INNOVATION, TECHNOLOGY DEVELOPMENT AND TRANSFER PROGRAMME

Annual Budget Monitoring Report

Financial Year 2022/23

October 2023

Budget Monitoring and Accountability Unit
Ministry of Finance, Planning and Economic Development
P.O. Box 8147, Kampala
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TABLE OF CONTENTS

ABBREVIATIONS AND ACRONYMS

BIRDC	Banana Industrial Research and Development Centre
BMAU	Budget Monitoring and Accountability Unit
Bn	Billion
cDNA	Complementary DNA
CHTC	China High-Tech Corporation
CLARF	Central Laboratory Animal Research Facility
CNC	Computer Numeric Control
COVAB	College of Veterinary Medicine, Animal Resources and Biosecurity
COVID-19	Corona Virus Disease
DLG	District Local Government
DNA	Deoxyribonucleic Acid
EAC	East African Community
ELISA	Enzyme-linked Immunosorbent Assay
GMP	Good Manufacturing Practice
GoU	Government of Uganda
HIG	Human Immunoglobulin
HPLC	High-Performance Liquid Chromatography
IFMS	Integrated Financial Management System
ISO	International Organization for Standardization
ITDT	Innovation Technology Development and Transfer
JCRC	Joint Clinical Research Centre
KMC	Kiira Motors Corporation
LGs	Local Governments
MAK-BRC	Makerere University Biomedical Research Centre
MDAs	Ministries, Departments and Agencies
MFPED	Ministry of Finance, Planning and Economic Development
MUST	Mbarara University of Science and Technology
NDA	National Drug Authority
NDP	National Development Plan
NMR	Nuclear Magnetic Resonance
NMS	National Medical Stores
NRIP	National Research and Innovation Program
NSTEIC	National Science, Technology Engineering, Innovation Centre
NSTEI-SEP	National Science, Technology Engineering, Innovation and Skills Enhancement Project

OP	Office of the President
PIAP	Programme Implementation Action Plan
PRC	Polymerase Chain Reaction
PRESIDE	Presidential Scientific Initiative on Epidemics
R&D	Research and Development
RNA	Ribonucleic Acid
RT-PCR	Reverse Transcription PCR
SARS-CoV-2	Severe Acute Respiratory Syndrome Corona Virus 2
TIBIC	Technology, Innovation and Business Incubation Centre
TSC	Technical Service Company
UCI	Uganda Cancer Institute
UIRI	Uganda Industrial Research Institute
UNBS	Uganda National Bureau of Standards
UNCST	Uganda National Council for Science and Technology
USD	United States Dollar

FOREWORD

With a strategic focus on the theme for Financial Year 2022/23, "Full Monetization of the Ugandan Economy through Commercial Agriculture, Industrialization, Expanding and Broadening Services, Digital Transformation and Market Access," the Government of Uganda has focused on the allocation of resources to strategic interventions which reflect a strong drive and dedication towards sustainable economic growth for the people of Uganda.

The findings from this year's annual monitoring exercise reveal commendable strides in the programme operations, however, the challenges we face in the pursuit of economic transformation are evident. Limited resources demand service delivery efficiency, thus the urgent need for strategic reforms if we are to reap the development dividends of our investments.

A recent project review in some programmes revealed ineffective usage of loans and counterpart funding. This raises concerns about potential funding losses and increased costs. I urge all the implementing agencies to ensure that adjustments in planning, financial monitoring and analysis, coupled with prudent management are undertaken immediately. Let us seize this moment to build a more prosperous and sustainable Uganda for generations to come.

Ramathan Ggoobi

Permanent Secretary/Secretary to the Treasury

EXECUTIVE SUMMARY

The Innovation, Technology Development and Transfer (ITDT) Programme seeks to increase the application of appropriate technology in the production and service delivery processes across the country. This will be through the development of a well-coordinated Science, Technology, Engineering and Innovation (STEI) eco-system. The programme had three sub-programmes, namely: Research and Development; STI Ecosystem Development, and Industrial Value Chain Development however, during the period under review, these were merged into one - STI Ecosystem Development Sub-programme.

The programme activities were executed through the Science Technology and Innovations (STI) Secretariat under State House (SH) and the Uganda Industrial Research Institute (UIRI). The programme has three subventions: Banana Industrial Research and Development Centre (BIRDC), Uganda National Council for Science and Technology (UNCST), and Kiira Motors Corporation (KMC). This report presents monitoring findings for the period 1st July 2022 to 30th June 2023 for planned interventions under the STI Ecosystem Development Sub-programme.

Overall Programme Performance

The approved budget for the ITDT Programme was Ug shs 274.420 billion (bn) excluding funds brought forward from financial year (FY) 2021/22. A total of Ug shs 213.834bn (77.9%) was released and Ug shs 213.557bn (99.9%) spent by 30th June 2023. The release and expenditure performance were good. The development component had a bigger share of the budget (67.48%) compared to the recurrent component. Funds for the FY2022/23 science and innovation grantees were disbursed by the STI Secretariat in the last quarter of the FY thus implementation was at initial stages by the time of monitoring.

The overall programme performance was fair at 63.4%. The interventions related to infrastructure development performed better than those for research and innovation. This was attributed to the delayed acquisition of some equipment and laboratory consumables for the scientists to timely meet their targets. The overall outcome performance was poor. Of the 21 annual planned outcome indicators, 17 were scored and only 29% of the targets were achieved.

STI Ecosystem Development Sub-programme

The sub-programme has 19 interventions, of which six were funded and monitored. The monitoring revealed that various prototypes were developed and registered by the National Research and Innovation Program (NRIP), Presidential Scientific Initiative on Epidemics (PRESIDE), crop value chains, and LEAP-agri grants under the Science Technology and Innovation (STI) Secretariat. The overall performance of the monitored interventions and outputs was good at 73.2% and the findings are summarized hereafter:

Presidential Scientific Initiative on Epidemics (PRESIDE)

Three vaccine candidate prototypes for COVID-19 were developed by the Uganda Virus Research Institute (UVRI) and College of Veterinary Animal Resources and Biosecurity (COVAB) and were ready for pre-clinical trials.

A lateral flow kit for the diagnosis of SARS-COV-2 using biomarkers was developed using serum and plasma samples (analytes). Two therapeutic products (UBV-01N and TAZCOV) for the treatment of respiratory diseases were approved for clinical trials by the National Drug Authority (NDA). A nano adjuvant as a carrier for the COVID-19 vaccines was developed and ready for preclinical trials.

The Central Laboratory Animal Research Facility (CLARF) at Makerere University was renovated and re-modelled and provided with a standby generator. Breeding of the procured small animals was ongoing including the swiss albino, Balb C, modified mice (AC2) and the wild type (P57+BC6), and albino rats. The approval of the CLARF by the National Biosafety Committee was pending.

An oligos (primers and probes) prototype for the Reverse Transcription-Polymerase Chain Reaction (R T-PCR) testing of COVID-19 and other infections using nasopharyngeal samples was developed by Ndiyo Biosciences Limited in collaboration with Makerere University Biomedical Research Centre (MAK-BRC) and approved by NDA and UNBS. The establishment of the test kit production facility that meets international Good Manufacturing Practices (GMP) was not achieved due to the change of site from Busunju, Mityana district to Katuugo-Nakasongola district at the proposed Pathogen Economy Park on the advice of the STI Secretariat.

The prototypes of medical and biomedical plastics by 3D additive manufacturing such as vacutainers, pipette tips, falcon tubes; and moulds /dies/equipment specifications were developed and the selection of appropriate equipment for production and suitable suppliers was ongoing.

Upgrading of the information and communication technology (ICT) platform for the pathogen economy was developed and integration of the application programming interface (APIs), system deployment, testing and piloting were ongoing for all platforms and systems. The STI Hub for all projects was developed and can be accessed via *http://hcd.cebigh.com* plus an e-learning platform accessed through *elearning.cebigh.com.*

Under the pathogen epidemiological studies, the genomics laboratory was equipped and bioassays were developed for seven of the 11 harvested plants. Prototypes were developed for wound infections, fungal skin and Gynae infections, the PCR enzyme extraction was completed and optimisation was ongoing.

A cancer biorepository was established at the Uganda Cancer Institute with more than 10,000 samples archived by 30th June 2023. The cancer research laboratory was equipped, however, the sequencing of human tissue was not done since it required high-capacity equipment which was not available. A high-quality biobank of samples from COVID-19 patients established at MAK-BRC collected 106,424 and distributed 50,346 specimens to qualifying researchers and a catalogue was developed *https://www.ibru.mak.ac.ug/catalogue* to digitise access to the specimens in the biobank.

A three-acre botanical garden was established at Busitema University, Nagongera to conserve at least 50 medicinal plants under threat of extinction. The Vitamin D levels in the population were tested and reference ranges were determined with Vitamin D deficiency prevalence at <5%. Dosing of Vitamin D was awaiting cytokine, Parathyroid Hormone (PTH) and D dimer analyses; the assessment of the impact of Vitamin D levels on COVID-19 pathogenesis was not achieved.

A sample prototype liquid smoke product for food flavouring was developed from eucalyptus grandis liquid smoke and the development of activated charcoal and vinegar was ongoing. It was noted

that component separation was slow and it required a heavy distillation system. The formulation of the prototype syrup and tablets from native *Matooke* starch was completed however, an industrial-scale trial run with the medicinal tablet and syrup formulations was yet to be undertaken.

National Research and Innovation Program (NRIP)

At Gulu University, 20 pairs of primers and probes for Banana Xanthomonas Wilt (BXW), cassava mosaic disease (CMD) and sweet potato viruses (SPVD) were developed. Lab tests and analysis of the 445 samples of infected banana, cassava and sweet potato were ongoing. The study on packaged shelf-stable and safe egg powder ready-consume products was completed at Kyambogo University and the contract for procurement of egg processing and value addition equipment was at the Solicitor General's Office pending approval. However, the project was behind schedule due to procurement and administrative challenges at the University.

Gravitational energy (GE) and precision agriculture (PA) irrigation prototype system were developed at Gulu University producing 6W with a complementary application; *The GEPA Mobi* for remote control. However, the technology is not deployable because of its capacity and testing of the system was not done due to limited funds. A prototype of the *Kawu* smart card was developed and piloted to enable access to digitized financial services without the use of a phone. The application was being tested in secondary schools.

For the recycling of plastic waste into eco-friendly interlocking blocks at Mbarara University, some raw materials and equipment were procured and onsite. However, only one of the three project objectives was achieved with 84% of the funds spent.

Under the substitution of mercury with bitter cassava products in gold beneficiation at Nkozi University, crude cyanide was extracted from bitter cassava by isolating linamarin from enzyme-linamarase in Kasanda District. However; it was observed that the product was effective with small particles of gold ores but it could not dissolve larger gold particles. An offsite laboratory was yet to be set up.

At Kabale University, an interactive web-based prototype application (virtual chemistry laboratory simulator) was developed for students' hands-on simulation of the chemistry laboratory experiments. The application can simulate atoms in 2D with a focus on the first 20 elements on the periodic table, however, it is yet to be deployed for external testing despite exhausted resources.

LEAP-Agri support

Products from insects (crickets) such as instant porridge were developed under the brand name *INSFOODS* and received a UNBS Q-mark. Additionally, product prototypes including modified cassava flour, modified cowpea flour, and some snack foods were developed, piloted and were being up-scaled with BROOD Bakery.

A modified plasma-assisted nitrogen fixation mini-fertilizer plant was installed at Mukono ZARDI Satellite Station, Kamenyamigo, in Lwengo District with the capacity to produce 1% nitrogen. The field tests were ongoing with a master's degree and PhD students attached to the project.

Crop Value Chain

Optimal formulas of lotion and jelly mosquito repellents were determined and prototypes (lotion and jelly) with a brand name of *Mrepel* were developed from ethnomedicinal plants and shea

butter. The value-added product prototypes from sweet potatoes were developed and ready for commercialisation under CURAD.

The Banana Industrial Research Development Centre (BIRDC) realised Ug shs 1.253bn (13.8%) in revenue from the sale of *Tooke* products against an annual target of Ug shs 9.03bn. the poor revenue performance was attributed to the delayed attainment of EFRIS from the Uganda Revenue Authority and the Limited advertising campaign. The BIRDC also processed a total of 526.7metric tonnes (MT) of raw bananas against an annual target of 364MT. The renewal of products and process certification was attained for both the pilot plant and the twelve new *Tooke* products (UNBS Q-mark, and Halal) however the International Standards Organisation (ISO) certification was not achieved. A total of 17 tricycles were procured to support product distribution and marketing. The BIRDC performance was fair emanating from the late release of operational funds, and procurement delays. The BIRDC commercialisation process was slow and likely to prolong the returns on investment.

Uganda Industrial Research Institute: Completion of operationalization of UIRI's Machining, Manufacturing and Industrial Skills Development Centre at Namanve, including recruitment of more staff, skilling curriculum development, training of trainers and allied capacity development services was not undertaken as planned. The equipment for a bakery and meat processing lines in Kabale were procured and installation was ongoing by July 2023.

Uganda National Council of Science and Technology (UNCST): Civil works for the construction of the National Science, Technology Engineering, Innovation Centre (NSTEIC) in Kiruhura District was behind schedule at 93% completion against 100% target. The delay was due to modifications in workshops 11 and 12. Manufacture of laboratory and workshops equipment was ongoing in China. The construction of the Technology Innovation and Business Incubation Centre (TIBIC) at Namanve was at 98% against 100% target pending finalization of the changes in the smart conference hall and site handover. The pre-shipment inspection for equipment for the NSTEIC was scheduled for July 2023, however, the loan time limit was due to expire in July 2023. The Business Intelligent System (BIS) and TIBIC website were under development at 60% completion.

A total of 216 units of engineering machinery equipment were delivered ahead of schedule and under the stewardship of the contractor. However, 141 units remained parked and unused for over a year. The user guidelines were developed. A total of 78 pieces of road construction equipment were leased to M/s Rohi Investments Limited and National Enterprise Corporation (NEC).

The Mpoma Satellite Ground Station was renovated and the geospatial data centre and space laboratory were equipped. The Pearl of Africa Sat-1 satellite designed by Ugandans was launched into the lower earth orbit during the period under review and calibration of ground equipment was finalised and the station was functional.

Kiira Motors Corporation: The design and engineering specifications for the Kayoola bus seat and web frame for the Kayoola Electronic Vehicle System (EVS) were completed. The draft design, engineering and manufacturing specifications for the 3-in-1 *Trike* cycle for the capacity to deliver 6,000 litres per hour of water for irrigation, generate 6kw of electricity for basic household and production, and transport goods up to 1,000kg were completed. Progress on the development of one engineering, one manufacturing and three production intent prototypes was at 54%. The Electric Bus Operator Skilling Program performed at 5% due to delayed receipt of funds from the Secretariat and by 30th June 2023, adverts were running for applications from eligible bus drivers/ operators.

The construction of the Kiira Motors Corporation (KMC) manufacturing and assembly infrastructure (phase 1) in Jinja Industrial and Business Park stood at 99.8% against a time progress of 100%, whereas phase II was at 75% physical progress. The overall project progress was at 75% and the operationalization and commissioning of the Kiira Vehicle Assembly Plant was expected in December 2023 compared to the earlier target of July 2023. The contract for the supply, installation and commissioning of the Kiira Vehicle Plant production and assembly line was awarded to M/s CHTC from China and delivery of all equipment was expected by 30th September 2023.

The pre-feasibility study and business plan for the Automotive Park in Kayunga District were concluded and submitted to the KMC Board for approval. The KMC sales revenue was Ug shs 2.216bn against an annual target of Ug shs 5.3bn. The Corporation experienced transaction losses due to variations in currencies for the Kiira Vehicle Production System and other imported production parts and materials. There were no new buses assembled during the period under review.

Conclusion

The overall Innovation, Technology Development and Transfer (ITDT) Programme performance was fair with subventions and research grants at varying levels of progress. Good progress for civil work was observed at the NSTEI-SEP at both Namanve and Rwebitete and the KMC assembly plant in Jinja District though all were behind schedule. Several research projects had developed prototypes for use in health, agricultural, energy and ICT applications. Some of the health-related innovations were ready for clinical trials. The BIRDC performance was fair owing to the late release of funds which affected the procurement of critical equipment and hence the poor revenue generation.

Most of the studies (grantees) experienced delays in the acquisition of critical equipment and a shortfall in funding, while some had not received critical equipment by 30th June 2023. None of the vaccine development projects moved to the clinical trial stage owing to lack of an approved facility for preclinical efficacy studies and the lack of a certified Good Manufacturing Plant facility for the production of human vaccines in the country. The situation was further exacerbated by the STI Secretariat's approach to piling all funds released in different quarters for disbursement to beneficiaries in a single tranche and the lack of feedback to researchers on grant continuity. The secretariat lacks a multiyear plan for supporting innovations which affects the morale of the scientists.

Recommendations

1. The STI Secretariat should streamline funding for projects with potential products for commercialisation in a phased manner to maximise the gains from the research and prototypes and ensure continuity.
2. The project principal investigators and the PRESIDE Secretariat should establish sustainable collaborations with and among research institutions for knowledge and resource sharing to ease the next steps in research and development.
3. The PPDA and MFPED should review the procurement process for science-based equipment and where possible give waivers for procurement of specific brands to mitigate the delays in procurement and acquisition of tested equipment.
4. The BIRDC should fast-track the commercialisation agenda to maximise gains on investment, generate internal revenue and attain self-sustenance.

5. The STI Secretariat should consider investing in establishing a central GMP facility at one of the collaborating institutions such as the COVAB to bridge the gap and increase efficiency in pathogen economy investments.

6. The STI Secretariat should develop a roadmap for funding innovations and improve communication on grant end dates or continuity. Studies heavy on academic achievement rather than product development and commercialisation should be minimised.

7. The STI Secretariat should review the portfolio supported with a view of phasing, postponing and terminating some of the studies given the fiscal limitations.

8. The STI Secretariat should explore funding alternatives such as public-private partnerships or independent projects through the Development Committee of MFPED for some prototypes that require long-term financing.

CHAPTER 1: INTRODUCTION

1.1 Background

The mission of the Ministry of Finance, Planning and Economic Development (MFPED) is, "*To formulate sound economic policies, maximize revenue mobilization, and ensure efficient allocation and accountability for public resources so as to achieve the most rapid and* sustainable economic growth and development."

The MFPED through its Budget Monitoring and Accountability Unit (BMAU) tracks the implementation of programmes/projects by observing how values of different financial and physical indicators change over time against stated goals and indicators. The BMAU work is aligned with budget execution, accountability, and service delivery.

Commencing FY 2021/22, the BMAU began undertaking Programme-Based Monitoring to assess performance against targets and outcomes in the Programme Implementation Action Plans (PIAPs)/Ministerial Policy Statements. Semi-annual and annual field monitoring of Government programmes and projects was undertaken to verify receipt and expenditure of funds by the user entities and beneficiaries, the outputs and intermediate outcomes achieved, and the level of gender and equity compliance in the budget execution processes. The monitoring also reviewed the level of cohesion between sub-programmes and noted implementation challenges.

The monitoring covered the following Programmes: Agro-Industrialization; Community Mobilisation and Mindset Change; Digital Transformation; Human Capital Development; Innovation, Technology Development and Transfer; Integrated Transport Infrastructure and Services; Manufacturing; Mineral Development; Natural Resources, Environment, Climate Change, Land and Water Management; Public Sector Transformation; Private Sector Development; Sustainable Development of Petroleum Resources; and Sustainable Energy Development.

This report presents findings from monitoring the Innovation, Technology Development and Transfer (ITDT) Programme for the period 1st July to 30th June 2023.

1.2 Programme Goal and Objectives

The goal of the ITDT Programme is to increase the application of appropriate technology in the production and service delivery processes through the development of a well-coordinated STI ecosystem.

The objectives of the programme are:

i. To develop requisite STI infrastructure.
ii. To build human resource capacity in STI.
iii. To strengthen Research and Development (R&D) capacities and applications.
iv. To increase development, transfer and adoption of appropriate technologies and innovations.
v. To improve the legal and regulatory framework.

1.3 Sub-programmes

The ITDT Programme is implemented through the following sub-programmes[1]:

i. STI Ecosystem Development
ii. Research and Development (R&D)
iii. Industrial Value Chains Development

1.4 Programme Outcomes

The third National Development Plan (NDPIII) ITDT Programme outcomes are:

i. Increased innovation in all sectors of the economy.
ii. Enhanced development of appropriate technologies.
iii. Increased R&D activities in the economy.
iv. Increased utilization of appropriate technologies.
v. An enabling environment for Science, Technology, Engineering & Innovation created.

The key targets to be achieved by this programme over the NDPIII period include:

i. Increase the Global Innovation Index from 25.3 to 35.0.
ii. Increase Gross Expenditure on R&D as a percentage of gross domestic product (GDP (GERD) from 0.4 percent to 1 percent.
iii. Increase business enterprise sector spending on R&D (percent of GDP) from 0.01 percent to 0.21 percent.
iv. Increase the number of Intellectual Property Rights registered per year from 2 to 50.

1 During the FY2022/23, the STI combined the three sub-programmes into one programme: STI Ecosystem Development for all outputs and the budgets.

CHAPTER 2: METHODOLOGY

2.1 Scope

This monitoring report is based on selected interventions in the ITDT Programme during FY2022/23. Implementation of the programme is spearheaded by the Science, Technology and Innovations (STI) Secretariat under the State House (Vote 002), and Uganda Industrial Research Institute (Vote 110). The funded subventions under STI include: the Uganda National Council for Science and Technology (UNCST), Kiira Motors Corporation (KMC), and Banana Industrial Research and Development Centre (BIRDC).

The monitoring involved analysis and tracking of inputs, activities, processes, outputs and in some instances intermediate outcomes as identified in the Programme Implementation Action Plan (PIAP), Ministerial Policy Statements (MPSs) and annual, and quarterly work plans, progress and performance reports of ministries, departments and agencies (MDAs).

A total of six funded interventions out of 22 under the PIAP were monitored[2]. The selection of the interventions to monitor was based on the following criteria:

i. A significant contribution to the programme objectives and national priorities.

ii. Level of investment and interventions that had a large volume of funds allocated were prioritized.

iii. Planned outputs whose implementation commenced in the year of review, whether directly financed or not. In some instances, multiyear investments or rolled-over projects were prioritized.

iv. Interventions that had clearly articulated gender and equity commitments in the policy documents

v. Completed projects to assess beneficiary satisfaction, value for money and intermediate outcomes.

2.2 Approach and Methods

Both qualitative and quantitative methods were used in the monitoring exercise. The physical performance of interventions, planned outputs and intermediate outcomes were assessed by monitoring a range of indicators. The progress reported was linked to the reported expenditure and physical performance.

A combination of random and purposive sampling was used in selecting interventions and outputs from the PIAPs, MPSs, and progress reports of the respective agencies for monitoring. To aid in mapping PIAP interventions against annual planned targets stated in the programme MPS and quarterly work plans, a multi-stage sampling was undertaken at three levels: i) Sub-programmes ii) Sub-sub-programmes and iii) Project beneficiaries. Regional representation was considered in the selection of beneficiaries and outputs.

2 Develop strategies to domesticate and implement international conventions and treaties that facilitate STI; Increase investment in R&D in key priority sectors like; agriculture, Oil & Gas, energy, health, transport; Support the establishment and operations of Technology & Business incubators and Technology Transfer centres; Create capacity on application of drones, satellite imagery through GIS, real-time disaster modeling, and widespread connectedness improve emergency response and production; Support the establishment and operations of Science and Technology Parks to facilitate commercialization; and Design and conduct practical skills development programmes.

2.3 Data Collection and Analysis

Data collection

The monitoring team employed both primary and secondary data collection methods. Secondary data collection methods include:

i) Literature review from key policy documents including, MPS FY 2022/23; National and Programme Budget Framework Papers, A Handbook for Implementation of NDPIII Gender and Equity Commitments, PIAPs, NDP III, quarterly progress reports and work plans for the respective implementing agencies, Quarterly Performance Reports, Budget Speech, Public Investment Plans, Approved Estimates of Revenue and Expenditure.

ii) Review and analysis of data from the Integrated Financial Management System (IFMS) and Programme Budgeting System (PBS) Quarterly Performance Reports.

Primary data collection methods on the other hand include:

iii) Consultations and key informant interviews with institutional heads and project/intervention managers.

iv) Field visits to various institutions, for primary data collection, observation and photography.

v) Callbacks in some cases were made to triangulate information.

Data Analysis

The data was analyzed using both qualitative and quantitative approaches. Qualitative data was examined and classified in terms of constructs, themes or patterns to explain events among the beneficiaries (interpretation analysis) and reflective analysis where the monitoring teams provided an objective interpretation of the field events. Quantitative data on the other hand was analyzed using advanced Excel tools that aided interpretation.

Comparative analyses were done using percentages, averages, and cross-tabulations of the outputs/interventions; intermediate outcome indicators and the overall scores. The performance of outputs/interventions and intermediate outcome indicators was rated in percentages according to the level of achievement against the annual targets. The assessment of grants under the PRESIDE and NRIP funding windows was based on the achievement of annual output targets (numbers) and the level of annual budget disbursements. The sub-programme score was determined as the weighted aggregate of the average percentage ratings for the output/intermediate outcomes in the ratio of 65%:35% respectively.

The overall programme performance is an average of individual sub-programme scores assessed. The performance of the programme and sub-programme was rated based on the criterion in Table 2.1. Based on the rating assigned, a BMAU colour-coded system was used to alert the policymakers and implementers on whether the interventions were achieved or had very good performance (green), good performance (yellow), fair performance (light gold) or poor performance (red).

Table 2.1: Assessment Guide to Measure Performance in FY 2022/23

Score	Performance Rating	Comment
90% and above		Very Good (Achieved at least 90% of outputs and outcomes)
70%-89%		Good (Achieved at least 70% of outputs and outcomes)
50%- 69%		Fair (Achieved at least 50% of outputs and outcomes)
49% and below		Poor (Achieved below 50% of outputs and outcomes)

Source: Author's Compilation

Ethical considerations

Introduction letters from the Permanent Secretary/Secretary to Treasury were issued to the respective MDAs, and beneficiaries were monitored. Entry meetings were held with the Accounting Officers or delegated officers upon commencement of the monitoring exercise. Consent was sought from respondents including programme or project beneficiaries. All information obtained during the budget monitoring exercise was treated with a high degree of confidentiality.

2.4 Limitation

Lack of reliable and real-time financial data on subventions on the IFMS.

2.5 Structure of the Report

The report is structured into four chapters. These are the Introduction, Methodology, Programme Performance, Conclusion and Recommendations respectively.

CHAPTER 3: PROGRAMME PERFORMANCE

3.1 Introduction

The Innovation, Technology Development and Transfer Programme contributes to objective four of the NDPIII to enhance the productivity and social well-being of the population. During the FY2022/23, the STI Secretariat continued to support the 53 research projects through two funding streams: 1) National Research and Innovations Programme (NRIP) with 26 grants (projects), and the Presidential Scientific Initiative on Epidemics (PRESIDE) with 27 grants (projects). The grantees were classified into the following categories: health, agriculture, ICT, energy and mineral development, and environment and waste management. The funds for the projects were released in June 2022 and permission was provided by MFPED to implement the projects during FY 2022/23.

The annual monitoring FY 2022/23 focused on the subventions of KMC, UNCST, and BIRDC as well as the funded research grants under NRIP, PRESIDE, LEAP-Agri and Crop Value-Chains.

3.2 Overall Performance

3.2.1 Financial performance

The approved budget for the ITDT Programme was Ug shs 274.42 billion (bn) excluding funds brought forward from FY2021/22. A total of Ug shs 213.84bn (77.9%) was released and Ug shs 213.562bn (99%) spent by 30th June 2023 (Table 3.1). The release and expenditure performance were good and very good respectively. The development component had a bigger share (67.48%) of the budget compared to the recurrent component.

The BIRDC absorbed only 67% of the funds it received, while the Kiira Motors Corporation (KMC) absorbed 53.51%. This was attributed to the delayed release of funds which affected procurement commencement. Funds to the FY2022/23 beneficiary grantees were disbursed in the last quarter of the FY hence grantees could not commence implementation in time. This was attributed to an approach by the STI Secretariat to pile all funds released in different quarters for disbursement to beneficiaries in a single tranche.

Table 3.1: Financial Performance for the ITDT Programme FY2022/23

Entity	Approved Budget	Released	Spent	% Budget Released	% Releases Spent
State House (STI-Secretariat[3])	247.688	189.769	189.769	76.6	100
Uganda Industrial Research Institute (UIRI)	25.502	22.834	22.566	89.5	98.8
Uganda Registration Services Bureau (URSB)	1.112	1.112	1.11	100	99.8
Uganda Embassy in Russia, Moscow	0.119	0.119	0.117	100	98.3
Total for Programme	**274.42**	**213.834**	**213.562**	**77**	**99.9**

Source: Quarter Four PBS Report FY2022/23

Physical performance

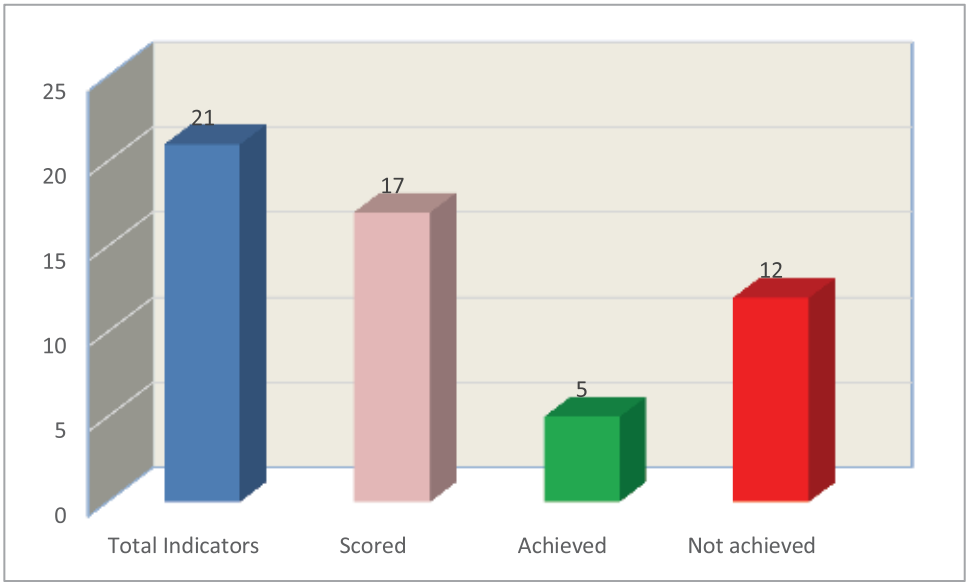
The overall ITDT Programme performance was fair at 63.4% (Table 3.2). The infrastructure development interventions and outputs performed better than those on research and innovation.

3 The funds are shared between the STI secretariat and the three subventions of Kiira Motors, UNCST and BIRDC.

Two therapeutics for the treatment of respiratory diseases were cleared by the National Drug Authority (NDA) for use in humans. Three vaccine candidates were ready for pre-clinical trials awaiting approval of a facility for pre-clinical efficacy studies and establishment of a certified Good Manufacturing Plant (GMP) facility for the production of human vaccines in the country. The Pearl of Africa Sat-1 satellite was launched into low earth orbit in November 2022.

The overall outcome indicator performance was poor. Of the 21 annual planned outcome indicators, 17 were scored and only five (29%) of these indicators were achieved as indicated in Figure 3.1.

Figure 3.1: Level of achievement of the outcome indicators in FY2022/23



Source: PBS

Implementation of the National Science, Technology Engineering, Innovation and Skills Enhancement Project (NSTEI-SEP) registered good progress, while the commercialization of the pilot plant operations at the Banana Industrial Research and Development Centre (BIRDC) was ongoing at a rather slow pace largely due to limited funding in the first half of the FY2022/23 and the spike in raw material (*matooke)* prices in the second quarter.

The construction of KMC manufacturing and assembly infrastructure (Phase 1) in Jinja District stood at 99.8% against a time progress of 100%, while Phase II stood at 75% progress. A contract for the supply of a production and assembly line was signed with M/s CHTC from the People's Republic of China.

Table 3.2: ITDT Programme Performance by 30th June 2023

Sub-programme	Performance (%)	Remark
STI Ecosystem Development	63.4	Fair performance

Source: Field Findings

Detailed performance of the monitored interventions is given hereafter:

3.3 STI Ecosystem Development Sub-programme

The sub-programme contributes to the five ITDT Programme objectives. The sub-programme has 22 interventions, of which six were funded and all monitored. The sub-programme performance was fair at 63.4%. Interventions contributing to STI Infrastructure Development, especially under

KMC and NSTIEC-SEP performed better than those related to Research and Development (R&D). The summary performance of the monitored interventions is given in Table 3.3.

Table 3.3: Performance of Interventions under the Industrial and Technological Development Sub-programme by 30th June 2023

Intervention	Colour Code	Remark
Develop strategies to domesticate and implement international conventions and treaties that facilitate STI	84.7%	Good performance
Increase investment in R&D in key priority sectors like; agriculture, Oil & Gas, Energy, Health, Transport	68.3%	Fair performance
Support the establishment and operations of technology & business incubators and technology transfer centres	81.6%	Good performance
Create capacity on application of drones, satellite imagery through GIS, real-time disaster modelling, and widespread connectedness to improve emergency response and production		Not assessed due to lack of financial information
Support the establishment and operations of science and technology parks to facilitate commercialization	90%	Very good performance
Design and conduct practical skills development programmes	100	Very good performance

Source: Authors' Compilation

3.3.1 Increase investment in R&D in key priority sectors like; agriculture, Oil & Gas, Energy, Health, Transport

The planned outputs under this intervention for FY2022/23 include: the COVID-19 research (PRESIDE) implemented, the National Research and Innovation Program Framework (NRIP), crop value chain and LEAP-Agri projects supported and implemented through grantees (Annex 1: Annex 2: Annex 3: Annex 4). The banana pilot plant at BIRDC operationalized and International Standards Organization (ISO) certification secured. Other planned outputs under the interventions were implemented through the Uganda Industrial Research Institute (UIRI).

The intervention performance was fair at 68.3%. This performance was attributed to difficulties in the procurement of requisite equipment and delayed delivery of reagents for the researchers. The performance of outputs under the intervention for the period under review is discussed hereafter under the respective funding categories.

a) Presidential Scientific Initiative on Epidemics (PRESIDE)

The PRESIDE is a platform set up to fast-track local research and development to generate products to enable the country to cope with the COVID-19 pandemic and future health security needs (pathogen economy). The funds for FY2022/23 were released to PRESIDE projects late in the fourth quarter, therefore, the monitoring focused on funds (Ug shs 52.064bn) disbursed to some of the 27 PRESIDE projects in June 2022, in addition, to two NRIP-supported research grants in the health sub-programme (Annex 2). The progress of monitored research grantees/projects is discussed hereunder;

1. COVID-19 sub-unit vaccine

The project implemented by the College of Veterinary Medicine, Animal Resources and Biosecurity (COVAB), Makerere University, aimed at developing a subunit/cellular vaccine to be used in the management of the COVID-19 spread. The project's main deliverable is a COVID-19 vaccine. Its one-year budget was Ug shs 1.820bn, which was all released and expended by 30th June 2023.

The isolation, gene coding of the spike protein and viral Deoxyribonucleic Acid (DNA) amplification and expression was achieved in *E.coli*[4]. The surface spike protein from the different SARS COV2 variants was freeze-dried and dosed in laboratory mice for safety, immunogenicity and toxicity preclinical studies. The results from the preclinical studies showed that the candidate vaccine was immunogenic and safe.

The pending activities included: preclinical studies in humanized mice for toxicity, safety, immunogenicity and efficacy, and clinical trials. However, these pending activities awaited the breeding of enough humanised mice at the COVAB's Animal Lab Facility and obtaining of good manufacturing practices. The project performance was fair.

2. Biomarker Research Facility

The project is implemented by COVAB-Makerere University and aims to strengthen the country's capacity to develop disease diagnostic/prognostic assays and drug development. The project's general objective is to develop a diagnostic biomarker test kit for diagnosing and management of COVID-19. The deliverables included: a biomarker research facility established at Makerere University, SARS-CoV-2 biomarkers in saliva, urine and blood with diagnostic/prognostic or therapeutic potential identified, and biomarker panels (lateral flow assays) developed.

The project budget was Ug shs 2.950bn, which was all released and expended by 30th June 2023. Equipping of the biomarker research facility was at 99% progress pending delivery of a mass spectrometer and a cutter which are vital machines to support biomarker prototype kit production. A total of 12 biomarkers were detectable in urine, saliva, blood, plasma and serum and a lateral flow kit for detecting severe SARS-CoV2 was developed to 60% using serum and plasma samples (analytes). The project recruited two master's students, two interns, and three junior scientists for capacity building and training in biomarker and lymphocyte function-associated antigen (LFA) design.

The ongoing activities included: sensitivity, specificity, performance, stability and clinical evaluation of the developed diagnostics. The Intellectual Property (IP) for the biomarker is not yet filed awaiting evaluation results. The project performance was good; however, it was delayed by the procurement of equipment that was not readily available on the market.

*3. Central Laboratory Animal Research Facility (*CLARF*)*

The project is implemented by the COVAB-Makerere University and it aims to establish a central shared laboratory animal research facility (for pre-clinical trials) at COVAB. The key project deliverables include a renovated and equipped CLARF, biological molecules used in the treatment and prevention and diagnostics for infectious disease produced, small laboratory animals bred, and consultancies in drug efficacy studies provided. The scope of work included: renovation and equipping the CLARF for small animal experimentation (laboratory to level 2 biosecurity and animal house to level three biosecurity), and construction of a perimeter wall around the facility.

The project budget was Ug shs 1.440bn which was all released and spent. Civil works were at 99% with partitioning complete and the heating, ventilation, and air conditioning installed and tested. Additionally, a standby generator to provide redundancy in case of power outages was procured and installed.

4 Escherichia coli (E. coli), is a type of bacteria that normally lives in animal intestines.

The breeding of the procured small animals was ongoing. These included: mice (swiss albino, balb C), modified mice (AC2) and wild type (P57+BC6), and albino rats. A request to have the animal facility (three labs) approved was submitted to the National Biosafety Committee and the committee made preliminary visits to the CLARF, and advised on the next steps for improvement and approval by the committee. The performance of this grant was good.

Some of the assorted equipment procured in the Biomarker Research Facility at COVAB

4. Inactivated COVID-19 vaccine development

The project goal was to reduce Uganda's chronic dependence on external partners and turn the threats of viral epidemics into an emerging economy by building local capacity for developing vaccines needed to respond to emerging and re-emerging viral diseases. The project's key deliverables are: tested and approved inactivated COVID-19 vaccine and local capacity for epidemic response preparedness built. The project budget was Ug shs 7.003bn and Ug shs 6.888bn was released and all spent by 30th June 2023.

The project registered progress in growing the viral cells, isolation and inactivation. A total of 200 doses of Delta lab prototype vaccine and 200 doses of Omicron for pre-clinical trials were produced. There was optimization and validation of five out of eight; Enzyme-Linked Immunoassay (ELISA), Neutralization, Luminex, ELISpot, and Isotyping assays for the detection of human responses. Pre-clinical studies in Swiss mice were done and five MSc students were mentored. The pending activities include immunogenicity tests and safety studies in transgenic mice.

The project was however affected by the decline in the number of COVID-19 cases and the availability of other vaccines in the country. The anticipated spinoffs from the project include the development of SARS-CoV-2 monoclonal antibodies, antigen proteins, and pseudoviruses.

5. Production and clinical evaluation of bee products

The overall project goal was to develop safe and effective natural products as preventative and therapeutic drugs against COVID-19 and other related diseases. The project's planned outputs include: the ethnomedicine properties of *Wabugia Ugandanensis* and bee products documented, preclinical studies of the formulated therapeutics; and standardised dosage clinical trials of the formulated therapeutics.

The project budget for the year was Ug shs 2.0bn which was all disbursed to the host institution-National Chemotherapeutic Research Institute (NCRI) and Ug shs1.981bn was spent by 30th June 2023. A therapeutic product from *Wabugia Ugandanensis* and bee products were developed (UBV-01N). Clinical trials for the UBV-01N were completed and the product got approval from the NDA and UNBS for use by humans for the treatment of respiratory diseases.

However, studies on standardized dosage and viral efficacy (UVRI) were in the final stages. A good manufacturing practice facility was set up and partially equipped at NCRI. The product was undergoing reformulation following comments of the Data Safety Monitoring Board (DSMB) after the clinical trial. The project progress was good however, completion of the pending studies was hindering the mass production of the product.

6. NANO-Adjuvant Therapeutics, vaccine adjuvant and materials testing

The project is implemented by the College of Engineering Design Art and Technology (CEDAT), Makerere University, MAPRONANO ACE. The project goal is to formulate and evaluate the adjuvanticity of nano-adjuvant[5] delivery systems for the SARS-CoV-2 subunit vaccine. The project title however changed with the STI-Secretariat's approval to include other vaccines and not only SARS-COV.

The project budget was Ug shs 1.485bn which was all released and Ug shs 1.265bn spent by 30th June 2023. The balance of Ug shs 0.219bn is committed to ICP-EOS equipment which is to be paid after equipment installation and training.

The following activities were completed: Formulation of chitosan and lipid nano-delivery systems, and its biocompatibility with the vaccine was determined. The developed adjuvant was reported to be compatible with the SARS-CoV-2 subunit vaccine developed by COVAB. A total of 300 laboratory mice were vaccinated with the vaccine-loaded nano-adjuvants to evaluate their safety, toxicity and immunogenicity profiles. The vaccine-loaded adjuvant was found to be safe/immunogenic and would induce the intended antibodies. However, there were mixed results from the cytokine profiling as there were no significant differences among all the treatment groups and therefore profiling of cytokines was ongoing.

The project faced the challenge of delayed delivery of laboratory consumables and power outages that affected the storage of spike materials and other consumables. The pre-clinical trial/evaluation of the vaccine adjuvant in humanised mice was yet to be done. The project performance was generally good.

7. Novel Adeno-vector COVID-19 vaccine

The project aimed at developing a SARS-CoV-2 vaccine using an adenovirus vector and viral spike (S-glycoprotein) from Ugandan viral strains. The project's planned outputs included: A Ugandan non-human primate (NHP) adenovirus vector developed, an adeno-vector COVID-19 vaccine developed, and technical capacity for vaccine production built.

The project budget was Ug shs 1.252bn which was all disbursed to the implementer and Ug shs 1.351bn was spent by 30th June 2023. The following progress was registered; genotypic characterization of 73 faecal samples collected from chimpanzees were completed; adeno-vector backbone was generated; three vaccine candidates (A23.1, Delta and Omicron) were generated from E1 deleted adeno-vectors; bulk laboratory stock of both the vaccine and vector were generated; and capacity building of project staff in areas of bioinformatics, next generation sequencing and cytometry flow panels was done. Additionally, a PhD student was recruited with a focus on developing capacity for multivalent vaccines.

5 An adjuvant is a substance that enhances the immune system's response to the presence of an antigen/vaccine.

The validation and testing of pre-existing immunity assays was ongoing with 400 tests done to provide insight into the relevance of the adenovector to the Ugandan population. The delays in the procurement of critical consumables like vivapure purification kits and cells for bulk production affected the timely attainment of the project-planned outputs. The project was at the initial stages of registering the intellectual property with the Uganda Registration Service Bureau (URSB) and the African Regional Intellectual Property Organization (ARIPO). The project performance was good.

Equipped laboratory for vaccine development research at UVRI

8. Development and production of medical and biomedical plastic supplies in Uganda

The project goal is to develop local capacity in the manufacture of medical and biomedical plastic products to reduce the importation of medical and biomedical supplies in Uganda and provide their sustainable supply to end users.

The project has two deliverables: The specifications and requirements for medical plastics developed, processes for the manufacture of medical and biomedical plastics developed and optimized, and validate processes for medical and biomedical plastic moulds/dies and equipment. The project budget was Ug shs 1.599bn and all was disbursed to the project. A total of Ug shs 0.835bn (52.2%) was spent by 30th June 2023.

The following had been achieved: the feasibility study on the manufacture of medical and biomedical plastics and stakeholder interactions was undertaken; prototypes of medical plastics by 3D additive manufacturing such vacutainers, pipette tips, falcon tubes; and moulds/dies/equipment specifications were developed. The ongoing activities were the selection of appropriate equipment and suitable suppliers and the finalisation of a feasibility report.

9. ICT Platform for the Pathogen Economy

The project goal was to develop a robust software platform to support critical internal business processes of the STI secretariat; and deployment of a commercial and integrated Artificial Intelligence (AI)-driven platform for disease screening. The project has six deliverables: grants application and management platform, Atlas system, training module for innovators, coordination, implementation and evaluation platform for STI secretariat, an integrated disease screening platform, and an artificial intelligence database for healthcare solutions.

The budget was Ug shs 0.999bn and all was disbursed and spent by 30th June 2023. The project developed all system requirements, design and modules for all the platforms; a Ugandan-based

cervical cancer image dataset; a system prototype for the disease screening, a mobile application and screening dashboard; and patient information exchange through the Open Health Exchange platform (OpenHIE) were developed. Others included; a Ugandan-based breast cancer image dataset; web-based data tools for the data collection, integration and preparation and Machine Learning (ML) pipelines for training image classification and object detection for medical images.

The development and integration of the application programming interface (APIs), system deployment, testing and piloting were ongoing for all platforms and systems. Data preparation and annotation by experts, ingestion pipeline design and evaluation of the AI model on a specific machine for the AI disease screening platform were also ongoing. Upgrade of the project to be the STI Hub for all AI-related projects was ongoing.

10. Pathogenic epidemiological studies

The project's main objective is to conduct an antimicrobial resistance (AMR) surveillance model and predict resistance and pharmaceutical needs and products that will support the fight against AMR. The project deliverables are three herbal and biotechnological products, a predictive model for AMR in Uganda in 2030, Polymerase Chain Reaction (PCR) diagnostic kits, data-driven treatment guidelines developed and capacity built.

The project received a grant worth Ug shs 2.621bn and Ug shs 2.143bn (81.8%) was spent by 30th June 2023. The unspent balances of Ug shs 0.438bn were committed to finalising models, PCR kit set-up, drug formulation and stability studies, and personnel costs. The project procured key equipment to be used in conducting the research; a total of 11 plant extracts were evaluated and three extracts were reported to have anti-microbial properties; a draft ARM predictive model was designed and seven masters' students were recruited for capacity building. Three products such as medicated soap, herbal wash and herbal sanitiser were ready for commercialisation. The project performance was good.

Some of the equipment procured under PRESIDE in the Microbiology Laboratory at Mbarara University of Science and Technology

11. The PCR and Anti-body diagnostic kits

The project is implemented by M/s Ndiyo Biosciences Limited in collaboration with Makerere University Biomedical Research Centre Limited (MAK-BRC). The project objective was to develop PCR diagnostics for COVID-19. The planned outputs were: i) A PCR and Antibody Diagnostics Kit factory that meets international Good Manufacturing Practices standards, ii) PCR and antibody-based diagnostics and research kits developed and manufactured, iii) Capacity to produce PCR/molecular diagnostic kits developed, and iv) A national biorepository facility to allow storage of specimens for pathogens of health security concern and non-communicable diseases established, constructed and equipped.

The budget for FY2021/22 was Ug shs 4.576bn which was all released and Ug shs 0.941.7bn (8%) spent by 30th June 2023. The unspent balance of Ug shs 3,896bn was committed to the pending project activities including the construction of the PCR and Antibody Diagnostics Kit factory. The project designed and developed Oligos (primers and probes) prototypes for reverse transcription-polymerase chain reaction (RT-PCR) testing of COVID-19 and other infections using nasopharyngeal samples

with eight components. These were validated and verified by the NDA and UNBS and are ready for upscaling.

The project had acquired a five-acre piece of land to establish the test kit production facility at Busunju, Mityana District and the factory structural designs were finalised. A contractor (NEC works) was directly procured and a contract was signed for the civil works. However, the STI Secretariat advised Ndiyo Biosciences Limited to relocate the facility to Katuugo Industrial Park (Proposed Pathogen Economy Park) in Nakasongola. This was based on the need to have a bigger piece of land (50 acres) to establish a national biobank and later a training institute. By 30th June 2023, the new site in Katuugo had not been officially handed over to Ndiyo Biosciences Limited.

The change of site from Busunju to Katuugo required fresh engineering designs, and an environmental impact assessment, and came with cost overruns since some resources had been used to fence and acquire the land at Busunju. There was no progress on the third output since it depended on the construction of the factory. There is a risk of delayed construction of the facility and cost overruns due to the requirement to develop a master plan for the entire science park under this grant. Moreover, the current investment directly contributes to the generation of assets in the form of land, buildings and equipment using public funds without following the public investment management guidelines and the targets were expanded to facilitate the development of the science park.

12. Network of STI Excellence as a Foundry for Accelerated Transformative STI Human Capital Development

The project aims to develop a functional national network of STI excellence as a foundry for accelerated transformative STI human capital development. The key planned outputs were: i) the ability of partner STI establishments to better manage STI and STI-driven national transformation in the various industrial value chains profiled, and ii) partner STI personnel in transformative STI and STI human capital in the various industrial value chains trained and skilled.

The project budget was Ug shs 1.642bn all of which was released and Ug shs 0.860bn (52%) spent by 30th June 2023. No funds had been spent on equipment, travel, and knowledge management and learning. The average performance and achievement of the planned outputs was 56.88% (Table 3.4).

Table 3.4: Status of output achievement for the project by 30th June 2023

	Output	Target (%)	Status (%)	Remarks
1	Establishment of Foundry Network	100	100	Achieved
2	An online inventory (National database) of STI establishments critical for establishing a network of excellence	100	90	It is 90% developed and functional and accessed through https://www.hcd.cebigh.com
3	Website hosting and knowledge management portal of STI	100	90	Website accessed through; http://hcd.cebigh.com
4	Competence profiles of STI establishments (8Ps)	100	65	8P refers to product, processes, promotion, physical location, personnel, physical assets, price and target population.
5	At least 15 science graduates certified in an industrial Program in prioritized industrial value chains	100	40	Created an e-learning platform accessed through elearning.cebigh.com

	Output	Target (%)	Status (%)	Remarks
6	Needs assessment report	100	30	Includes human capacity development needs, commercialization of products, manufacturing establishments needs and special procurement systems.
7	Curriculum for STI practice (STIP)	100	20	Areas of training include: Research Development, Innovation process, product development, critical thinking and leadership among others.
8	Draft document of STI Foundry Network of Excellence	100	20	Foundry established and registered.
	Average performance	100	56.88	Fair performance

Source: Author's Compilation

The project faced the challenge of slow procurement and delayed release of funds through the Makerere University system.

13. Matooke starch as a pharmaceutical excipient in selected medicinal formulation for the treatment of COVID-19

The project is being implemented by the Banana Industrial Research and Development Centre (BIRDC) and is intended to develop native *matooke* starch to be used in pharmaceutical formulations for the treatment of COVID-19. The main project deliverables are: equipment procured, native *matooke* starch extracted, modified and characterised; toxicological profile of both raw and modified starch established, and *matooke* starch tablet and syrup formulated and characterised.

The project budget was Ug shs 797,438,750 which was all released and spent by 30th June 2023. The following was achieved: assorted equipment (refrigerator, deep freezer, centrifuge, oven, tablet hardness and disintegration testers) was acquired to aid project activities. The quality attributes of *matooke* concerning physiological indices were established. At least 127.5kg of Native *Matooke* Starch (NMS) were extracted, characterized and modified. The toxicological profile of NMS was determined and formulation of the prototype syrup and tablets was completed and the friability for the *matooke* starch tablet was found to be better than other starches experimented.

The pending activities included: the design of a pilot plant for the production of the NMS, Intellectual property registration and performance of an industrial-scale trial run with the medicinal tablet and syrup formulations. The project performance was fair but behind schedule and the implementers noted the delayed budgetary releases as the key impediment to achieving set targets.

14. Establishment of a high-quality biobank of samples from COVID-19 patients to facilitate research in diagnostics, treatment, and vaccines

The project is implemented by Makerere University Biomedical Research Centre (MAK-BRC) with the main objective of establishing a biobank of well-annotated and characterised samples of symptomatic and asymptomatic COVID-19 positive patients and negative as controls.

The project budget was Ug shs 2.354bn which was all released and Ug shs 1.995bn (85%) spent by the end of FY2022/23. The MAK-BRC acquired the following equipment that boosted the testing capacity to 6,000 samples per day: Five (05) PCR UNITS, two (02) deep freezers (-80oC) and two (02) sequencers two freezers with a capacity of 600,000 vial samples (2ml) among others.

The facility continued to replenish the bank with biospecimen stocks (collected 106,424 samples) and distributed 50,346 specimens to qualifying researchers and students in the Uganda pathogen economy. The specimens collected and processed included NP and OP SARSCoV-2 PCR, Serum, Plasma, stool, and saliva aliquoting, and PBMC isolation among others. The facility also validated over 30 serological and molecular diagnostic kits. A total of 7 laboratory Staff were trained in Pathogen genomics and Sequencing Protocols. In collaboration with STI-OP, the MAK-BRC initiated the registration of a patent for a PCR proficiency test for COVID-19). A catalogue was developed *https://www.ibru.mak.ac.ug/catalogue* to digitise access to the specimens in the biobank.

The facility was approved by the Makerere University Institutional Review Board, the Uganda National Council of Science and Technology (UNCST) and was accredited by the National Institute of Health (NIH), and College of American Pathologists (CAP) as an Integrated Bio-repository of H3Africa Uganda (IBRH3AU). The facility was also appointed by the Ministry of Health to be the authorised validating entity for equipment and PCR.

However, the sustainability of the facility for future use was not well streamlined in case the goodwill of the STI Secretariat ends. For example, the material transfer agreement does not spell out gains sharing and the storage costs are not spelt out.

15. Evaluation of the Anti-SARS-CoV-2 Activity of Tephrosia linearis, Zanthoxylum chalybeuum and Albizia coriaria and formulation of herbal product for the management of COVID-19

The research aimed to evaluate the natural products for their anti-SARS-CoV-2 activity and formulate herbal product(s) for the management of COVID-19 however, with the reduction in COVID-19 cases, the research was expanded to focus on other acute respiratory-related diseases (viral infections). The planned outputs were; a natural therapeutic product formulated, preclinical data of efficacy generated, doses produced for trial, 50 medicinal plants planted, the ground floor of the Good Laboratory Practices (GLP) facility constructed at Busitema University-Mbale campus, and laboratory equipment procured.

Samples of the natural therapeutic product (Tazcov) undergoing clinical trials

The project budget was Ug shs 2.302bn all of which was released and Ug shs 2.252bn spent by 30th June 2023. One natural therapeutic product (Tazcov) was developed and registered with the NDA and preclinical data on efficacy and safety was generated. A total of 1,000 doses of Tazcov were produced.

The product was undergoing clinical trials and the process of registering for intellectual property for the industrial design and trademark was ongoing. The laboratory was renovated, expanded and equipped with Nuclear Magnetic Resonance (NMR) spectroscopy, thermo scientific centrifuge, preparative HPLC machine, Bulk extractor, Rotary Evaporator and freezers among others.

The ground floor of the GLP Facility for Research and Development in Natural Products was constructed.

A three-acre botanical garden was established at Busitema University-Nagongera campus to conserve at least 50 medicinal plants under threat of extinction and for training of conservation biologists and botany students. Due to reduced cases of COVID-19, the TAZCOV was repurposed for management of acute respiratory illness. The project performance was good however, it was affected by the delayed release of funds and lengthy procurement processes.

16. Assessment of Vitamin D Plasma Levels in high-risk groups

The project aimed to: a) assess and describe the serum Vitamin D3 levels of different selected Ugandan sub-populations, b) establish the Ugandan reference range of Vitamin D3 and c) assess the impact of Vitamin D levels on COVID-19 pathogenesis. The project budget was Ug shs 1.600bn all of which was released and Ug shs 1.599bn spent by 30th June 2023.

The study was undertaken at a private laboratory (Windsor Laboratories) and study samples were obtained from the COVID-19 biobank at Mak BRC. By 30th June 2023, the Vitamin D levels in the population were tested and reference ranges were determined. The prevalence of vitamin D deficiency in the population was reported at <5% and a very high prevalence of suboptimal vitamin D in the general Ugandan adult population was observed. The male participants generally had higher vitamin D >40ng/ml compared to females. The study recommended vitamin D supplementation in the general population to raise the vitamin D levels. The findings were yet to be peer-reviewed for confirmation. The project was awaiting Cytokine, Parathyroid Hormone (PTH) and D dimer analyses to guide the dosing. The third output was not achieved because the COVID-19 cases were reduced significantly.

17. Liquid smoke (Bio-based Polyphenol)

The project aimed to determine the efficacy of bio-based polyphenol and mineral supplements extracted from eucalyptus grandis wood smoke in the management of bacterial and viral infections. The planned outputs were: to develop drugs from polyphenols (antiviral and antibacterial), develop activated charcoal for tablets and other uses, and produce vinegar from the by-product and other products from liquid smoke.

The project was executed by Mbarara University. The budget was Ug shs 0.250bn all of which was released and Ug shs 0.238bn spent by 30th June 2023. By the end of FY2022/23, 20 litres of liquid smoke had been extracted and was in the laboratory and all the liquid smoke components were identified by chemical structures (GC-MS Analysis). A sample prototype liquid smoke product for food flavouring was developed and the development of activated charcoal and vinegar was ongoing.

The component separation was ongoing but at a rather slow pace and it required a heavy distillation system to complete the separation. The polyphenols product samples were internally tested for efficacy on bacteria and viruses yielding positive results. The samples were submitted to UVRI for external testing and were waiting for the results. The toxicity and mutagenicity tests were ongoing. A water tank had not been installed as planned. The project was affected by the small capacity of the dryer and the absence of a functional rotary evaporator which caused a loss of solvents.

b) **National Research and Innovation Program (NRIP)**

The NRIP aims to transform Uganda into a knowledge-based economy and to better deliver services. A total of 48 grants out of 369 applications were awarded in 2022 under NRIP and eight (8) were monitored.

18. Establishment of a Centre for Cancer Biomarkers at the Uganda Cancer Institute

The goal of the project was to promote the advancement of cancer care, research and training in Uganda through the establishment of a pan-cancer biorepository and equipping a basic and translational cancer research laboratory at the Uganda Cancer Institute (UCI).

The key outputs are; i) a cancer biorepository at the UCI established and expanded, ii) a basic and translational cancer research laboratory at the UCI equipped, iii) the biomarker assays for the commonest cancers in Uganda developed, and iv) molecular and immunophenotypic characterization of cancers in Uganda undertaken. The budget was Ug shs 0.600bn all of which was released and Ug shs 0.576bn spent by 30th June 2023.

A cancer biorepository was established at UCI with the capacity to store Formalin fixed Paraffin Embedded (FFPE) and other biological materials. The cancer research laboratory was equipped with Freezers, Applied Biosystems Quantastudio 5 and 7 PCR machines, BD FACS LYRIC flow cytometer, and other assorted laboratory equipment plus cabinets for housing tissue blocks and tissue slides. The laboratory supported research and clinical diagnostic service, sequencing, flow cytometry, HPV testing, Quantastudio 7 & 5, PCR, Gel electrophoresis, bioinformatics analysis, and microbiology. By June 2023, more than 10,000 samples were archived.

The development of candidate cancer biomarkers identification was ongoing and the sequencing of human tissue was not done since it required high-capacity equipment which was not available.

A Quad Studio 7 pro and a -80 freezer at the Uganda Cancer Institute Laboratory in Mulago

19. Development of a rapid low-cost point-of-care nucleic acid diagnostic tools for Banana Xanthomona wilt (BXW), Cassava Mosaic (CMD)and Sweet Potato Viruses (SPVD)

The goal was to develop, test and market simple low-cost paper-based assays suited for resource-limited rural settings for effective banana, cassava and sweet potato disease management and control. The project planned outputs are a paper-based lateral flow assay for detection of BXW, CMD and SPVD developed and optimized; an optimized prototype of multiple lateral flow paper-based assays developed; and a business plan for commercialization and dissemination of the developed assays established.

The project budget was Ug shs 0.502bn which was all released and Ug shs 0.250bn was spent by 30th June 2023. Much of the unspent balances (Ug shs 0.121bn) are committed to the procurement of equipment. The unspent balances are attributed to delays in procurement and delivery of the equipment.

The following progress was achieved; training of project staff and graduate students on field sweet potato virus, banana and cassava disease symptoms identification, scoring and sampling procedures; completed designing of 20 pairs of primers and probes for BXW, CMD and SPVD; 445 samples of infected banana, cassava and sweet potato were collected and laboratory tests and analysis was ongoing; and fabrication of the incubators, paper channels and cassettes was completed. A business plan for commercialisation and dissemination of assay targeting the parish development model was being developed. The project performance was fair.

The project was affected by the delayed authorization from the STI Secretariat to spend, lengthy procurement processes for some equipment, and delayed delivery of some reagents.

20. Improving the livelihood of poultry farmers through egg processing and value addition

The project goal is to establish an egg-processing pilot plant and incubation centre. The planned project deliverables are: value-added shelf-stable egg products (pasteurised liquid whole egg, egg white and egg yolk; and powdered whole egg, egg white, yolk and shell); an atomized spray drier for egg powder production; and secondary value-added products.

The project budget was Ug shs 0.53bn which was all disbursed to the host institution (Kyambogo University) and Ug shs 0.200bn (37.7%) was spent by 30th June 2023. From the project's preliminary experiments, a branded and packaged shelf-stable and safe egg powder ready-to-consume product was developed. Trials were conducted and success was registered for the ready-to-consume flavoured egg powder. Research and trials were ongoing for egg powder for infant formula and integration of egg powder into baking products.

The procurement of the egg processing and value-addition equipment experienced several procurement delays including the initially identified best-evaluated bidder failing to honour a pre-shipment inspection. Subsequently, the team that travelled for the inspection with the help of the Ugandan Embassy in China, had to look elsewhere for manufacturers of egg processing equipment. By July 2023, the procurement process was still ongoing pending clearance of the new supplier from Solicitor General. There was a change in the design for an atomized spray drier from a 2kg/hr prototype to a 10kg/hr commercial atomized spray dryer. Most components of the dryer were made, however, construction of a hunger to house the atomised spray dryer had not commenced. The project performance was poor and behind schedule due to procurement delays.

21. Harnessing gravitational potential energy for domestic and precision agricultural application

The goal was to support smart agriculture in Uganda by automating the irrigation process and monitoring soil nutrient levels to achieve optimal productivity through the development of Gravitational Energy (GE) and precision agriculture (PA) irrigation systems. The outputs were: 1) Gravitational energy for powering devices that support precision agriculture harnessed, 2) The precision agriculture solution that automates irrigation, thereby ensuring that crops grow under the required conditions of soil moisture designed, and 3) The precision agriculture solution installed and tested on six selected farms.

The project budget was Ug shs 0.26bn which was all advanced to the implementer and Ug shs 0.166bn spent by 30th June 2023 representing a 64% absorption.

The GE unit prototype consisting of three sets of planetary gearboxes (a sun gear, a planet carrier, and three planet gears) to produce 6W was developed. The modification of the GE unit was ongoing to increase the power output to 35 watts. However, the technology is not deployable because of its capacity.

The Precision Agriculture[6] (PA) design was categorized into three, namely, field/garden design, cloud design and the user interface. The prototype was completed with the fabrication of an electric valve which uses 5 watts, fabricated moisture sensors using earth rods, and the farm/field implementations (sensor components, a microcontroller, irrigation accessories, a water pump and a water storage tank). A cloud configuration plus a complementary mobile app-*Gepa mobi* for remote control were developed. The GEPA Mobi was designed to enable interaction with other subsystems (modules server, sensor, microcontrollers, and the soil database) using mobile devices.

The site identification for testing the PA solution was complete and six sites were identified in Gulu City (Gulu University's Faculty of Agriculture and Environment irrigation garden) and the districts of Gulu, Pader, Omoro, Amuru and Nwoya. The installation of the PA solution at the six sites was not undertaken partly due to a delay in the procurement and delivery of ESP32 wireless microcontrollers and their accessories.

The pending activities include the procurement of additional wireless microcontrollers, a 3D printer, the development of a database for different crop water requirements and field testing of the prototype. The project performance was fair and behind schedule.

22. Recycling of plastic waste into eco-friendly interlocking blocks to address the challenges of houses for poor people and the construction of UPE/USE school classrooms

The project's goal is to produce Lego-like interlocking blocks as an alternative construction material. The project has 5 key objectives. The project's one-year budget was Ug shs 0.326bn all of which was released and Ug shs 0.272bn (84%) spent by 30th June 2023.

By July 2023, some raw materials (arsh and plastic waste) were supplied and on-site and equipment including; a laptop, shredder, temperature gun, weighing scale, mixer and heater, two air quality meters, fire extinguishers, and LPG gas cylinders were procured. All equipment was not in use except for the laptop. It was noted that the core piece of equipment (product machine) which was supposed to be fabricated by a local fabricator was yet to be delivered due to capacity gaps. The project technician has to closely work with the fabricator to optimize the final product however, there was no budget to facilitate this process.

Some of the fabricated equipment in a temporally structure at Mbarara University of Science and Technology

6 Precision Agriculture is a smart farming approach for monitoring plants' nutrient requirements and environmental conditions (humidity and temperature).

A temporally structure was set up to act as the pilot production facility at Mbarara University and was housing some of the procured equipment. The pending activities were; the production and testing of the proposed products, optimizing the mixing ratios of raw materials, and conducting the survey using the approved data collection tool. The performance of the project was poor as only one of the five project objectives was achieved with 84% funds absorption. The project is at risk of not achieving the intended objectives.

23. Eco-Friendly Gold Ores Beneficiation through Substituting the Highly Toxic and Environmentally Persistent Mercury in Artisanal Gold Mining with the Abundant and Renewable Resource; Cassava

The project aims to substitute exported mercury with cassava-based cyanogenic glucosides (linamarin) products in the process of gold beneficiation. The key planned activities were; stakeholder meetings to operationalize the project, identification and selection of pilot sites to host the field post, equipment procurement and delivery, selection and procurement of the appropriate cassava tubers, arrange a laboratory facility to conduct the off-site experiment component, and profiling AGM in Uganda/publication/dissemination. The budget was Ug shs 0.246bn all of which was released and Ug shs 0.218bn (88%) spent by 30th June 2023.

The project conducted stakeholder engagements and identified the Kafeene artisanal gold mining site in Kasanda to partner with for experiments and an agreement was signed to host the extractor project. This was selected based on the availability of a clean source of energy (grid connection) and a licence to mine gold. The equipment (ball mill and three motors) was procured to aid in the experiments. Two areas (Iganga and Kiryandongo) with bitter cassava as a raw material for cyanide were identified and the project concluded on one (Kiryandongo) for supply however, the bulk procurement of cassava was affected by the delayed release of funds, end of the cassava harvesting season and lack of some essential chemicals and reagents on the local market.

The research team developed a working protocol for the determination of the total cyanide content in bitter cassava tubers using a cyanide detection machine and methods for isolating linamarin from enzyme-linamarase as well as for extracting linamarin for encapsulation. The crude cyanide product was extracted from cassava and used in field experiments. Preliminary findings indicated that the cassava extract was able to dissolve finer gold particles but not larger particles. Further refining and scaling of the cassava product was ongoing. The setting of a lab for field/offsite experiments at Muni University was not done pending a benchmarking visit to a selected University in the USA. The project performance was fair but behind schedule with 88% of the funds spent.

24. Kawu Financial platform

The project goal was to increase access to convenient and affordable digital financial services for students who are not allowed to own phones at school yet need upkeep in the form of money. The planned project deliverables were: *Kawu* smart card developed and piloted in schools, three applications developed and hosted, and *Kawu* smart card certified for e-transactions.

The project budget was Ug shs 0.075bn which was all released and spent by 30th June 2023. The project had registered the following progress: a prototype of the *Kawu* smart card was developed and a total of 5,000 cards were printed. The application was piloted in 65 schools with over 20,000 users, (parents and agents). The project developed three applications: Kawu parents; agents and web-based applications. The project performance was good.

25. A Virtual Chemistry Laboratory Simulator (V-CHEMLAB)

The objective of the project was to develop a virtual chemistry laboratory. The proposed Virtual Chemistry Laboratory simulator (V-chemlab) is an application that will help students, educators and researchers to simulate chemistry experiments that would have been done in a physical laboratory. The planned output is a Virtual Chemistry Laboratory application (Vchemlab) developed and tested.

The one-year project budget was Ug shs 0.119bn, all of which was released to Kabale University and Ug shs 0.110bn (92%) expended by 30th June 2023. The key activities during the period under review are: database architectural design, purchasing Application Programming Interfaces (APIs), API hosting, system development (prototype development), and system testing (controlled testing).

By 30th June 2023, an interactive web-based prototype application was developed for students' hands-on simulation of the chemistry laboratory experiments. It can simulate atoms with a focus on the first 20 elements on the periodic table and it can simulate experiments in 2D. The system is being redeveloped to simulate in 3D. A detailed system requirements documentation was developed and internal testing of the system was undertaken with the core research team and the partner teachers. The system is yet to be deployed in the partner schools for external testing. The delayed release of funds and the termly nature of the school calendar affected some of the key project timelines.

c) Crop value chain

Two (2) projects on special crop value chains received funding from the STI at the end of FY 21/22. These were monitored and the findings are discussed hereafter:

26. Production of Mosquito Repellent Lotions from Ethno-medicinal Plants and Shea Butter

The goal of the project was to develop novel value-added mosquito repellent products from ethnomedicinal plants and shea butter to reduce the malaria burden. The key outputs were; i) Formulas of mosquito repellents from plant extracts and shea butter developed and optimised. ii) Efficacy testing - entomological study (laboratory and semi-field study) of the mosquito repellent products carried out, and iii) products market validation and post-market surveillance of the mosquito repellent products undertaken.

The project budget was Ug shs 0.788bn which was all released and spent by 30th June 2023. The identification and screening of ten mosquito repellent plants was done and two ethnobotanical plant oils were selected for prototyping. Optimal formulas for lotion and jelly mosquito repellents were determined and prototypes (lotion and jelly) with a brand name of Mrepel were developed.

The sensory (smell, texture and appearance) tests were done. Laboratory and semi-field tests were conducted on selected security personnel for efficacy and performance. The effective protection time of the prototypes was at least 5 hours. The product obtained a UNBS mark and the PI was planning on setting up a pilot plant to test the possibility for commercialisation however, the products had a risk of costing higher than the existing mosquito repellent products on the market.

Samples of Mrepel lotion and jelly ready for commercialization at Gudie Leisure Farm, Najjera

27. Sweet potato value chain development through technology transfer and promotion

The study goal was to commercialize the sweet potato (SP) value chain by producing innovative value-added products that can contribute to import substitution and export promotion in Uganda and help address poverty in the Bukedi, Teso and Busoga sub-regions. The project deliverables are SP varieties profiled for value addition; priority recipes for the production of candidate SP-based products catalogue; technically viable SP-based product prototype developed; and industrial process prototyped.

The year one project budget was Ug shs 1.260bn which was all released and expended by 30th June 2023. The profiling of SP varieties for the production of value-added products (ethanol, cakes, bread, doughnuts, *mandazi* and *chapatti*) was done. Technically viable product recipes were developed and procurement of pilot plant equipment and construction of pilot plant was ongoing at Kampala Industrial and Business Park-Namanve. The market validation of products, corporate formation, and supply chain optimization were not done. The project performance was good with most of the planned outputs achieved.

d) The Long-term EU- Africa research and innovation Partnership (LEAP-Agri) Project

LEAP-Agri is a joint Europe-Africa Research and Innovation (R&I) initiative related to Food and Nutrition Security and Sustainable Agriculture is a joint Europe and Africa Research and Innovation (R&I) initiative on Food and Nutrition Security and Sustainable Agriculture (FNSSA) launched in the framework of the Horizon 2020 (H2020) European program. A total of 12 projects were funded and each project was implemented in a consortium with other projects in Africa and Europe. A total of three projects were sampled and monitored during the period under review and the findings are discussed below:

28. Enhancing food and nutrition security through the promotion of edible insects' value chain in Eastern Africa

The project's intended outcomes were; i) Governance of insect value chains established and strengthened, ii) At least 2,000 farmers and 40 MSMEs engaged in insect-related businesses, iii) Increased utilization of insects and insect foods among households, iv) Insects integrated in the food and feed industry, and v) Improved enabling policy environment for insect production and marketing.

The approved budget for the project was Ug shs 0.354bn which was all released and spent by the end of FY2022/23. By the end of FY 2022/23, an insectary was partitioned into an insect rearing and processing facility and equipped with rearing and processing equipment. Five farmers who agreed were offered extension services they actively and successfully participated in all the field experiments. Two edible insects'-based recipes from cricket and grasshopper were developed and an edible insects' cookbook was developed.

Products were developed and branded as INSFOODS and the packaging material for developed insect and insect-based products were selected and under shelf life testing. Nutritional characteristics of the developed products were determined. Instant porridge received a UNBS Q-mark while Krickies did not pass the Q-mark and was re-submitted for certification. The tools were developed for the Rapid Market Assessment (RMA) to inform insect-foods and feed product development; however, data collection was not done due to funding shortages. Overall project performance was good.

29. On-site air-to-fertilizer mini-plants relegated by sensor-based ICT technology to foster African agriculture

The project aimed at improving sustainable small-scale farming in Africa through; a) providing a green fertilizer production process for sustainable agriculture, b) reducing the yield gap in African agriculture using a cost-affordable fertilizer, and c) a cost-affordable fertilizer produced. The project budget was Ug shs 0.308bn all of which was released and expended by 30th June 2023. The proof of concept and prototype were concluded.

The project designed the fertilizer production process and mini-plant prototype for field tests in Africa. A modified plasma-assisted nitrogen fixation mini-fertilizer plant was installed at the Kamenyamigo Satellite Station of Mukono ZARDI in Lwengo District. The modified design eliminated the calibration unit for the gas product and the diagnostic unit for the gas product to lower the cost of running the plasma reactor. The mini-fertilizer plant produces nitrogen-based liquid fertilizer while running on solar energy, water and air as a raw material. The nitrogen content from the produced liquid fertilizer was 1 percent. One PhD student and one master's student were being trained on the Plasma Assisted Nitrogen fixation technology among others to optimise the quantity of nitrogen in the fertilizer.Experiments were conducted to test the impact of the plasma fixed nitrogen fertilizers on maize and rice and their comparison with conventional nitrogenous fertilizers. The results indicated more concentration of nitrates and nitrogen with increased running hours of the plasma reactor. Studies were ongoing to validate the crop yields from the maize. The project performance was good and the fertiliser system was ready for commercialisation.

On site air-to-fertilizer mini-plant prototype installed in a laboratory at Kamenyamigo Satellite Station-MUZARDI in Lwengo District

30. Innovative approaches to value-addition and commercialization of climate-smart crops for enhanced food security and nutrition in Africa and beyond

The goal of the project was to increase the use of climate-smart food crops (CSFC) in baked products to provide nutritionally-rich food that meets consumer needs. The planned outputs were; i) consumer needs and key limitations in the supply and market chain of CSFC identified, ii) High-quality functional ingredients from the CSFC for use in palatable breads developed, iii) The functional ingredients used in pilot testing breads, and iv) business opportunities in the CSFC value chain identified, and v) SMEs to commercialize the developed technology nurtured.

The budget was Ug shs 0.320bn all of which was released and spent by 30th June 2023. Using part of the resources, the project acquired equipment such as a dough mixer, proofer, flour packaging unit, a laptop, printer, and desktop computer to aid in product development.

A market study was conducted in Kampala and Wakiso to identify consumer needs. Using different technologies, modified cassava, modified cowpea, and modified cassava-cowpea flour ingredients were produced for use in baking. The flour ingredients were tested and found to have a wide range of applications in different food products without compromising the aesthetic, sensory and

nutritional properties. These were bread with 20% wheat substitution, chapati with 60% wheat substitution, snacks, and porridge flour.

The product prototypes including modified cassava flour, modified cowpea flour, and a number of snack foods were developed, piloted and scaled up with BROOD Bakery, millers and chapati makers in Kampala. The project enrolled one PhD student who graduated and two Master of Science students who were in the final stages of their research work. The project performance was good as most of the key outputs were accomplished.

The Banana Industrial Research Development Centre (BIRDC)

The planned outputs for FY2022/23, include operationalizing the BIRDC model, the banana pilot plant and research laboratories commercialized, continuous product development, bio-waste utilized through R&D, product development and branding; and Global supply chain development and operationalization.

The approved budget to BIRDC was Ug shs 38.03bn inclusive of non-tax revenue from the sales of *Tooke* products (Ug shs 9.03bn). By 30th June 2023, Ug shs 25.78bn was released (67.79%) and Ug shs 17.8bn spent (69,05%). The poor absorption was attributed to the late release of quarter-one funds which led to the late initiation of planned activities and lengthy procurement of some equipment.

Some of the branded tricycles procured by BIRDC

The operationalization of the pilot plant at the BIRDC-Bushenyi was ongoing at a rather slow pace. A total of 526.7 metric tons (MT) of raw bananas were purchased from farmer cooperatives and processed against an annual target of 3,640MT representing a 14.5% achievement of the annual target. This was attributed to the rise in the price of raw bananas from October 2022 to January 2023. On the other hand, there was increased registration of Tooke Farmer Cooperatives to 22, with a total membership of 6,440 members.

The BIRDC procured 17 tricycles to help in the transportation and delivery of *Tooke* products to retail points. The procurement of 2 -10ton all-weather delivery trucks, 1 double cabin, 2 single cabins, 1 van, 3 agricultural tractors, additional laboratory equipment[7], and the automation equipment for the processing plant was at the Solicitor General's office for clearance.

It was observed that the procurements for pilot plant equipment[8] initiated in FY2021/22 had not been completed as at 30th June 2023.

The BIRDC sold *Tooke* products worth Ug shs 1.235bn during the period under review against the Ug shs 9.03bn annual target. This represents a 13.6% achievement of the annual revenue forecast. The poor performance was attributed to delayed funds release and delayed certification of products by the UNBS and the International Standards Organisation (ISO).

7 Crisps line; Doughnut Machine; Continuous bag stitching machine; Biscuit packaging machine; Differential proportional scale and mixer for flour composite line; Flour packaging machine; Metal detector machine; Banana washing machine; Banana peeling machine; Multiple depositor Machine.

8 Drum dryer, dicer, fluidized bed dryer, and distribution truck.

The BIRDC developed twelve new products ready for market testing[9] with new standard packaging. The renewal of products and process certification was attained for both the pilot plant and *Tooke* products (UNBS Q-mark, and Halal). The scope for UNBS certification was increased from two to twelve products[10]. The ISO certification was still pending by the end of FY2022/23 with the first stage of audit concluded.

The BIRDC participated in four international and eight local trade exhibitions during the period under review. The product awareness and advertisement was done through TV broadcast, radio mentions and print media (magazines). Additionally, 2 marketing hubs were identified in Jinja and Kampala however, operationalisation was pending completion of relevant rental and tenancy agreements. The BIRDC also completed registration for the URA Electronic Fiscal Receipting and Invoicing System (EFRIS).

The BIRDC performance was fair however, the outputs related to the commercialization of the pilot plant performed poorly. The BIRDC did not achieve commercialization as planned in FY2022/23 due to a lack of a clear strategic direction for commercialization, shifting priorities, and delayed procurements.

The Uganda Industrial Research Institute (UIRI)

The planned outputs for FY2022/23 were: i) Administrative and Support Services, ii) Research and Development, iii) Technology and Innovation, and iv) model value addition services. By the end of the FY2022/23, the UIRI achieved the following;

***Administrative support services*:** the agency fabricated at least 20,630 pieces of personal protective equipment (PPEs) for both medical and non-medical use against a target of 20,000 and A total of 10 prototypes of medical hazmat were developed to protect frontline workers against infectious diseases. The medical hazmat and PPE materials were for the UIRI staff who work in their laboratories.

The certified reference materials and standards from UNBS for accurate test results for all analytical laboratories (chemistry and microbiology) were purchased and 41 staff (high calibre scientists, engineers, technicians and support personnel) were recruited for the Machining, Manufacturing Industrial Skills Development Centre (MMISDC).

The completion of operationalization of UIRI's machining, manufacturing and industrial skills development centre at Namanve, including recruitment of more staff, skilling curriculum development, training of trainers and allied capacity development services was not undertaken.

***Research and development**:* A total of 908 out of the planned 2,600 textiles, food and non-food samples were analysed by the chemistry and microbiology laboratory section. One prototype of keration from chicken feathers was developed by the chemistry laboratory section for use in lotions and creams. There was a formulation of posiline from at least 5 materials and a sample was developed.

9 Gluten free bakery flour; Tooke High fibre biscuits Vanilla flavoured; Tooke High fibre biscuits Coffee flavoured; Tooke High fibre biscuits Chocolate flavoured; Tooke Rusks; Tooke herbal tea/beverage; Tooke Composite porridge; Tooke gluten free biscuits Vanilla flavoured; Tooke gluten free biscuits Coffee flavoured; Tooke gluten free biscuits Chocolate flavoured; Tooke Chocolate Biscuit; Tooke Coffee Biscuit.

10 Raw Tooke Baking Flour, Instant Tooke Flour, Tooke Biscuits, Tooke Scones, Tooke Mandazi, Tooke Bread, Tooke Dough nuts, Tooke Crisps, Tooke Buns, Tooke Queen Cakes, Tooke Instant porridge and Tooke Cookies.

A solar dryer prototype was developed. Prototype sunscreen lotions for the prevention of skin cancer in the albino communities were developed and ready for community trials. Finger probes and pulse oximeters for the MUTIMA Diagnostic tool for pneumonia were developed, passed laboratory tests and sent to the Ministry of Health for further scale-up.

In addition, the UIRI mapped different parts of the country to assess the availability of fibres available in different localities. A total of 12 samples were collected and 7 were analysed in the labs. The aim was to explore the use of fibre as an alternative raw material in making medical products. As a result, ten different products were developed including sanitary pads, bandages, and wool. The renovation of the mushroom production facility including its expansion was ongoing.

Technology and Innovation: The UIRI planned to fabricate machines and bee hives, develop a high-performance drier, and promote energy-efficient briquettes. By 30th June 2023, a total of 20 textile machines, 30 soap slicing machines and 50 bee hives to support bee hive farmers were fabricated as planned, and a solar drier prototype was developed for faster drying of produce for export. In addition, communities were trained in briquette production as an alternative source of fuel derived from agricultural wastes such as maize stalks. This was aimed at reducing dependency on charcoal and firewood by the rural communities.

Model value addition services: In a bid to operationalize 3 model value addition centres and conduct targeted capacity building for local neighbouring communities, the UIRI initiated the recruitment of staff and at the time of monitoring (July 2023), one staff had been recruited at Kabale Incubation Centre. The upgrade of the existing UIRI's value addition centres in Lira, Kanungu, Bugweri, and Mbale was not undertaken as planned due to the non-release of funds. It was noted that some implemented activities did not correspond with the planned outputs and some outputs did not have targets making assessment difficult.

3.3.2 Develop strategies to domesticate and implement international conventions and treaties that facilitate STI

The intervention aims at increasing the development, transfer and adoption of appropriate technologies and innovations. The planned outputs under this intervention for FY2022/23 were: Localized Kayoola EVS Frame, Preliminary Design of the Bus Seat (Coach), 3-in-1 Trike Design and Engineering Specification developed, 25 buses built; Six 3-in-1 Trike[11] Prototypes developed (Engineering, Manufacturing, Production Intent), and a market validation report of 3-in-1 Trike produced. The overall intervention performance was good at 84.7% as most outputs were achieved.

The design, engineering and manufacturing process specifications for the Kayoola Bus Seat and Kayoola EVS web frame and chassis localization with Victoria Engineering and pumps were at 100%. Progress on the preliminary design of the bus seat was completed and fabrication of the bus seat and prototyping of the food tray was ongoing.

The five (5) buses whose assembly and production started in FY2021/22 were delivered to M/s Tondeka Metro Company and rolled out on the city roads. These were operating along the Wandegeya–Nakawa–Ntinda–Bukoto ring road. The design and vehicle technical specifications for the 25 buses were completed. Overall progress for the output stood at 22%.

11 A trike is a three wheeled vehicle with capacity for mobility, irrigation and power generation.

The draft three-in-one Trike Design, Engineering, Manufacturing and Test case specifications were completed. The design intent of the Trike is for the capacity to deliver 6,000 litres of water per hour for irrigation, generate 6kw of electricity for basic household and production, and transport goods up to 1,000kg (1 tonne).

The design prototype development was completed and the production of one (1) engineering prototype, one (1) manufacturing prototype and four (4) production intent prototypes progressed at 60%. The deployment of the trike on 6 farms for testing was not undertaken as planned and a market validation report was not produced since the manufacturing process was still ongoing. The overall progress for the output was 54% by 30th June 2023.

Left: The localized Kayoola EVS Frame at the KMC vehicle plant in Jinja. Right: Fabrication of the 3-in-1 Trike prototype at KMC office in Ntinda

The electric bus operator skilling program performed at 5% progress by the end of June 2023. The KMC received a grant worth Ug shs 259 million from the STI Secretariat to skill one hundred (100) electric bus operators. The KMC developed a comprehensive skilling program and implementation plan and the call for applications from eligible participants for admission to the skilling in electric bus operation program was made but the training was expected in FY 2023/24.

3.3.3 Support the establishment and operations of technology & business incubators and technology transfer centres

The intervention contributes to the ITDT Programme's objective: to develop the requisite STI infrastructure. The planned and monitored budgeted outputs for FY2022/23 under the interventions are: civil works for UNCST-Technology Innovation and Business Incubation Centre (TIBIC) and National Science, Technology, Engineering and Innovation Centre (NSTEIC) executed, technical service company established and operationalized, a framework for operationalization of the TIBIC & NSTEIC developed, and Infrastructure Development and Management under Uganda Industrial Research Institute (UIRI). The overall intervention performance was good at 81.6%. The good performance is attributed to the good progress of construction works for the National Science Technology Engineering Innovation-Skills Enhancement Project (NSTEI-SEP). The performance of the monitored outputs is discussed hereafter:

The National Science Technology Engineering Innovation-Skills Enhancement Project

The NSTEI-SEP is a multiyear project implemented by the Uganda National Council for Science and Technology (UNCST) that started on 1st July 2019 with an end date of 30th June 2024. The project is funded through a loan from the Government of the People's Republic of China and counterpart funding by the GoU. The FY2022/23 approved budget for the NSTEI-SEP under the UNCST is Ug shs 63.65bn, of which Ug shs 30.44bn (47% of the budget) was released and Ug shs 24.27bn spent by 30th June 2023.

Civil works for the National Science, Technology, Engineering and Innovation Centre

The National Science, Technology and Engineering Innovation Centre (NSTEIC) is located at Rwebitete-Kiruhura District. It is being established to enhance the technological and innovative base of Ugandans through *a flexible factory learning and infrastructure model*. The progress of construction works at NSTEIC in Rwebitete was at 93% and behind schedule by 6%. This delay was due to modifications in workshops 11 and 12 to accommodate the revised quotation of laboratory equipment. Furthermore, the outbreak of COVID-19 affected the works due to travel restrictions and difficulties in the importation of some materials.

The performance of different components is as follows: metallurgical and industrial hub plus machinery and civil construction hub stood at 95%, electro-pneumatic, automotive and agricultural hubs were at 96%, guest house 95%, all dormitories were at 98%, staff accommodation 96%, cafeteria and students centre 97%, administration office and resource centre 96%, workshops 90%, villas 96%, guard houses 90%, and external works (including roads, walkways, drainage, and parking aprons) were estimated at 74%. The construction of the recreation facilities was ongoing with earthworks for the football pitch substantially completed and construction of a pavilion stand in progress.

The manufacture of laboratory and workshops equipment was ongoing in Asia with the manufacturing inspection already completed pending the pre-shipment inspection that was scheduled for July 2023. It should be noted that there was a change in specification of the equipment from the originally quoted which was found to be of low grade and could not suit the current technological requirements of the NSTEIC which caused delays. This is because the project was first conceived in 2014 and over time the technology has evolved which required a change in the equipment specification.

Additionally, the project management team lacked adequate technical capacity in the initial stages to sufficiently appreciate the equipment requirements for the kind of facility that is being established. However, the project management team co-opted other stakeholders with the technical competencies to execute the task.

Civil works for the Technology Innovation and Business Incubation Centre

L-R: Substantially completed boy's hostels. Incomplete external works at the staff quarters at the NSTEIC at Rwebitete-Kiruhura District

The TIBIC is located at Kampala Industrial and Business Park-Namanve. It is to act as a platform for technology development via the *Process Industry Learning Factory Model*, including common user facilities and shared workspaces for scientists and innovators. The civil works for the TIBIC were substantially completed by the end of March 2023 except for the auxiliary building at 97%

and the maintenance workshop at 95%. The equipment installation and testing in the maintenance workshop at TIBIC was complete. The commissioning of equipment was awaiting site handover by the contractor.

Some of the procured equipment at the TIBIC in Namanve Industrial and Business Park

The pending works at the TIBIC were: The completion of the changes in the smart conference hall, addressing the snags identified, and variations such as the provision of laptops, smart screens and software. Other pending works include approval of the site for the waste treatment plant by NEMA and its construction, and the equipping and operationalization of the ICT and Multimedia hub.

A benchmarking visit to India to learn and identify finished leather products processing technology equipment was undertaken by two project officers from 30th January to 3rd February 2023. The textile technology equipment list and specifications for product design and pattern making, fabric testing, inspection and quality control, garment production, garment finishing and packaging equipment were developed and sent to a manufacturer in Italy.

To have a paperless Business Intelligence System (BIS) for the TIBIC as a platform for streamlining the business, management and operational processes, the TIBIC Application and TIBIC website were under development (60%) by 30th June 2023. The web portal will be used to manage the online application system for the management of incubation processes and the TIBIC digital ID access system.

Other components of the BIS under development were: the TIBIC Techno-prenuership Service Platform and an Online Lab share Gateway of Science and Technology facilities and scientific equipment, and procurement of telematics systems for heavy machinery and equipment. An operation manual for the centre was developed and the process of recruitment of staff namely; the maintenance manager, automotive engineer, store controller and three technicians was in the early stages.

Technical Service Company established and operationalized

The project is expected to establish a technical service company with engineering machinery and equipment for hire to enhance the capacity of local and other contractors. By 30th June 2023, a total of 216 units of engineering machinery and equipment were delivered and are under the stewardship of the project contractor. It was observed that the Technical Service Centre (TSC) equipment was delivered ahead of schedule and was idle for over one and a half years.

A functional equipment leasing and machinery rental program was implemented through the operationalization of the Memorandum of Understanding (MoU) between UNCST and National Enterprise Corporation (NEC) for the rental of some units of engineering machinery and equipment to generate revenue. Subsequently, thirty (30) officers of the UPDF under NEC were trained in Lyantonde as machinery and equipment operators.

By 30th June 2023, a total of 48 and 30 units of road construction equipment were leased to M/s Rohi Investments and M/s National Enterprise Corporation respectively and 15 equipment & machine operators were recruited, trained and certified to support the contract for the rental of engineering machinery and equipment at the construction site of the Central Processing Facility at the King Fisher Oil Rig in Kikuube District. The rest of the equipment remained parked at the Courtyard Hotel, unused. Moreover, the client was meeting the costs for routine maintenance and servicing on top of parking charges. The investment faced the risk of the equipment warrant expiring before they are used.

Some of the equipment procured for the Technical Service Centre at Lyantonde District

Framework for operationalization of the TIBIC and NSTEIC developed

To ensure a smooth transition from the construction (civil works) to the implementation phase for training and skills enhancement, a framework for industry-led training and capacity development programs was yet to be developed due to delays in the release of GoU funds.

To operationalize the TIBIC and NSTEIC, the NSTEISEP signed MoUs between UNCST and Private Sector Foundation Uganda (PSFU), the Electricity Regulatory Authority (ERA), the Directorate of Industrial Training (DIT), and the Uganda Business and Technical Examinations Board (UBTEB). The following technology majors were considered for the skills enhancement phase: construction machinery technology, civil engineering technology, automotive technology, agricultural mechanization, industrial/mechanical technology, metallurgical technology, and electronic and electrical engineering.

The project management team is undertaking the following strategic activities toward the operationalization of the proposed centres:

1. Preparation of Operational Plan and Guidelines for the National Science, Technology, Engineering, and Innovation Centre (NSTEIC) in Kiruhura District.

2. Development of Operational Management Guidelines and Instruction Curriculum for the Technology Innovation and Business Incubation Centre in Mukono District.
3. Developing a Training and Instruction Curriculum for the National Science, Technology, Engineering, and Innovation Centre (NSTEIC).
4. Development of an Integrated Framework for the creation and operationalization of UNCST Technical Service Company (TSC).
5. Development and Operationalization of a Framework for Recruiting and Deploying Trainers of Trainers (Facilitators and Technicians) for the Project.

Project Risks: The change in equipment specifications affected the timely delivery of the project. The delayed payment of approved certificates to the contractor by the EXIM Bank of China poses a risk of an increase in project costs arising from the contractor's claims based on payment delays. The inadequate budget for GoU counterpart funding and poor releases from the STI secretariat to the subvention further create requirements for an extension of the project completion date. For example, no resources were made available to recruit and build the capacity of instructors before project handover.

Project challenges

1. Delayed response and approvals, especially for variations for example variations for the workshops.
2. The contractor's refusal to adhere to instructions delayed work on site and compromised the quality of works.
3. Delayed payment of approved certificates to the contractor by the EXIM Bank of China.
4. Communication gaps within the contractor's team especially the contractor's team on site and the team at head office (Kampala). This delays action on instructions issued to the contractor by the consultant for example the washroom area for the Guest House-Block 2.
5. The changing contractor's teams especially the coordinators. This hinders progress as the new team leaders need orientation time to catch up.

Recommendations

1. The UNCST/client should expedite the decision-making process of submitted variations to redeem time.
2. The client/UNCST through the Attorney General should act as per the contract provisions where the contractor does not adhere to and implement instructions of the consultant and client.
3. The EXIM Bank of China should expedite the processing of payments to contractors to enable the contractor to execute tasks as per the schedules.
4. The contractor should review and speed up the internal communication and information-sharing mechanisms to avoid time wastage and hasten decision-making.
5. The contractor-AVIC INTL should avoid further changes in the implementation team and where it happens ensure a smooth transition between the outgoing and incoming staff especially the team leaders/coordinators to redeem time and have a seamless transition.

Industrial and technological incubation: By 30th June 2023, the UIRI supported 20 in-house and virtual incubatees in dairy, bakery, carpentry, textiles, fruit processing and cosmetic and soap making as planned. A bi-model (in-house/virtual) program nurturing business start-ups in various industry sectors were strengthened to enable to them grow into competitive business (two of the planned five facilities were strengthened).

Infrastructure Development and Management: This is implemented under Project 1598 Retooling of Uganda Industrial Research Institute. The UIRI planned for five outputs namely; Numerical Control machine (CNC) pleasing plate cutter purchased, dye sinking Electric discharge machining (EDM)-CNC purchased, accessorial attachments to existing machines purchased, industrial portable x-ray NDT instruments and 24 tool magazine CNC vertical milling procured. By the end of FY2022/23, the used purchased meat value addition equipment for the Kabale Innovation Centre and installation was ongoing. Additionally, a firewall for online security, a fire suppression system and cameras to mitigate security measures were procured. However, it was observed the procured equipment was not in plan.

The procurement of industrial portable x-ray NDT instruments for testing defects in products and for quality assurance, dye sinking EDM CNC for making mould casting process and purchase of 24 tool magazine CNC vertical milling for the production of intricate high accuracy products was not undertaken during the period under review due to non-release of funds.

3.3.4 Create capacity on application of drones, satellite imagery through GIS, real-time disaster modelling, and widespread connectedness improve emergency response and production

The intervention contributes to the programme's objective of strengthening R&D capacities and applications. The intervention NDPIII output is National Space Science and Aeronautics Program Feasibility Study and Strategy developed. The planned outputs for the FY2022/23 include: Mpoma ground station renovated and equipped, Pearl Africa Sat-1 launch into the low earth orbit done, stakeholder mapping for aeronautics and space science done, national strategy for aeronautics and space science bureau developed, capacity skills audit done, and feasibility study report for the aeronautics and space science programme developed.

Pearl Africa Sat-1 launch into the lower earth orbit done

Uganda with support from the United States of America National Aeronautics and Space Administration (NASA) successfully launched its first-ever satellite into international space in November 2022. The cube-type satellite, Pearl Africa Sat-1, was deployed into the low earth orbit in December 2022. The satellite is designed to provide research and observation data that will provide solutions in weather forecasts, land, and water bodies, mineral mapping, disaster preparedness, border security and agriculture monitoring. The equipment of the ground station was calibrated, and the station was functional.

Mpoma ground station renovated and equipped

The STI Secretariat renovated, remodeled and equipped the ground earth station at Mpoma in Mukono District for command, control and management of the Pearl Africa Sat-1 satellite. The snags identified were addressed by the contractor and a site handover report was submitted in April 2023. The furnishing of the office space was partially complete.

National Aerospace Strategy for Uganda developed

An Inter-Ministerial Committee was constituted to aid the conduction of the following activities: stakeholder mapping per sector; needs assessment per sector, human capacity audit, infrastructure audit, a market survey for products and pilots in each sector that can be supported, business model template starting with saving money on projects being implemented locally and working towards putting products on the market, providing employment and expert services within the country and the region, Uganda Aerospace Policy Draft, and fulfilling international requirements for outer space exploration. By 30th June 2023, the Draft Aerospace Strategy and Policy were developed by the Inter-Ministerial taskforce pending internal review and presentation to the Inter-Ministerial Committee.

Sub-programme challenges

i. Delayed release of funds for continuing research projects in FY2022/23.
ii. Withdraw of COVID-19 research collaborators thus straining ongoing research.
iii. Restrictions by international suppliers on procurement of some COVID-19 research consumables to Sub-Saharan Africa.
iv. Lack of a critical path, strategic direction and a governance board for BIRDC to achieve commercialisation.
v. Lengthy processes of acquiring land for public investments.

3.3.5 Support the establishment and operations of science and technology parks to facilitate commercialization

The intervention contributes to the programme objective of the development of requisite STI infrastructure and has three outputs to be attained over the NDPIII period. These are: Kiira Vehicle Plant operationalised and functional; automotive industrial and technology park established; and banana industry infrastructure park established.

The planned annual outputs for FY2022/23 are: Functional Kiira Vehicle Plant Operationalised by June 2023 (Kiira Vehicle Plant Facilities Phase I, Kiira Vehicle Plant Facilities Phase II, Kiira Vehicle Plant Production System, Kiira Vehicle Plant Last Mile Fibre Connection), a master plan for the Automotive Industry and Technology Park (AITP) developed and a feasibility study for the AITP conducted. The performance of the intervention is discussed hereafter:

The overall intervention performance was very good at 90.02% attributed to good progress at the KMC plant at the Jinja industrial park. The construction of the KMC manufacturing and assembly infrastructure (phase 1) contracted to the NEC at the Jinja Industrial and Business Park stood at 99% against a time progress of 100% as at 30th June 2023. This involved the construction of an assembly shop, R&D and general offices, a 3.5km road, biological waste treatment plant, elevated water tank, 4km perimeter fence and gate; and a 1.7km main drainage channel. Other works such as road marking, final painting and gate works were pending completion of related works. The overall infrastructure development of the Kiira Vehicle Plant stood at 75%.

The KMC signed a contract with M/s CHTC Motor Company Limited, the Technology Partner, for the supply, installation, testing, training and support of the Kiira Vehicle Plant production system. The contract commenced on 8th December 2022 and the design, technical specification

and manufacture of the equipment was completed and shipment was ongoing. The delivery of all equipment was expected by the end of September 2023 and thereafter installation will commence. The operationalization and commissioning of the Kiira Vehicle Assembly Plant was projected for December 2023.

The *Last Mile* fibre connection to the Kiira Vehicle Plant was completed by the Research and Education Network for Uganda (RENU) and was undergoing final tests to correct any snags.

The KMC cited a challenge of transaction loss due to variations in currencies for the Kiira Vehicle Production System and other imported production parts and materials. The master plan for the Automotive Park was completed and approved by the Kayunga District Council in October 2022. The pre-feasibility study and business plan for the AITP were concluded and submitted to the KMC board for approval.

Left: Ongoing road works at one of the KMC Plant Roads. Right: Constriction of the paint workshop at KMC plant Jinja District

The KMC sales revenues (sale of Kayoola Diesel Buses, contract manufacturing of buses and bus lease/hire operations with Kalita Transporters and other VIP shuttle services) was Ug shs 2.216bn against an annual target of Ug shs 5.3bn representing 42% revenue budget performance as at 30th June 2023. Annex 3.5 shows the sub-programme performance.

Challenge

Transaction loss due to variation in currencies for the Kiira Vehicle Production System and other imported production parts and materials.

3.3.6 Design and conduct practical skills development programmes

The intervention contributes to the program objective of Build institutional and human resource capacity in STI. The planned outputs under the intervention were: research and technologies awareness, and industrial skills development. The performance of the intervention is discussed hereafter:

Research and Technologies Awareness: The UIRI planned to generate public awareness of the innovations, services and technologies, outreaches conducted, and guided tours at UIRI Nakawa and Namanve campuses conducted. The UIRI conducted seven radio features and six television shows out of the planned ten to make the general public aware of UIRI innovations, services and technologies.

Also, 12 out of 10 planned outreach motivational talks on value addition were carried out to change the mindset of youth from job seeking to creating their jobs with locally available materials. A total of 320 guided tours out of the planned 200 were carried out at UIRI Nakawa and Namanve campuses, including promotional tours for youth, women and marginalized groups with a focus on showcasing available opportunities from which they can benefit.

Industrial Skills Development: Three against a target of 13 UIRI staff were trained in good laboratory practices such as ISO 170252017 and implementation of quality management systems based on ISO 90012015. A total of 233 against the targeted 100 students from higher institutions of learning were given hands-on training in modern welding, fabrication, machine maintenance and repair.

Additionally, 130 youths against a target of 200 were trained in paper production from locally available raw materials such as sawdust and fibre, 320 small-scale farmers were trained in value addition in dairy, fruit processing, and bakery against a target of 500, and 12 against the planned 10 persons with disabilities were trained in soap making, cosmetic and handcrafts. The UIRI reported a funding deficit that affected the achievement of targets.

CHAPTER 4: CONCLUSION AND RECOMMENDATIONS

4.1 Conclusion

The overall programme performance was fair at 63.4%. However, the overall outcome performance was poor at 29% as less than half of the indicators were achieved. The performance of the intervention aimed at increasing investment in research and development was fair, with some projects registering prototypes and others at pre-clinical and clinical stages. Some of the project deliverables especially those related to COVID-19 vaccines and test kits were affected by reduction in COVID-19 cases and the existence of alternatives from elsewhere in the world. However, there was a refocusing of the research and prototypes to address other therapeutics and diagnostics that are not necessarily COVID-19 related.

Most of the studies experienced delays in the acquisition of critical equipment. None of the vaccine development projects moved to the clinical trial stage owing to the lack of an approved facility for preclinical efficacy studies and lack of funding from STI during the year under review.

The approval process for the CLARF to perform preclinical efficacy studies was initiated however, there was no Good Manufacturing Practices (GMP) facility for the production of human vaccines in the country. The above challenges put the research projects at risk of not attaining the intended outputs and outcomes in time, demotivation of researchers and a likelihood of delayed commercialisation of ready prototypes.

The BIRDC performance was fair partly owing to the late release of funds which affected the procurement of critical equipment and delayed commercialisation. The internal revenue generation component performance poorly against targets. There was limited attention on promoting raw and instant flour in international markets due to a lack of ISO certificates. The centre did not attain commercialisation as anticipated in FY2022/23.

Good progress was observed for infrastructure development-related outputs like the NSTEI-SEP at both Namanve and Rwebitete, renovation of the Mpoma Satellite Station, and the KMC assembly plant in Jinja although all were behind schedule. The KMC cited a challenge of transaction loss due to variations in currencies for the Kiira Vehicle Production System and other imported production parts and materials and the transition of the STI secretariat from various Votes which caused a loss of time.

4.2 Recommendations

1. The STI Secretariat should streamline funding for projects with potential products for commercialisation in a phased manner to maximise the gains from the research and prototypes and ensure continuity.
2. The project principal investigators and PRESIDE Secretariat should establish sustainable collaborations with and among research institutions for knowledge and resource sharing to ease the next steps in research and development.
3. The PPDA and MFPED should review the procurement process for science-based equipment and where possible give waivers for procurement of specific brands to mitigate the delays in procurement and acquisition of tested equipment.
4. The BIRDC should fast-track the commercialisation agenda to maximise gains on investment, generate internal revenue and attain self-sustenance.

5. The STI Secretariat should consider investing in establishing a central GMP facility at one of the collaborating institutions such as the COVAB to bridge the gap and increase efficiency in pathogen economy investments.
6. The STI Secretariat should develop a roadmap for funding innovations and improve communication on grant end date or continuity. Studies heavy on academic achievement rather than product development and commercialisation should be minimised.
7. The STI Secretariat should explore funding alternatives such as public-private partnerships or independent projects through the Development Committee of MFPED for some prototypes that require long-term financing.
8. The STI Secretariat should review the portfolio supported with a view of phasing, postponing and terminating some of the studies given the fiscal limitations.

REFERENCES

1. Government of Uganda (2020) National Development Plan III, FY 2020/21 to FY2024/25 (NDPIII), National Planning Authority, Kampala.
2. National Planning Authority (2021) National Development Plan Programme Implementation Action Plan, Kampala.
3. Project Implementation Progress Reports (Q1-Q2), FY2022/23.
4. State House (2022); Quarterly Performance Reports (Q1-Q4) FY2022/23.
5. Uganda Industrial Research Institute (2022); Quarterly Performance reports (Q1-Q4) FY2022/23.

Annex 1: List of Projects funded under the PRESIDE

Project Name	Institution	Grant Amount	Release
PCR based Diagnostic assays	Joint Clinical Research Centre	2,967,663,556	2,967,663,556
Inactivated COVID-19 Vaccine development project	Uganda Virus Research Institute	7,003,000,000	7,003,000,000
Equipment for the biomarker research facility	Makerere University COVAB	2,950,000,000	2,950,000,000
Establishment of a high-quality biobank of samples from COVID-19 patients to facilitate research in diagnostics, treatment, and vaccines	Mak-BRC	2,354,852,786	2,354,852,786
In-vitro studies for Herbal research	Uganda Virus Research Institute	1,419,713,194	1,419,713,194
Saliva Diagnostic Kit	Makerere University College of Health Sciences (Mak-CHS)	1,030,000,000	1,030,000,000
NANO-Adjuvant Therapeutics, Vaccine adjuvants & materials testing	Mapronano ACE, College of Engineering, CEDAT	1,485,000,000	1,485,000,000
The PCR and Anti-body diagnostic kits	Ndiyo Biosciences Limited	4,576,200,000	4,576,200,000
Development of Antibody ELISA for COVID-19 surveillance	Makerere University-COVAB	845,000,000	845,000,000
Novel Adenovector COVID-19 Vaccine	MRC/UVRI & LSHTM	2,500,000,000	2,500,000,000
Sub-unit vaccine	COVAB	975,000,000	975,000,000
Convalescent plasma for production of Hyper Immune Globulin (HIG)	Joint Clinical Research Centre (JCRC)	600,000,000	600,000,000
Bee products and Warbugia Ugandensis	Natural Chemotherapeutic Research Institute	2,000,000,000	2,000,000,000
Assessment of Vitamin D Plasma Levels in high-risk groups	WINDSOR & Mak-SPH	1,600,000,000	1,600,000,000
Evaluation of the anti-SARS-COV-2 Activity of *Tephrosia linearis, Zanthoxylum chalybeuum and Albizia coriaria* and formulation of a herbal product for the management of COVID-19	Busitema University	2,375,412,744	2,375,412,744
Matooke Starch as a pharmaceutical excipient in selected medicinal formulation for the treatment of COVID	PIBID/BIRDC	797,438,750	797,438,750
Lab Animal House	Makerere-COVAB	1,440,000,000	1,440,000,000
Ivermectin & Low-dose Aspirin study (IVCOM)	Mak-CHS, Department of Pharmacology & Therapeutics	1,000,000,000	88,587,244
Clinical Trials for Natural Therapeutics (CONAT)	Makerere University Lung Institute	3,160,640,000	3,160,640,000
Pathogen Epidemiological studies (Antimicrobial Resistance Modelling and PCR development)	Mbarara University of Science and Technology (MUST)	2,620,771,250	2,620,771,250

Project Name	Institution	Grant Amount	Release
ICT for Pathogen Economy Labs	Makerere University-CoCIS, CEDAT	1,000,000,000	1,000,000,000
Investigation of local material for the development of Medical Masks	Uganda Industrial Research Institute (UIRI)	800,000,000	800,000,000
Fermented finger millet nutraceutical	Makerere University School of Public Health	2,390,227,256	2,390,227,256
Liquid smoke (Bio-based Polyphenol)	Mbarara University of Science and Technology (MUST)	250,000,000	250,000,000
Developing a National Network of STI Excellence as a Foundry for Accelerated Transformative STI Human Capital Development	Makerere University	1,642,300,000	1,642,300,000
Assessment of feasibility, acceptability, safety, effectiveness and immunogenicity of COVID-19 vaccines among children in Uganda	Makerere University Lung Institute	681,000,000	681,000,000
Development and production of medical and biomedical plastic supplies in Uganda	MAPRONANO ACE, College of Engineering, CEDAT	1,599,853,134	1,599,853,134
Total		**52,064,072,670**	**51,152,659,914**

Annex 2: List of Projects funded under the NRIP

Project	Institution	Grant Amount	Release
Innovative work space prototype	MOTIV	1,300,000,000	1,300,000,000
Development of rapid low-cost point-of-care nucleic acid diagnostic tools for Banana Xanthomona wilt, cassava mosaic disease and sweet potato viruses	Gulu University	500,000,000	500,000,000
Science-Led Productivity Accelerator Tool for Fast-Tracking Parish Development Model: Validation of Tool	AFRISA	1,098,218,000	1,098,218,000
Yo Waste: a mobile and cloud-based hauler and garbage collection service app	Yo-Waste Limited	60,471,000	60,471,000
Anti-tick vaccine	Alfasan	400,000,000	400,000,000
Establishment of a Centre for Cancer Biomarkers at the Uganda Cancer Institute	UCI	600,000,000	600,000,000
Domestic Manufacture of Triad Engine for Mobility, Irrigation and Power Generation	Kiira Motors	649,478,100	649,478,100
Azadirachta indica,(neem) powder, oil and cake, an organic pesticide and fertilizer for crop farmers in Karamoja Sub-region	Karamoja Christian Ethnoveterinary Program (KACHEP)	300,000,000	300,000,000
Direct Reduction technology for metallization of Ugandan Iron Ore	MAK	440,195,000	440,195,000
KAWU Financial Platform	Lira University	75,114,000	75,114,000
Recycling of plastic waste into eco-friendly interlocking blocks to address the challenges of houses for poor people and the construction of UPE/USE school classrooms	MUST	326,393,288	326,393,288
Eco-Friendly Gold Ores Beneficiation Through Substituting the Highly Toxic and Environmentally Persistent Mercury in Artisanal Gold Mining with The Abundant and Renewable Resource; Cassava.	UMU Nkozi	246,680,001	246,680,001
Harnessing gravitational potential energy for domestic and precision agriculture applications	Gulu University	260,653,200	260,653,200
A virtual chemistry laboratory simulator. (v-chemlab)	Kabale University	119,776,118	119,776,118
Development and Commercialisation of Bee Products for Increased Income and Export in Uganda	Muni University	220,265,217	220,265,217
Apokor cassava value addition project (acavap)	Apokor Farmers SACCO	119,292,600	119,292,600
Optimizing Suitable Substrates for Mass Production of Black Soldier Fly Larvae (BSFL) as Ingredient for Quality Cost-Effective Fish Feeds	NARO	151,666,667	151,666,667
Validation of Anti-plasmodium and Artemisinin pharmacokinetic enhancement potential of medicinal plants used by communities to manage symptoms of malaria	MAK-CHS	228,000,000	228,000,000

Project	Institution	Grant Amount	Release
Design and fabrication of a continuous flow reactor for the production of biodiesel from locally available waste	MAK	35,000,000	35,000,000
Improving livelihoods of poultry agribusiness entrepreneurs through egg processing and value addition	Kyambogo University	529,998,000	529,998,000
Production scale-up and commercialization of the Makerere Smart Solar-electric Cooker for households, catering businesses and learning institutions: MakSol Cooker	MAK	175,000,000	175,000,000
The Parish Level Night - Day Solar crop dryer and 30 Tonne silo storage system	Busitema University	502,000,000	502,000,000
Develop a model for the commercialization of mushroom production Parishes in each district in the Bukedi region	Great Lakes Industrial Institute (GLIDE)	450,478,809	450,478,809
Development of Iron Oxide Nanoparticles from steel waste for Applications in Water Treatment	Makerere University	259,540,400	130,000,000
Bioelectricity production for wastewater treatment and soil fertility enhancement	Gulu University	200,459,600	130,000,000
Valorization of Cassava Peels Into Nano Adsorbents For Wastewater Treatment In Uganda	Makerere University	140,000,000	140,000,000
Total		**9,388,680,000**	**9,188,680,000**

Annex 3: Projects Funded under Crop Value Chains

Sweet Potato Value Chain Development through Technology Transfer and Promotion	CURAD	1,260,399,882	1,260,399,882
Production of Mosquito Repellent Lotions from Ethnomedicinal Plants and Shea Butter	Gudie Leisure Farm	788,316,380	788,316,380

Annex 4: Projects Monitored under LEAP-Agri

Project	Institution	Grant Amount	Release
University-based Community Action Research for Increasing Viability of cereal-legume Value Chains Towards Improved Nutrition and Livelihoods in Sub-Sahara Africa	Makerere University	314,848,112	314,848,112
Innovative approaches to value-addition and commercialization of climate-smart crops for enhanced food security and nutrition in Africa and beyond.	Makerere University	320,465,400	320,465,400
Enhancing food and nutrition security through the promotion of edible insects' value chain in Eastern Africa	Makerere University	354,986,394	354,986,394
On-site air-to-fertilizer mini-plants relegated by sensor-based ICT technology to foster African agriculture	National Agricultural Research Organisation- MUZARDI Mukono	308,047,547	308,047,547

Annex 5: Performance of the STI Ecosystem Development Sub-programme as at 30th June 2023

Intervention	Output	Financial Performance			Physical Performance			Remark
		Annual Budget (Ug shs)	% of budget received	% of budget spent	Annual Target	Cum. Achieved Quantity	Physical performance Score (%)	
Develop strategies to domesticate and implement international conventions and treaties that facilitate STI	Localized Kayoola EVS frame	95,913,704	100	100	1	1	100	Very good performance; design and manufacturing specifications for the bus web frame were completed.
	Preliminary designs of the bus seat	2,849,936	100	100	100	100	100	Very good performance as the design and manufacturing specifications for the bus seat were completed.
	3-in-1 trike	649,478,100	100	59	100	54	54	Fair performance. The assembly of prototypes commenced.
Increase investment in R&D in key priority sectors like; agriculture, Oil & Gas, Energy, Health, Transport	BIRDC model operationalized	9,680,000,000	100	100	3	1.7	56.7	Fair performance. Delayed appointment of a governance framework.
	Banana pilot plant commercialized	3,680,000,000	100	70	4	2	50	Fair performance. A total of 12 *Tooke* products were certified; only 13.6% of the annual sales revenue target was realized. The plant did not achieve full commercialization as planned
	Research and development and product marketing	15,640,000,000	72.2	49	559	553.2	100	Very good performance. A total of 12 new *Tooke* products were developed and undergoing market testing. Marketing was ongoing with points of sale identified and finalizing tenancy arrangements.

Intervention	Output	Financial Performance			Physical Performance			Remark
		Annual Budget (Ug shs)	% of budget received	% of budget spent	Annual Target	Cum. Achieved Quantity	Physical performance Score (%)	
	Kawu financial platform	75,114,000	100	100	3	3	100	Very good performance; KAWU smart card for digital financial inclusiveness for people with no or limited access to phones was developed and piloted in 65 schools.
	Harnessing gravitational energy for domestic and precision agriculture	260,653,200	100	64	3	1.5	50	Fair performance. The prototype was developed but is yet to be tested on the six selected sites; a mobile application was developed.
	Production of mosquito repellent lotions from ethnomedicinal plants and shea butter	788,000,000	100	100	3	2.8	93.3	Good performance. Two (lotion and cream) mosquito repellent products are ready for commercialisation under the brand name *Mrepel.*
	Sweet potato value chain development	1,260,399,882	100	92	5	4	80	Good performance. Value-added products developed from sweet potato, tested and ready for commercialisation.
	Rapid low-cost point-of-care tool for diagnosis of BBW, CMD & SPVD	500,000,000	100	50	4	2	50	Fair performance. Paper-based lateral flow assay was developed for BBW, CMD and SPVD detection and tested in labs.
	Enhancing food and nutrition security through the promotion of edible insects' value chain in Eastern Africa	354,000,000	100	100	5	3	60	Fair performance. Products were developed and branded as INSFOODS, Instant porridge received a UNBS Q-mark.

Intervention	Output	Financial Performance			Physical Performance			Remark
		Annual Budget (Ug shs)	% of budget received	% of budget spent	Annual Target	Cum. Achieved Quantity	Physical performance Score (%)	
	Egg processing and value addition	529,988,000	100	38	3	1	33.3	Poor performance due to procurement delays; egg powder product developed. egg processing and value addition facility not established due to delayed procurement of equipment; construction of a hunger to house the atomised spray dryer had not commenced.
	Innovative approaches to value-addition and commercialization of climate-smart crops for enhanced food security and nutrition in Africa and beyond.	320,000,000	100	100	4	3.8	95	Very good performance; Product prototypes including modified cassava flour, modified cowpea flour, and a number of snack foods were developed, piloted and being upscaled with BROOD bakery, millers and chapati makers in Kampala.
	On-site air-to-fertilizer mini-plants relegated by sensor-based ICT technology to foster African agriculture	308,000,000	100	100	3	2.8	93.3	Very good performance; A modified plasma-assisted nitrogen fixation mini-fertilizer plant was installed at the Kamenyamigo Satellite MUZARDI Station.
	Recycling of plastic waste into eco-friendly interlocking blocks to address the challenges of houses for poor people and the construction of UPE/USE school classrooms	326,000,000	100	83	5	1.5	30	Poor performance and behind schedule; only one out of 3 objectives achieved with 84% funds absorption; Project likely not to achieve objectives.

Intervention	Output	Financial Performance			Physical Performance			Remark
		Annual Budget (Ug shs)	% of budget received	% of budget spent	Annual Target	Cum. Achieved Quantity	Physical performance Score (%)	
	Eco-friendly gold ores beneficiation through substituting the highly toxic and environmentally persistent mercury in artisanal gold mining with the abundant and renewable resource; cassava	246,000,000	100	89	4	2	50	Fair performance. Equipment (ball mill and three motors) were procured to aid in the experiments; a working protocol for determination of the total cyanide content in bitter cassava tubers using a cyanide detection machine; a lab for field/offsite experiments at Muni University not yet established.
	A virtual chemistry laboratory simulator. (V-CHEMLAB)	119,000,000	100	92	3	2	66.7	Fair performance. An interactive web-based prototype application was developed for students' hands-on simulation of the chemistry lab experiments in 2D; the system is yet to be deployed in the partner schools for external testing.
	COVID-19 Sub-unit Vaccine	1,820,000,000	100	100	3	1.2	40	Poor performance. The sub-unit vaccine was developed; preclinical trials in humanised mice are yet to be done.
	Biomarker Research Facility	2,950,000,000	100	100	3	2.5	83.3	Good performance. The biomarker facility was equipped to 99% and a prototype of the biomarker kit was developed; tests for sensitivity, specificity, performance, stability and clinical evaluation of the developed diagnostics was ongoing.

Intervention	Output	Financial Performance			Physical Performance			Remark
		Annual Budget (Ug shs)	% of budget received	% of budget spent	Annual Target	Cum. Achieved Quantity	Physical performance Score (%)	
	Central Laboratory Animal Research Facility	1,440,000,000	100	100	1	0.9	90	Very good performance. Civil works were at 99% completion; Breeding of the procured small animals was ongoing; the facility awaited approval by the National Biosafety Committee after preliminary visits to the CLARF.
	Inactivated COVID-19 vaccine	7,003,000,000	98.4	100	3	1.9	64.4	Fair performance. The vaccine prototype was developed; immunogenicity tests and safety studies in transgenic mice pending completion and approval of the CLARF at COVAB.
	Bee products produced and evaluated	2,000,000,000	100	99	3	2.8	93.3	Very good performance. UBV-01N for the treatment of respiratory infections in humans was approved by NDA. The product undergoing reformulation following comments of the Data Safety Monitoring Board (DSMB) after the clinical trial.
	Nano-adjuvant and therapeutics	1,485,000,000	100	85	2	1.6	80	Good performance. The adjuvant was developed, tested and found to be safe/immunogenic; The pre-clinical trial/evaluation of the vaccine adjuvant in humanised mice was yet to be done.

Intervention	Output	Financial Performance			Physical Performance			Remark
		Annual Budget (Ug shs)	% of budget received	% of budget spent	Annual Target	Cum. Achieved Quantity	Physical performance Score (%)	
	Novel adeno vector COVID-19 vaccine	1,252,179,500	100	108	5	2.6	52	Fair performance. Three vaccine candidates (A23.1, Delta and Omicron) were generated from E1 deleted adeno-vectors; validation and testing of pre-existing immunity assays was ongoing. The project was affected by the delayed procurement of some consumables.
	Medical and biomedical plastic supplies produced	1,599,853,134	100	52	2	1.5	75	Good performance. Prototypes of medical plastics by 3D additive manufacturing were developed. selection of appropriate equipment and suitable suppliers was ongoing.
	ICT platform for the pathogen economy	999,831,800	100	100	6	4	66.7	Fair performance. The system was developed. Testing and piloting were ongoing for all platforms and systems.
	Pathogenic epidemiological studies	2,620,771,250	100	82	5	3	60	Fair performance. Key equipment was procured; Three products such as medicated soap, herbal wash and herbal sanitiser were ready for commercialisation.
	Network of STI excellence as a foundry for accelerated transformative STI human capital development	1,642,000,000	100	52	8	5.5	68.8	Fair performance. A foundry was established and registered; the website was developed and can be accessed through; http://hcd.cebigh.com.

Intervention	Output	Financial Performance			Physical Performance			Remark
		Annual Budget (Ug shs)	% of budget received	% of budget spent	Annual Target	Cum. Achieved Quantity	Physical performance Score (%)	
	The PCR and anti-body diagnostic kits	4,576,000,000	100	8	4	1.5	37.5	Poor performance. An Oligos (primers and probes) prototype for RT-PCR testing of COVID-19 and other infections was designed, developed and verified by NDA and UNBS. The establishment of the test kit production facility did not take due to a change of site.
	Establishment of a centre for Cancer Biomarkers at the Uganda Cancer Institute	600,000,000	100	96	4	2.4	60	Fair performance. A cancer biorepository was established at UCI and a cancer research laboratory was equipped. Development of Candidate cancer biomarkers identification was ongoing and the sequencing of human tissue was not done.
	Evaluation of the Anti-SARS-CoV-2 activity of tephrosia linearis, zanthoxylum chalybeuum and albizia coriaria and formulation of herbal product for the management of COVID	2,302,000,000	100	98	5	4.4	88	Good performance. The laboratory was renovated, expanded and equipped. One natural therapeutic product (*Tazcov*) was developed and registered with the NDA. Preclinical data on efficacy and safety was generated and the product was undergoing clinical trials.
	Assessment of Vitamin D plasma levels in high-risk groups	1,600,000,000	100	100	3	2	66.7	Fair performance. The Vitamin D levels in the population were tested and reference ranges were determined. to guidance on dosing were pending cytokine, Parathyroid Hormone (PTH) and D dimer analyses.

Intervention	Output	Financial Performance			Physical Performance			Remark
		Annual Budget (Ug shs)	% of budget received	% of budget spent	Annual Target	Cum. Achieved Quantity	Physical performance Score (%)	
	Liquid smoke (Bio-based Polyphenol)	250,000,000	100	95	3	2	66.7	Fair performance. A sample prototype liquid smoke product for food flavouring was developed and the development of activated charcoal and vinegar was ongoing. The lack of a heavy distillation system affected component separation.
	Matooke starch as a pharmaceutical excipient in selected medicinal formulation for the treatment of COVID-19	797,438,750	100	100	5	3	60	Fair performance. Lab equipment was procured. Quality attributes of matooke established. Formulation of the prototype syrup and tablets was completed.
	Establishment of a high-quality biobank of samples from COVID-19 patients to facilitate research in diagnostics, treatment, and vaccines	2,354,000,000	100	85	3	2.6	86.7	Good performance. Biobank established. A catalogue was developed to digitise access to the specimens in the biobank. https://www.ibru.mak.ac.ug/catalogue. The sustainability of the facility for future use was not well streamlined.
	Administrative support services (UIRI)	17,952,000,000	97.3	100	9	7	79.9	Good performance. A total of 41 staff were recruited for the Machining, Manufacturing Industrial Skills Development Centre (MMISDC).

Intervention	Output	Financial Performance			Physical Performance			Remark
		Annual Budget (Ug shs)	% of budget received	% of budget spent	Annual Target	Cum. Achieved Quantity	Physical performance Score (%)	
	Research and Development (UIRI)	2,140,000,000	69	99	100	34	49.3	Poor performance. Prototype sunscreen lotions for the prevention of skin cancer in albino communities were developed. Completion of the operationalization of UIRI's MMISDC at Namanve was not done.
	Technology and Innovation (UIRI)	1,000,000,000	40.2	97	3	2.5	100	Good performance. A total of 20 textile machines, 30 soap-slicing machines and 50 bee hives to support bee hive farmers were fabricated.
	Model value addition (UIRI)	642,000,000	28	100	7	1	51	Fair performance. One staff recruited at Kabale Industrial Centre while the upgrade of the existing UIRI's value addition centres in Lira, Kanungu, Bugweri, and Mbale was not undertaken.

Intervention	Output	Financial Performance			Physical Performance			Remark
		Annual Budget (Ug shs)	% of budget received	% of budget spent	Annual Target	Cum. Achieved Quantity	Physical performance Score (%)	
Support the establishment and operations of technology & business incubators and technology transfer centres	TIBIC constructed	32,336,074,422	73.6	100	100	95	100	Very good performance. The civil works for the TIBIC were substantially completed. Equipment for the maintenance workshop were installed and tested. The TIBIC Application and website were developed to 60% completion.
	NSTEIC constructed	22,755,162,662	99.6	100	100	92	92.4	Very good performance. Civil works progressed to 93%. The manufacture of laboratory and workshops equipment was ongoing in Asia. The project was behind schedule.
	Project steering committee programs implemented	613,800,000	28.1	60	100	20	71.2	Good performance
	Framework for operationalization of the TIBIC and NSTEIC developed	613,800,000	28.1	60	100	40	100	Very good performance. Development is ongoing.
	Project vehicles procured	1,450,100,000	53.2	100	5	2	75.2	Good performance two pickups were procured.
	Infrastructure development and Management under UIRI	2,800,000,000	98	97	4	2	51	Fair performance as only two out of four outputs were implemented.
	Industrial and technological Incubation supported	528,000,000	61.4	100	2	1	81.5	Good performance. Meat value addition equipment for the Kabale Innovation Centre was procured and installation was ongoing.

Intervention	Output	Financial Performance			Physical Performance			Remark
		Annual Budget (Ug shs)	% of budget received	% of budget spent	Annual Target	Cum. Achieved Quantity	Physical performance Score (%)	
Support the establishment and operations of science and technology parks to facilitate commercialization	Functional Kiira vehicle plant operationalized	174,404,000,000	93.7	78	100	75	80.05	Good performance. The launch is projected for December 2023.
	Automotive Industrial and Technology Park (AITP) established	1,149,000,000	100	100	2	2	100	Very good performance. The feasibility was completed as planned.
	Total	**330,512,294,316**[12]						
Average Output Performance							73.2	Good performance
Outcome Performance								
Outcome Indicator				**Annual Target**	**Achieved**		**Score (%)**	**Remark**
No. of new technologies adopted				5	5		100	Achieved
Business enterprise sector spending on R&D (% of GDP)				0.1	0.1		100	
Global Innovation Index (%)				31	119		100	
Number of applications for IP protections per annum				1000	4000		100	
Number of intellectual properties registered				14	3396		100	
No. of laboratories/ R&D facilities improved or established				6	5		83	Moderately achieved

12 Includes funds brought forward from FY2021/22

Intervention	Output	Financial Performance			Physical Performance			Remark
		Annual Budget (Ug shs)	% of budget received	% of budget spent	Annual Target	Cum. Achieved Quantity	Physical performance Score (%)	
Proportion of the population using appropriate technologies				0.2	0.1		50	Average performance
No. of ST&I Laws and Regulations drafted and submitted to cabinet/ parliament				2	1		50	
No. of incubators established and operationalized				6	2		33	Not achieved
Technicians in R&D (per million people)				80	15		19	
No. of firms graduating from incubators				40	5		13	
Researchers in R&D (per million people)				300	30		10	
Gross Expenditure on R&D (GERD) as a % of GDP				7	0.4		6	
Percentage of new technologies or research results commercialized				4	0.1		3	
Percentage of firms using innovative technologies				15	0.1		1	
No. of technology transfer centres established and operationalized				15	0		0	
No. of firms graduating to S&T parks				5	0		0	

Intervention	Output	Financial Performance			Physical Performance			Remark
		Annual Budget (Ug shs)	% of budget received	% of budget spent	Annual Target	Cum. Achieved Quantity	Physical performance Score (%)	
Average outcome performance							45.1	
Overall sub-programme performance							63.4	Fair programme performance

Source: Project Implementers and Field Findings

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