maruzi

Public Procurement & Disposal of Public Assets Authority (PPDA)

PPDA in its procurement audit of Government Ministries and Agencies, gave NARO a satisfactory risk rate score of 11.3 (0-30 is satisfactory). NARO exhibits a high level of professionalism, a requirement in the management of public Procurement and disposal of assets.

Assessment based on the Budget Framework Paper

NARO annually contributes to the National Budget Framework Paper. The National Budget Framework Paper is the Government's overall strategy document for the budget, and provides the link between the Government's overall policies (identified in the National Development Plan) and the annual budget. It is presented to the Parliament by the 31st of March each year, prior to the finalisation of the Annual Budget. In FY 2023-2024, NARO was rated at 73%.

Equal Opportunities Commission

The Equal Opportunities Commission is a statutory body established by an Act of Parliament to effectuate Article 32(3) and Article 32 (4) of the Constitution of Uganda (a constitutional mandate). The EOC is mandated to eliminate discrimination and inequalities against any individual or group of persons on the ground of sex, age, race, colour, ethnic origin, tribe, birth, creed or religion, health status, social or economic standing, political opinion or disability, and take affirmative action in favor of groups marginalised on the basis of gender, age, disability or any other reason created by history, tradition or custom for the purpose of redressing imbalances which exist against them, and to provide for other related matters.

EOC undertakes compliance checks on MDAs Ministerial Policy Statements on compliance with gender and equity compliance. EOC recommends (MDAs which are deemed compliant above 40% mark) for issuance of a certificate of compliance (a budgetary requirement under the Public Finance and Management Act (PFMA) 2015). Past and present rating are as follows: FY 2022-2023 was at 76%, while FY 2023/2024 was at 73%. In FY 2024/25, NARO was at 75%, (24th out of 162 MDAs)


华大BGI
GREETINGS
FROM UGANDA
Liu Huan
Dr Yona Baguma

CHAPTER 6

Profiles of Selected Projects

6.1 NARO Performance Under the Regional Development Programme for FY 2023/2024

The Regional Development Programme (RDP) aims to accelerate equitable regional economic growth and development. The programme has been designed to take into account the International commitments by the government such as the Sustainable Development Goals (SDGs), which strive to end poverty and hunger by 2030. The programme is also in line with Uganda Vision 2040, which emphasises balanced development and inclusiveness of all regions of the country. NARO contributes to the growth potential of the Busoga, Bugisu, Sebei, and Bukedi sub-regions through area-based agribusiness local economic development initiatives.

Intervention areas supported have been delivered through a couple of activities including;

i) **Production of quality seed;** A total of 2.4 tonnes of maize (Longe 5D) and 1 tonne of beans (500 kg of NAROBean 1 and 500 kg of NABE 15) were successfully produced as early-generation seed. This high-quality seed was distributed to local seed businesses across the districts of Budaka, Bugiri, Bugweri, Iganga, Kaliro, Kamuli, Kibuku, Namutumba, Mayuge, Sironko, Kween, Kapchorwa, and Bulambuli. This extensive distribution not only strengthens the local agricultural landscape but also supports farmers in these communities in achieving greater productivity and sustainability.

ii) **Training of maize local seed businesses (LSBs**); Quality seed is a key determinant to increased yields and incomes to the farmers, as such, capacity of LSBs to produce seed has been enhanced thus increasing farmers access to quality seed. Seven farmers representing nine LSBs from nine districts of Budaka, Bugiri, Bugweri, Iganga, Kaliro, Kamuli, Kibuku, Mayuge, and Namutumba and District Agricultural Officers were trained on Good Agricultural Practices (GAPs) of maize seed production with major focus on Open-pollinated varieties (OPVs). crop management including pest and disease management.

iii) **Establish and maintain on-station demonstration plots;** Two maize demonstration sites were established at Bulegeni and Ikulwe Satellite stations covering a total of 6 and 15 acres, respectively to showcase improved crops. The demos further provide farmers with reliable and timely information to accelerate technology diffusion and adoption.

iv) **Agricultural research facilities rehabilitated;** To enhance the production of quality Arabica coffee seedlings, a coffee nursery shade with a capacity to handle 50,000 seedlings was rehabilitated at Buginyanya ZARDI. As a result, 34,108 coffee seedlings SL 14 (17,059), KP 162 (12,614), KP423 (2,223), SL 28 (2,212) have been produced.

In addition, a total of 10,014 clonal KR varieties (KR1 - 649, KR3 1,903, KR4 - 1,915, KR52 - 43, KR6-2,902, and KR7- 602 clones) have been successful propagated at Ikulwe Satellite station.

Table 6: Summary of achievements under the Regional Development Progarmme for the FY 2023/2024

Output	Achievements
Quality seed produced and extended to farmers for improved productivity	• 63 local seed business groups identified in Busoga and Bugisu sub-regions (Budaka, Bugiri, Bugweri, Iganga, Kaliro, Kamuli, Kibuku, Namutumba and Mayuge) and supported with 2.2 tonnes of maize Longe 5D • 18 local business identified in Bugisu sub-region (Bulambuli, Kapchorwa, • Sironko, and Kween)
	• 2.4 tonnes of maize Longe 5D, 500kgs of NARO bean 1, and 500kg of NABE 15 were produced • 34,108 Arabica coffee seedlings produced • 10,014 cloned coffee seedlings (KR varieties) produced
	• A total of 500kgs of NARO bean 1, and 500kg of NABE 15 distributed to 18 Local Seed Businesses from Sironko, Kween, Kapchorwa, and Bulambuli districts
Demonstration centers established for maize and beans enterprises to facilitate technology uptake and utilization in the zone	• Two maize demonstrations both at established at Bulegeni (6 acres) and Ikulwe (15 acres) Satellite stations • Three acres of bean demonstration established at Bulegeni Satellite station
Agricultural research facilities rehabilitated	• A coffee nursery shade based at Buginyanya ZARDI with a capacity to handle 50,000 seedlings was rehabilitated
Farmers and value chain actors equipped with knowledge, information, technologies and skills to enhance productivity in maize production	• 63 LSBs from nine districts (Budaka, Bugiri, Bugweri, Iganga, Kaliro, Kamuli, Kibuku, Mayuge, and Namutumba) and District Agricultural Officers of respective districts were trained on Good Agricultural Practices (GAPs) and requirements for maize seed production.
Information materials to facilitate adoption and utilization of improved technologies developed and disseminated	• 2000 information materials developed and disseminated to uptake pathways

6.2 NARO-CABI collaboration

PlantwisePlus program

The ambition of the CABI-led PlantwisePlus program is to reach 75 million smallholder farmers in low and lower-middle income countries, providing them with access to the knowledge and skills they need to improve their production practices during the scale out phase from 2024 to 2030. The program continues to support countries to predict, prevent and prepare themselves for plant health threats in the face of a changing climate to achieve its goal. This will ensure that farmers reduce their crop losses and produce more and safer food using practices that safeguard human health and the environment. In doing so, the programme contributes to local, national and regional efforts to build climate-resilient food systems.

The programme contributes to the 2030 Agenda for Sustainable Development as it builds on a whole-system approach to the agricultural sector and interventions address multiple Sustainable Development Goals (SDGs). The programme is being implemented through three impact pathways and the following activities have been carried out in Uganda in collaboration with NARO, MAAIF and private sector actors.

i. Pest preparedness: to coordinate and strengthen systems for detection and response to pest outbreaks

This pathway will:

- Support the development and enhancement of processes that enable countries and regional organisations to quickly and effectively identify, prioritise and respond to pest threats, integrating the latest information on pest distribution and climate-change models.
- Support countries to develop and implement coordinated plans for responding to priority crop health threats before they arrive and to share timely and accurate advice with smallholder farmers through tailored pest risk alerting systems.

Activities included:

Horizon scanning

PlantwisePlus trained 5 NARO scientists among other participants from MAAIF, Makerere, Kyambogo and Mountains of the Moon Universities on how to use the horizon scanning tool and the CABI Crop Protection Compendium, to identify priority pests for regulation. The tools compose of a data driven system with country specific information for decision making. The participants included entomologists, plant pathologists, mycologists and nematologists.

The training imparted skills to establish an early warning system at regional level so that the pest risks are identified, prioritised and response systems developed. As a result, a pest risk register of over 500 pests and response mechanism was developed.

ii. Pesticide risk reduction pathway: to increase awareness, access and use of affordable integrated pest management solutions

This pathway aims to;

- Identify opportunities for pesticide risk reduction and implement solutions with national and local government bodies, commercial companies and farmers.
- identify and implement classical biocontrol solutions to reduce the impact of priority pests.
- Develop and adapt augmentative biocontrol and biopesticide solutions for use against priority pests.

Activities included:

Biological control of Papaya mealybug



A farmer scouting for papaya mealybugs after release of A.papaye on his field.

Field assessments undertaken by CABI in 2022 in central, eastern and northern Uganda confirmed that several crops were affected by papaya mealybug causing 70-100% crop losses. The study also revealed that farmers were losing up to Ugx 5million ($1350) per acre per season after invasion by the pest. The most prevalent control method was pesticide sprays though farmers reported that they were ineffective, an issue which is in part due to the mealybug's waxy covering.

These findings informed government's decision to collaborate with CABI in dissemination of biological control methods including using parasitoids and sanitation practices. The decision was also supported by the positive results obtained in the classical biological control of the papaya mealybug in Kenya. The results indicated a significant decline in mealybug populations and damage with parasitism rates of up to 73% that was observed in less than 2 years after the first releases and 78% of farmers reducing the use of their chemical pesticides on papaya as a result.

With this backdrop, CABI and NARO team drafted a dossier for importation of parasitoids (*Acerophagus papaya*) for biological control of the Papaya mealybug. The dossier was reviewed by 12 NARO scientists among other stakeholders and importation permits later granted. The parasitods were imported from Kenya, CABI parasitoid rearing facility in Muguga. CABI supported the refurbishment of a rearing facility at the National Agricultural Research Laboratories (NARL), Kawanda.

NARO scientists have so far released the parasitoids at nine sites in Kayunga, Mukono, Luwero and Wakiso districts as pilot districts in November 2023. A post release survey was later conducted to evaluate establishment and spread of the parasitoid across the sites. Sixty non-release sites were surveyed for the presence of *A. papaya*, alive *A.papayae* were observed in 53.3% while parasitoid mummies were observed on 83.3% of all the non-release sites in all the surveyed sites. The results indicated successful establishment and the fast spread of the *A.papaye* among the papaya farms. NARO has also trained 30 extension staff and community-based facilitators from Luwero, Wakiso, Kayunga and Mukono as trainers on Classical Biological Control of the Papaya Mealybug (PMB) to support farmer training.

Opportunities for pesticide risk reduction: PlantwisePlus also engaged stakeholders from NARO and other institutions in consultative meeting to discuss the different avenues for pesticide risk reduction in Uganda with the aim of identifying risks and opportunities for pesticide risk reduction through Hazard Analysis Critical Control Points (HACCP) assessment, using a 'One Health lens' to understand stakeholder perceptions and actions on pesticide risks and risk reduction in Uganda and a planned gender study on access and use of lower risk plant protection products with a focus on tomato planned for end of 2024. These assessments shall inform the design of the program to address key challenges.

iii. Farmer advisory: to enhance knowledge and uptake of integrated pest management practices through responsive digital and non-digital approaches

This pathway will:

- Equip agricultural service providers with gender equitable information and decision-support tools so they can share integrated pest management (IPM) knowledge with farmers.
- Enhance the suite of digital tools so that the information and learning agricultural service providers need is easily accessible for use in plant health monitoring and management.
- Support PlantwisePlus countries to maintain the functioning of plant health systems.
- Work with mandatory government licensing schemes for agro-input dealers to identify gaps in agro-input dealer knowledge on plant health and IPM practices and adapt training materials accordingly.
- Support rural youth, women and men in developing and pursuing new income generating opportunities in agricultural service provision

iv. Training of agro-input dealers and extension workers on lower risk plant protection products (LRPPP)

In Uganda, agro-dealers are often the go-to source of knowledge for farmers seeking pest management advice. However, even those who are certified can face challenges in providing accurate information. This can be due to limited training and technical knowledge. PlantwisePlus is working to change this, supporting the MAAIF Inspectors who train agro-input dealers to upskill and learn more about non-chemical pest control.

Using the updated manual developed by partners including MAAIF, Makerere University (certification body), and NARO, PlantwisePlus facilitated trainings of 31 trainers (9 female and 22 male) from MAAIF's departments of Crop Inspection and Certification and Crop protection and Makerere University staff to support in delivering these modules to extension workers and agro-input dealers. A total of 28 agroinput dealers (15 female and 13 males) underwent pilot training using the manual and the feedback used to improve it further.



One of the trainees of LRPPP who now produces bio-pesticides.

These trainings are aimed at building a pool of agro-input dealers who can stock lower risk products such biopesticides as well as promoting the opportunities for recommending these products by the extension workers. This will promote availability and uptake of the lower risk plant protection products as well as provide alternatives to highly hazardous pesticides. The trainees were also trained on how to navigate the CABI bioprotection portal which is a platform where one can find registered bioproducts in the country and their suppliers or manufactures. This platform promotes availability and accessibility of the LRPPPS.

v. Promoting Local Seed businesses among youth groups

In 2023, Plantwise Plus facilitated the assessment of feasibility of local seed businesses through engagement with seed companies, NARO, MAAIF and Universities. The participants identified gaps such as weak regulations, monitoring and opportunities such as available market and high profitability in the sector. The program has since embarked on engaging youth in the Local seed businesses. Two NARO staff from NACCRI and MuZARDI and one MAAIF staff from department of crop inspection and certification trained 30 youths in local seed businesses in partnership with Integrated Seed and Sector Development Uganda (ISSD Uganda). These youths were a part of 10 existing farmer groups in the districts of Luwero, Kayunga, Nakaseke and Nakasangola. The team assessed the youth groups for readiness to engage in the seed business and trained to produce quality declared seed that is fit for the market. The youths plan to produce seed of *nakati*, red amaranthus *(bugga),* beans and pasture seed. NARO is fundamental in the success of these businesses since it plays a major role in technical backstopping and supply of foundation seed.

vi. Training of plant doctors on CABI digital tools

CABI introduced 25 plant doctors including NARO scientists, University lecturers and MAAIF staff to the PlantwisePlus toolkit which comprises the CABI bioprotection portal, Fact sheet library, Knowledge bank, Crop sprayer App and The CABI academy. These digital resources, that are now incorporated into the existing plant doctor modules, are aimed at supporting scientists in training extension and farmers in proper pest management practices and as well as enhancing their knowledge in crop production and pest diagnosis.

vii. Improved market access for papaya, mango, avocado, and citrus by managing invasive scale insect pests in Eastern Africa

Uganda's export market is hampered by high pest incidence and prevalence such as scale insects. To maintain and increase market access for these four important commodities, it is important that scale insects are managed along their value chain using recommended phytosanitary measures. The National Plant Protection Organisation (NPPO) of Uganda, working with the various export product value chain actors from both public and private sector, need to be able to assess the risk posed by scale insects that affect production and productivity of the four commodities: papaya, mango, avocado and pineapple for effective management. CABI in collaboration with NARO and MAAIF partnered to undertake a baseline survey Uganda, of the management practices, incidence and prevalence of scale insects along their production value chain to be able to carry out monitoring and evaluation of the project implementation and effectively assess its impact. The project intends to improve management and surveillance of scale insect pests to facilitate SPS compliance for traded mangoes, pineapples, avocado and papaya from Uganda.

The NPPO and NARO led on the undertaking of a baseline survey for scale insects in the export production value chain for specifically, avocado, mango, papaya and pineapples. The purpose of the baseline specific survey was to obtain information on incidence, prevalence and management practices for scale insects of phytosanitary concern in the production areas, at storage and packing facilities as well as at border points. The survey was conducted in selected districts with the highest export volumes such as Luwero, Nakaseke, Nakasongola, Mukono, Kayunga, Iganga, Kamuli, Ntungamo, Masaka,

Mayuge, Mpigi and Fortportal, established using the NPPO export farmer data base, CABI Darwin Initiative and Plantwise Plus program. The baseline survey findings will also help to provide useful information for pest lists of commodities produced under specific practices, economic impact and in the preparation of host pest lists where data from general surveillance is lacking and determine the stakeholder perceptions on the scale insect problem and environmental concerns.

viii. Feed the Future Agriculture Research Activity

Feed the Future (FtF) Uganda Agriculture Research Activity is both a Research and Development initiative that aims to promote use and commercialization of improved crop and livestock technologies with yield and nutrition enhancing characteristics.

To achieve this objective, the Activity focuses on continued improvement of crop genetics, bio-fortification, integrated pest and disease management for both crops and livestock in response to market-demand. The acticity directly contributes to the second Development Objective DO2 in USAID/Uganda's Country Development Cooperation Strategy (CDCS) 2022-2027: "Resilience Growth Enhanced" Jointly with Ugandans facilitate Agriculture, climate and conflict sensitive, private sector-led growth and human capital that lifts the most vulnerable in target regions out of extreme poverty. Further, the Activity partly contributes to DO3 "Accountability Strengthened", particularly to Intermediate Result 3.3 Domestic resource mobilization improved.

a) Participant Engagement

9,286 (4728M, 3539F and 329FY, 690MY) belonging to different farmer groups engaged in production across targeted value chains, hosted demonstration fields & trials, trained on improved technologies (GAP and PHH), multiplication of several planting materials and private sector actors.

b) Research and Development

The Activity continued tracking new or improved technologies, practices, and approaches in 3 categories - Plant Improvement Research, Production Systems Research, and Social Science Research. These are at different levels of development.

c) Private partner engagements

For the period under review, 5 private sector partners (Movit Products Ltd, Doctor's choice, Technology for tomorrow, Nature Fusions limited and SOSPPA) were engaged to jointly develop, refine and market test the value-added products in preparation for scale-out.

d) Commercialization of NARO's technologies

Six seed companies have so far expressed interest in multiplying and commercializing NAROs Improved crop technologies.

e) Capacity Building

The Activity has continued to support 21 students (15MScs and 6 PhDs), 2 master's students are earmarked to graduate in January 2024.

f) Infrastructural development

The Activity finalized installation of an advanced anthocyanin ultrasonic extractor equipment to generate sufficient quantities of colorants for market testing. Also, ARA commenced the construction of a screen house in Abim District to facilitate multiplication of clonal CWD-r coffee seedlings

g) Systems strengthening

Supported six (6) seed companies on license application processes, seed planning and breeder seed acquisition. Similarly, the different product development teams have also been supported in developing trademarks and file patent applications.

6.3 NARO - Kopia collaboration

Citrus Production in Uganda

Citrus, is mostly grown in Eastern Uganda and it is a rich source of Vitamin C. The crop also acts a source of food, income, employment, and environmental conservation (MAAIF, 2001; UIA, 2009, 2016, Yusuf 2013)

Upto 12,000 farmers are involved in citrus production under a total area of 27,000 hactares. As a result, 800,000 tons are produced translating into 32 million USD annually. Citrus farmers experience challenges including pests and diseases, low fruit quality and post-harvest losses, water stress, nutrient deficiency, and marketing challenges.

Project Title: Establishment of Citrus Management Technology Demonstration Sites, Market Development, and Model Village Delivery Pathway in Teso, Uganda

Project Objectives:

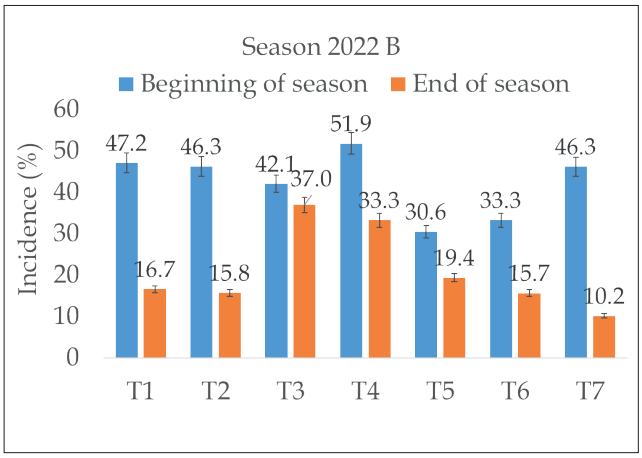
- To increase the adoption of citrus pest and disease management practices and techniques by 160 citrus farmers,
- To increase the adoption of integrated soil fertility and water management practices by 300 citrus farmers.
- To increase marketing volumes of citrus fruits as a result of improved citrus production, post-harvest management, and value chain development

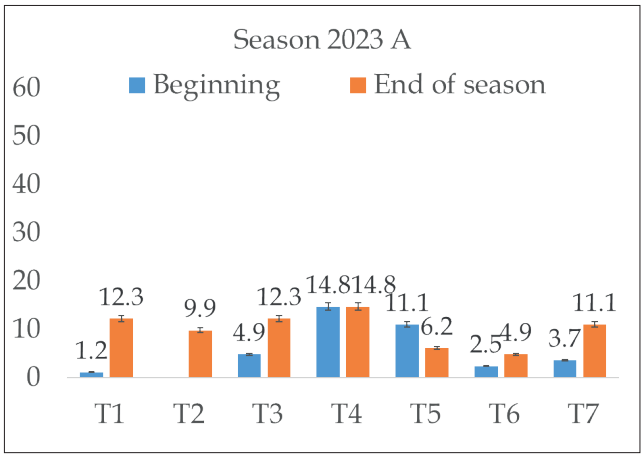
Achievements

a) **Dissemination of Safe Chemical in the Management of Pseudocercospora Spot Disease**. The disease is caused by Pseudocercospora angolensis with 50 – 100 % yield loss. In addition, it causes decline in fruit quality and significant reduction in the juice content. Carbendazim-based management was deployed and it has proven the most effective disease control option.

As a result of the intervention, 203 farmers acquired skills in pest and disease management and 253 non-project farmers reached, Over 97% adoption of disease management practices by project farmers and 70% by secondary beneficiaries, and 40% decrease in pseudocercospora prevalence over two seasons.

Steady decline in disease pressure with the dissemination of disease management





b) Development of fertilizer recommendations for Citrus

- For citrus trees of both 4-7 – year and 8- and above year-old trees, the economically optimum NPK recommendation for citrus was determined as 556 kg NPK (17:17:17)/ha/yr equivalent to 2 kg/tree/yr. This should be applied in 3 splits of 800g, 600g & 600 within a circular ring in 5-cm deep furrow around each tree during April, June & August and covered with soil.
- 350 farmers trained in low-cost soil water and fertility management for citrus
- 150 demos maintained (40 in Ngora, 40 in Kumi, 40 in Soroti and 30 in Kalaki) for primary project beneficiaries

c) Fruit Quality Management and Value Addition

- A training manual for both farmers and extension workers on citrus post-harvest handling was developed and published.
- Chitosan coating application for improved fruit quality was validated among model village farmers in Arapai, Atutur, and Ngora, and optimum harvest maturity for April – June season determined as recommended management practices for improved fruit quality, post-harvest and safe handling.
- Four citrus value-added products developed; Ready to drink pasteurised juice, Concentrate, Jam and Marmalade.
- 117 farmers in Arapai (Kalaki and Soroti), Atutur (Kumi) and Ngora model village were trained in citrus product development, quality assurance and safety

Table 7: Market Support - Sales Volumes

Model Village	Quantity sold this season	Sales Avenue
Arapai	• 220 tons (3 tons for each 50 farmers and 10 tons for 10 farmers)	• Sales lead • Middle men
Atutur	• 80 tons sold	• Fruit factory (30 tons) • 30 tons sold to Kenyans and Rwandans • 20 tons given to sales lead
Ngora	• 35 tons	• Rwandans and Kenyans • 5 tons sold to Kampala consumers

d) Upscaling – Farmer-to-Farmer Training

- Seventy-two project and non-project farmers were trained in Soil fertility and water management, disease management and tree control using nylon strings in all model villages.
- Yield increment of 220% and an improvement in incomes of 268% within one of two harvest seasons.

6.3 NARO - USAID collaboration

Feed the Future agricultural research activity

Feed the Future (FtF) Uganda Agriculture Research Activity is both a research and development initiative that aims to promote use and commercialization of improved crop and livestock technologies with yield and nutrition enhancing characteristics.

To achieve this objective, the Activity focuses on the continued improvement of crop genetics, bio-fortification, integrated pest and disease management for both crops and livestock in response to market-demand. The ARA directly contributes to the second development objective DO2 in USAID/Uganda's Country Development Cooperation Strategy (CDCS) 2022-2027: "Resilience Growth Enhanced" Jointly with Ugandans facilitate Agriculture, climate and conflict sensitive, private sector-led growth and human capital that lifts the most vulnerable in target regions out of extreme poverty. Further, the Activity partly contributes to DO3 "Accountability Strengthened", particularly to IR3.3 Domestic resource mobilization improved.

Research and Development: The Activity continued tracking the development of new and/or improved technologies, practices and approaches in three categories - Plant Improvement Research, Production Systems Research and Social Science Research.

As such, it facilitated release of 7 candidate crop varieties as NABE12 CR & NABE 14R beans and NARONUT 3R, 4R & 5R groundnuts varieties. Additionally, 2 specialty forage varieties for sorghum and pearl millet, developed under the COMESA arrangement were released as SUGARGRAZE forage sweet sorghum hybrid and NUTRIFEED a forage pearl millet hybrid. **Private Partner Engagements:** 12 private sector partners (Digimark Comms, Doctor's Choice, Technology for Tomorrow, TEXFAD, Nature Fusions (Afros&Mo), Hot Loaf Bakery, Psalms Foods, Divine Organics, JP Investments, Cake Signatures, Omukazi W'omutima and Movit Products Limited) were engaged to jointly develop, refine and market test the value-added products in preparation for commercialization.

Commercialization of NARO's Technologies: Continued to enforce compliance among the licensed seed companies and interest new seed companies to apply and obtain licenses for utilization of NARO plant varieties.

In addition, 10 new seed companies (Brac Seeds, Century Seeds, Premier Seeds, Green Firm Africa, Golden Bull Africa, Rhino Seeds, Savana Seeds, Masindi Seeds, Okeba Seeds and SUPA seeds) were licensed to legally multiply and commercialize NARO's Improved crop technologies of their interest.

Capacity Building: To build the capacity of NARO to commercialize her research outputs, ARA has continued to support 21 students (15 MScs and 6 PhDs) to complete their courses. 2 Masters students (1M; 1F) graduated from Makerere University with Master of Arts in Gender Studies and Master of Science in Botany respectively, bringing the total number of graduated students to 3, representing (14.3%).

Additionally, 306 (114F, 192M) NARO scientists across the ten institutes were equipped with skills in gender mainstreaming in agricultural research to aid development of gender-responsive technologies.

Infrastructural Development: Construction of a screen house in Abim District to facilitate multiplication of clonal CWD-r coffee seedlings for access by farmers in the Karamoja region was completed, finalized installation of an advanced anthocyanin ultrasonic extractor equipment to generate sufficient quantities of colorants for market testing and continued to maintain and orient staff on operation of the installed incubation equipment

Systems Strengthening: To streamline systems in NARO to foster commercialization of her technologies, the Activity supported; development of the anti-tick vaccine commercialization strategy, reviewed the partnership information system and the draft research data guidelines to operationalize the NARO research data management policy 2021.

In an effort to enforce compliance among seed companies, IP enforcement visits were conducted to address infringement on NARO's improved crop varieties by unlicensed seed companies, requiring them to apply for and obtain licenses. This initiative also sought to boost compliance among licensed companies.

The activity further facilitated the 45th NVRC meeting that was convened to review and maintain the National Variety list and approve new varieties for release.

6 seed companies were also supported on license application processes, seed planning and breeder seed acquisition. Similarly, the different product development teams were supported in developing trademarks and file patent applications.

Participant Engagement: For the period under review, 13,530 (4,361Female-Adults, 5,594Male Adults and 1,236 Female-Youth, 2,339Male-Youth) individuals belonging to different farmer groups and categories were engaged in; production of targeted commodities, hosted demonstration fields & trials, trained on improved technologies (GAP and PHH), multiplication of several planting materials, market testing, and commercialization of technologies. In addition, schools also participated in enhancing the school feeding program in Karamoja Sub-region.

On the other hand, private sector actors were involved in joint product development, market testing, refining and commercialization.

PICTORIAL: EVENTS



International labour day celebrations



NARO and Busoga kingdom join hands to bring cutting edge agriculture technologies t the Busoga region.



"Connecting innovation with culture" NARO commits to work with Rwenzururu kingdom for economic transformation



NARO leading innovative scientific strategies to tackle invasive water weeds for environmental conservation



Agriculture committee of the 11th parliament paid courtesy visit to NARO. (Hon. Okori-Moe janet – chairperson of the agric commiitee)



Harvest money Expo



NMG- strengthening farm clinics



Charles Peter Mayiga visit to NARO



Prime minister hand over mgt of Entebbe botanical gardens from NARO to UWEC to boos t tourism



Farmer field day promoting orange fleshed sweet potato production and value addition at Nakapiripirit district and Namalu mixed primary school October 2023



Seeds of gold Farm clinic Nassari



Kisoboka zukuka farmer mobilization campaign in greater Masaka region



Breeding teams of newly released varieties recognized for their commitment and dedication to agriculture research



Strategic partnership between NARO and Buganda Kingdom



Signing 5 year MoU between NARO and Movit Products Limited towards scaling out NARO prototypes suited for the cosmetic industry



WFD "Water is life"



Commissioning of Ngetta ZARDI hatchery and seed testing lab by Hon. Fredrick Bwino Kyakulaga



Handing over two community agro-market hubs to farmer cooperatives in Nwoya and Pader districts for technology demonstration, training, bulking and access to input and output business for farmers in the area



Handover of multi purpose laboratory complex



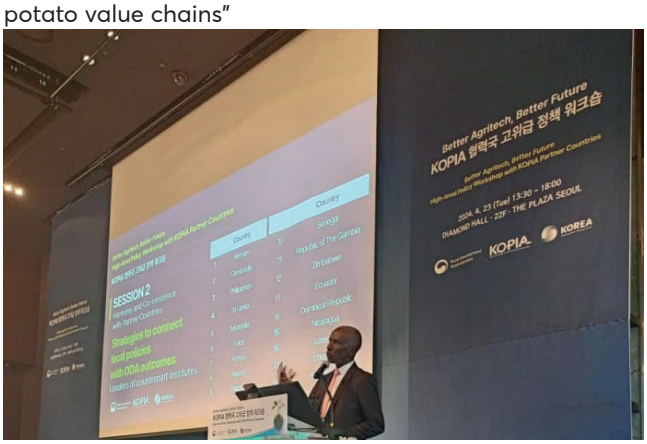
Equal Opportunities commission visit NARO to understand how gender and equity is being integrated into the agriculture research and development agenda of Uganda.



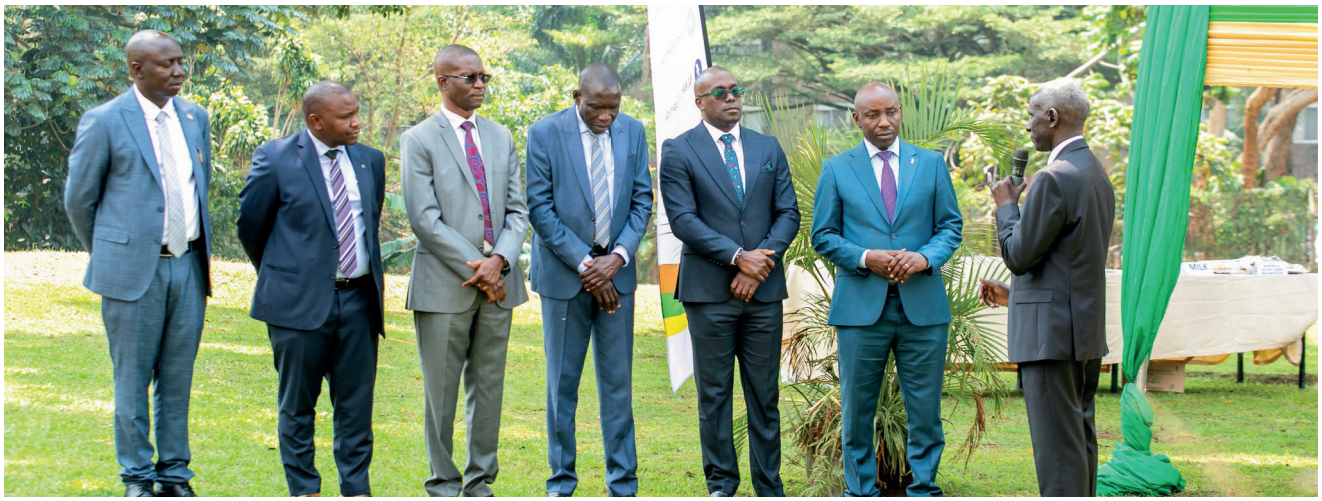
Press conference of the 13th tri-annual African Potato Association conference. Theme " Fostering climate-smart cropping systems for sustainable potato and sweet potato value chains"



Egyptian delegation concretise arrangements for joint production of vaccines for foot and mouth diseases



Dr. Yona Baguma addressing high-level policy workshop in Seoul, south Korea during celebration of 15-year anniversary of Korea partnership for innovation of agriculture (KOPIA).



Members of the NARO Top Policy Management



MoU signing between NARO and MeFarms to boost goat farming in Uganda.



NARO partners with VETAL Animal Health Products Inc. from Turkey to establish a center of excellence for FMD vaccine production facility and building capacity of researchers in the region.



Commissioning a local chicken breeding unit at Mukono Zardi.



NARO_DG hosting the Country Director of @ KopiaUganda (Dr. Park Teason in Entebbe. They discussed how best to ensure the successful implementation and sustainability of rice initiatives



Lead breeders presenting during the 44th sitting of the National Variety Release committee. L-R: Dr Bernard Yada (Sweet Potato), Dr. Jimmy Lamwo (Rice), Dr. Charles Lwanga Kasozi (Maize), and Dr. Julius Sserumaga (Lab lab)



A state-of-the-art research vessel, enhancing our capabilities and commitment to sustainable practices



Celebrations to mark the international year of millets in Uganda. # Rich in heritage, rich in potential.



District councillors from Tororo visit NARO – Ntawo to learn about NARO research technologies for improved livelihoods.



NARO hosting His Excellency Luosang Jiangcun, the Deputy-Chairman of the Standing Committee of the National People's Congress, and the esteemed delegation from China at ARDC Kajjansi

NARO

The National Agricultural Research Organisation (NARO) informs the general public especially the agro-input dealers, seed buyers and farmers that in a bid to ensure quality assurance and stewardship of seed to the end-users, seed companies that fulfilled requirements signed license agreements. The public is hereby informed that the following seed companies are the only ones currently authorized to produce certified seed from NARO plant varieties as of 30th August, 2023. Any procurement/ purchase of seed from unlicensed seed companies is at own risk and peril as NARO shall not guarantee quality and authenticity. Certified seed from these licensed seed companies shall have packaging consisting of a NARO Varietal Identification Number (NVIN) as indicated in the table.

Details of allocated plant varieties by respective licensed seed companies is available on the NARO website *www.naro.go.ug*. Any additional licensees will be published in same way.

VARIETY NAME	NVIN	COMPANY ALLOCATED	TYPE OF LICENSE
CROP: MAIZE			
Longe 6H	NARO/2002/MAZ/009	Farm Input Care Centre (FICA)	Exclusive
Longe 8H	NARO/2002/MAZ/011	Syova seeds	Exclusive
Longe 9H	NARO/2009/MAZ/012	FICA	Exclusive
Longe 10H	NARO/2009/MAZ/013	Nalweyo Seed Company (NASECO)	Exclusive
UH 5354	NARO/2013/MAZ/022	NASECO	Exclusive
NAROMAIZE 61 (UH5961)	NARO/2019/MAZ/041	Advanta Seed International	Exclusive
UH 5053	NARO/2012/MAZ/019	Okeba seeds	Exclusive
UH5401	NARO/2013/MAZ/023	Green Firm Africa	Exclusive
Longe 11H	NARO/2009/MAZ/014	Pearl Seeds	Semi-exclusive
Longe 7H	NARO/2002/MAZ/010	Ayellape Agro, Daylight Agro, Equator Seeds and Grow More Seeds	Semi-exclusive
UH 5355	NARO/2013/MAZ/023	Miika Albertine, Gacvic Industries, Pearl Seeds	Semi-exclusive
UH5403	NARO/2015/MAZ/031	Syova seeds	Semi-exclusive
UH 5051	NARO/2012/MAZ/017	Gavic Industries, Equator Seeds, Century seeds, Savana Seeds	Semi-exclusive
UH 5052	NARO/2012/MAZ/018	BAK Holdings, Pearl Seeds	Semi-exclusive
UH 5556	NARO/2015/MAZ/029	Savana Seeds	Semi-exclusive
NARO MAIZE 62	NARO/2019/MAZ/042	FICA, Equator Seeds, Pearl Seeds	Semi-exclusive
NAROMAIZE 731	NARO/2017/MAZ/036	FICA, Equator Seeds, Daylight Agro, Grow More Seeds	Semi-exclusive
NAROMAIZE 60IR	NARO/2017/MAZ/040	Ayellape Agro, FICA	Semi-exclusive
LONGE 5	NARO/2000/MAZ/040	FICA, Syova seeds, BAK Holdings, Equator seeds, Ayellape Agro, Daylight Agro, Miika Albertine, NASECO, Rhino Seeds Africa, BRAC Social Business Entreprise Ug Ltd, Golden Bull (U) Limited, Green Firm Africa, Century Seeds, Savana Seeds, Grow More Seeds	Non-exclusive
Myezi Mitatu	NARO/2010/MAZ/015	FICA, Equator seed, Daylight Agro, Miika Albertine, Syova seeds, Century Seeds, Grow More Seeds	Non-exclusive
Longe 5D	NARO/2012/MAZ/015	FICA, Syova seeds, Pearl seeds, Gavic industries, Equator seeds, NASECO, Okeba Seeds, Supa Seeds Africa, Century Seeds, Savana Seeds	Non-exclusive
CROP: BEANS			
NABE 4	NARO/1999/BEN/008	FICA, NASECO, Syova, Equator, Ayellape, Pearl	Non-exclusive
NABE 5	NARO/1999/BEN/009	Daylight Agro, Pearl Seeds, Grow More Seeds	Non-exclusive
NABE 12C	NARO/2005/BEN/016	Pearl Seeds, Okeba seeds, Green Firm Africa, Grow More Seeds	Non-exclusive
NABE 14	NARO/2006/BEN/018	FICA, NASECO, Pearl Seeds, Okeba seeds, Grow More Seeds	Non-exclusive
NABE 15	NARO/2010/BEN/019	FICA, Pearl, Syova, Equator, Ayellape, Daylight, NASECO, Rhino Seeds Africa, BRAC Social Business Entreprise Ug Ltd, Golden Bull (U) Limited, Century Seeds, Savana Seeds, Grow More Seeds	Non-exclusive
NABE 16	NARO/2010/BEN/020	NASECO, Miika, Syova, Rhino Seeds Africa, BRAC Social Business Entreprise Ug Ltd, Okeba seeds, Supa Seeds Africa, Golden Bull (U) Limited, Grow More Seeds	Non-exclusive
NABE 17	NARO/2012/BEN/021	FICA, Pearl, Syova, Equator, Ayellape, Daylight, NASECO, Miika, Rhino Seeds Africa, BRAC Social Business Entreprise Ug Ltd, Okeba seeds, Golden Bull (U) Limited, Century Seeds, Savana Seeds, Grow More Seeds	Non-exclusive
NABE 19	NARO/2012/BEN/023	FICA, Pearl seeds, Daylight, Miika, NASECO, Supa Seeds Africa, Century Seeds, Savana Seeds, Grow More Seeds	Non-exclusive
NAROBEAN 1	NARO/2016/BEN/032	FICA, Pearl seeds, Daylight, Miika, NASECO, Syova, Equator, Rhino Seeds Africa, BRAC Social Business Entreprise Ug Ltd, Okeba seeds, Golden Bull (U) Limited, Savana Seeds, Grow More Seeds	Non-exclusive
NAROBEAN 2	NARO/2016/BEN/033	FICA, Pearl seeds, Syova, Equator, Ayellape, Daylight, BAK Holdings, Miika Albertine, NASECO, Okeba seeds, Golden Bull (U) Limited, Green Firm Africa	Non-exclusive
NAROBEAN 3	NARO/2016/BEN/034	Okeba seeds, Golden Bull (U) Limited, Green Firm Africa, Savana Seeds, Grow More Seeds	Non-exclusive
NAROBEAN 4C	NARO/2016/BEN/035	Pearl Seeds, Syova	Non-exclusive
NAROBEAN 5C	NARO/2016/BEN/036	Pearl Seeds, Syova, Savana Seeds	Non-exclusive
NAROBEAN 6	NARO/2019/BEN/037	Pearl Seeds	Non-exclusive
NAROBEAN 7	NARO/2019/BEN/038	Pearl Seeds, Syova, Savana Seeds	Non-exclusive

Savana Seeds Ltd
NASECO SEEDS better seeds for higher yields
Miika Albertine Seeds.
HIGH QUALITY SEEDS FICA Fica Seeds
Gavic Seeds
BAK HOLDINGS CO. LTD
DAYLIGHT AGROTECH LIMITED
ADVANTA
EQUATOR SEEDS LIMITED Quality seeds for a better living

CROP: RICE			
NAMCHE 1	NARO/2013/RIC/011	FICA, Equator, Ayellape, Pearl	Non-exclusive
NAMCHE 2	NARO/2013/RIC/012	Equator seeds, Ayellape, Pearl seeds	Non-exclusive
NAMCHE 3	NARO/2013/RIC/013	NASECO, Equator, Ayellape, Daylight, Pearl, Grow More Seeds	Non-exclusive
NAMCHE 4	NARO/2013/RIC/014	Equator seeds, Ayellape, Pearl seeds, Century Seeds	Non-exclusive
NAMCHE 5	NARO/2013/RIC/015	FICA, Equator, Ayellape, Pearl, Syova, Miika, Daylight, NASECO, BRAC Social Business Entreprise Ug Ltd, Savana Seeds	Non-exclusive
NAMCHE 6	NARO/2013/RIC/016	Pearl Seeds	Non-exclusive
WITA 9	NARO/2014/RIC/021	FICA, Equator, Syova, Ayellape, Daylight, Pearl, BRAC Social Business Entreprise Ug Ltd, Century Seeds, Savana Seeds	Non-exclusive
Komboka	NARO/2014/RIC/018	Syova seeds, Savana Seeds	Non-exclusive
Arize-1	NARO/2019/RIC/022	FICA, Savana Seeds	Semi-exclusive
Chinuga 1	NARO/2019/RIC/023	Syova seeds, FICA, Savana Seeds, Grow More Seeds	Non-exclusive
Nerica 4	NARO/2007/RIC/010	Okeba, Century Seeds	Non-exclusive
CROP: SORGHUM			
SESO 3	NARO/2011/SGM/007	FICA, Equator, Ayellape, Daylight, Ntungamo, Pearl, Rhino Seeds Africa, BRAC, Century Seeds, Grow More Seeds	Non-exclusive
NAROSORG 1	NARO/2017/SGM/008	FICA, Equator, Ayellape, Daylight, Ntungamo, Rhino Seeds Africa, BRAC Social Business Enterprise Ug Ltd, Century Seeds	Non-exclusive
NARO SORG 2	NARO/2017/SGM/009	Pearl Seeds, Ayellape, Daylight, Equator, Rhino Seeds Africa, BRAC Social Business Entreprise Ug Ltd	Non-exclusive
NAROSORG 3	NARO/2017/SGM/010	Ntungamo Real Foods, NASECO, Rhino Seeds Africa, BRAC Social Business Entreprise Ug Ltd	Semi-exclusive
NAROSORG 4	NARO/2017/SGM/011	FICA, Pearl, Equator, Ayellape, Daylight, NASECO, Century Seeds	Non exclusive
CROP: FINGER MILLET			
NAROMILL 1	NARO/2017/FMT/008	NASECO, Ntungamo, Syova, Savana Seeds, Grow More Seeds	Non-exclusive
NAROMILL 2	NARO/2017/FMT/009	NASECO, Ntungamo, Syova	Non-exclusive
NAROMILL 3	NARO/2017/FMT/010	Syova seeds, Ayellape, Daylight, Ntungamo, Equator	Non-exclusive
NAROMILL 4	NARO/2017/FMT/011	NASECO, Syova, Century Seeds	Non-exclusive
NAROMILL 5	NARO/2017/FMT/012	Syova seeds, Ayellape, Daylight, Ntungamo, Equator, Century Seeds	Non-exclusive
Seremi 2	NARO/1999/FMT/006	BRAC Social Business Entreprise Ug Ltd, Century Seeds	Non-exclusive
CROP: PEARL MILLET			
ICMV 225	NARO/2010/PMT/003	FICA, Grow More seeds	Semi-exclusive
CROP: GROUNDNUTS			
Red Beauty	NARO/1968/GNT/003	NASECO, Syova, Ayellape, Pearl, Rhino Seeds Africa, BRAC Social Business Entreprise Ug Ltd, Century Seeds, Grow More Seeds	Non-exclusive
Serenut 7T	NARO/2011/GNT/014	NASECO, Ayellape, Equator, Savanna Seeds	Non-exclusive
Serenut 9T	NARO/2011/GNT/015	NASECO, Savanna Seeds	Non-exclusive
Serenut 11T	NARO/2011/GNT/016	FICA, NASECO	Non-exclusive
Serenut 13T	NARO/2011/GNT/017	Syova seeds	Non-exclusive
Serenut 8R	NARO/2011/GNT/018	NASECO	Non-exclusive
Serenut 10R	NARO/2011/GNT/019	NASECO	Non-exclusive
Serenut 12 R	NARO/2011/GNT/020	NASECO, Savanna Seeds	Non-exclusive
Serenut 14R	NARO/2011/GNT/021	NASECO, Equator, Ayellape, Syova	Non-exclusive
NARONUT 1R	NARO/2019/GNT/022	FICA, Pearl seeds Syova seeds , NASECO, Century Seeds	Non-exclusive
NARONUT 2T	NARO/2019/GNT/023	FICA, NASECO, Syova, Century Seeds	Non-exclusive
CROP: SESAME			
Sesim 1	NARO/2006/SSM/001	Pearl seeds, FICA, Syova, Equator, Ayellape, Daylight, Pearl, Century Seeds	Non-exclusive
Sesim 3	NARO/2013/SSM/003	FICA, Syova, Equator, Ayellape, Daylight, Pearl, Century Seeds	Non-exclusive
Sesame 2	NARO/2006/SSM/002	Rhino Seeds Africa, Golden Bull (U) Limited, Century Seeds, Grow More Seeds	Non-exclusive
CROP: COW PEA			
SECOW 1WT	NARO/2003/CWP/001	Equator seeds, Ayellape, Daylight, Syova	Non-exclusive
SECOW 2W	NARO/2003/CWP/002	FICA, Equator, Ayellape, Daylight, Pearl, Rhino Seeds Africa, Golden Bull (U) Limited, Savanna Seeds, Grow More Seeds	Non exclusive
NAROCOW 3	NARO/2017/CWP/008	Equator seeds, Daylight, Ayellape	Non-exclusive
NAROCOW 4	NARO/2017/CWP/009	Syova seeds, Century Seeds	Non-exclusive
NAROCOW 5	NARO/2017/CWP/010	Equator seeds, FICA, Ayellape, Century Seeds	Non-exclusive
CROP: GREENGRAM			
NAROGram 1	NARO/2016/GGM/001	FICA, Syova, Savana seeds, Grow More Seeds	Non-exclusive
NAROGram 2	NARO/2016/GGM/002	FICA, Syova, Equator, Ayellape, Daylight, Pearl, Rhino Seeds Africa, Savana seeds, Grow More Seeds	Non-exclusive
CROP: PIGEON PEA			
Sepi 2	NARO/1999/PGP/002	Pearl seeds, Syova, Century Seeds	Non-exclusive
Sepi 1	NARO/1999/PGP/001	Rhino Seeds Africa	Non-exclusive
CROP: SUNFLOWER			
SESUN 1H	NARO/2010/SFW/003	Ayellape Agro, Equator, Savana seeds, Century Seeds	Semi-exclusive
SESUN 2H	NARO/2010/SFW/004	Equator seeds, Ayellape, Syova, Century Seeds	Semi-exclusive

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