African Centre for Technology Studies
ACTS
knowledge for better livelihoods

SCIENCE GRANTING COUNCILS INITIATIVE SGCI IOSRS INITIATIVE DES ORGANISMES SUBVENTIONNAIRES DE LA RECHERCHE SCIENTIFIQUE

Public Private Partnerships in Technology Transfer and Uptake of Research Results: Lessons from Science Granting Councils Initiative (SGCI)-Phase II

Prepared for International Development Research Centre (IDRC)

Authors

Alfred Oduor
Tom Ogada
Agnes Lutomiah
Nicholas Odongo
Caroline Mbaya
Eunice Omwoyo
Kevin Ouko
Clarrise Mideva

Synthesis Report

March 2026

Foreign, Commonwealth & Development Office | IDRC · CRDI International Development Research Centre / Centre de recherches pour le développement international, Canada | NRF National Research Foundation | Sida | DFG Deutsche Forschungsgemeinschaft German Research Foundation | Norway

ACKNOWLEDGMENT

The African Centre for Technology Studies (ACTS) sincerely appreciates the support of its funding partners: International Development Research Centre (IDRC), the UK's Foreign, Commonwealth & Development Office (FCDO), South Africa's National Research Foundation (NRF), the Swedish International Development Cooperation Agency (Sida), Deutsche Forschungsgemeinschaft (DFG) - German Research Foundation, and the Norwegian Agency for Development Cooperation (Norad).

We also thank the leadership and staff of the Science Granting Councils (SGCs) for providing the information that formed the basis of this synthesis and for their commitment to strengthening evidence-based national innovation systems. Appreciation is extended to the Collaborating Technical Agencies (CTAs) for their expertise in policy, monitoring and evaluation, research management, gender inclusion, science communication, and innovation, which greatly supported capacity building within the SGCs. We also acknowledge the researchers, innovators, policymakers, and private sector actors whose contributions demonstrate the impact of Science Grating Councils Initiative (SGCI) in advancing African science for sustainable development.

Finally, we thank the research team for their dedication in compiling this synthesis and its key lessons.

EXECUTIVE SUMMARY

1. Context

The Science Granting Councils Initiative (SGCI) in Sub-Saharan Africa is focused on strengthening the capacities of councils to support research and evidence-based policies that will contribute to economic and social development in the region. This synthesis report distils information relating to the implementation of Public Private Partnerships (PPP) under SGCI-2 research projects. It aims to provide a better understanding of the anatomy, outputs and outcomes of SGCI-2 investments, and how these can influence the design of similar projects in future. Specifically, this synthesis aims to:

- Examine the characteristics of PPP projects under SGCI-2 research initiatives.
- Evaluate the performance of PPP projects under SGCI-2 research initiatives.
- Identify best practices, lessons learned and challenges arising from the implementation of PPP research initiatives under SGCI-2.
- Provide practical recommendations to strengthen PPP models in driving innovation and sustainable development.

2. Key Issues

The key issues arising from this synthesis report are highlighted below:

1. The implementation of PPP research projects under the SGCI-2 focused on sectors that are both vital to sustainable development and central to socio-economic transformation in many African contexts. The projects mainly gravitate toward agriculture and food security, renewable energy, mining, health, and biotechnology – each representing a nexus of national priorities and global challenges.
2. The PPP projects successfully delivered tangible outputs and outcomes across multiple sectors. These include development of new technologies and commercial products; building the technical capacity of various community groups; creating jobs and improving income for different groups; enhancing food security, agricultural productivity and environmental sustainability; strengthening councils' capacity in research governance and finally, facilitating technology transfer from academia to industry.
3. The main challenges facing technology transfer and commercialization of research outputs through PPPs under SGCI-2 include lengthy procurement processes and bureaucratic inefficiencies, which delay timely equipment acquisition and implementation; lack of clear formal agreements on PPPs; weak participation/engagement of private entities; difficulties in scaling project innovations due to market barriers, regulatory constraints and lack of business development support.
4. The PPP projects under SGCI-2 are spread across the three main categories of Technology Readiness Levels (TRLs) – research/ideation, development/testing and deployment/uptake. It is important to note that research projects at different TRLs require different kinds of support. Understanding these support levels and requirements helps in identifying investment opportunities, necessary policy interventions and potential collaborations to drive these innovations towards market success. Different TRLs for specific projects indicate the need for stage-appropriate funding and partnerships – governments and investors can prioritize according to both opportunity and risk.
5. Several bilateral and trilateral collaborative research initiatives were implemented under SGCI-2, specifically in Botswana, Zimbabwe, Malawi, Mozambique, and Zambia. These collaborative projects provided platforms for interaction, knowledge exchange and implementation of joint activities, which contributed to strengthening research ecosystems in the region. However, divergent regulatory and compliance frameworks between collaborating countries and language

barriers complicated joint projects. Other challenges included delays in cross-border sample sharing and complication around fund transfer between the countries.

6. The private sector actors under PPP arrangements in SGCI-2 projects served not only as a beneficiaries of research but also as co-implementers, resource providers, validators of research outcomes, and pathway to commercialization, thereby enhancing the relevance and impact of research projects on industrial and social development. The private sector acted as a key partner in the implementation, commercialization and application of research outputs across different countries involved in SGCI-2. The key methods used to identify private sector entities under PPPs mainly included structured calls for research proposals by the councils – with a mandatory requirement for private sector partnerships; identification of private partners by project teams, tailored technologies targeting specific private sector entities and online platforms.
7. Several PPP best practices also emerged: testing and validation of research outputs by private sector, reciprocal learning and exchange visits by councils, use of private sector infrastructure for research, industry-focused research design, and online platforms for linkages, as well as training on Intellectual Property (IP).

3. Findings and Recommendations

PPPs under SGCI-2 have demonstrated great potential for enhancing technology transfer and commercialization of research projects. To further improve the outputs and outcomes of PPPs, the following actions are proposed.

Finding 1: Lack of clear formal agreements and engagement frameworks

Recommendation: Councils need to ensure PPP projects develop and implement standardized agreements outlining ownership rights, revenue-sharing mechanisms and responsibilities of each partner.

Finding 2: Many PPP projects lack clear post-project sustainability plans

Recommendation: Councils need to link PPP-generated innovations with business incubation and innovation hubs as well as other support systems to guide start-ups in commercializing research findings. Inclusion of private sector/industry/regulatory authority or end user of the research outputs from ideation to dissemination is crucial.

Finding 3: Inadequate financial resources for full commercialization

Recommendation: PPP project teams need to be trained on developing practical business plans and resource mobilization strategies and pitching to raise funds after the project. They should also be made aware of other sustainable financing mechanisms, e.g venture capital involvement and angel investors where high-net-worth individuals invest early in exchange for equity.

Finding 4: Weak industry-academic linkages in most universities and research institutions are undermining effective implementation of PPP projects

Recommendation: It is critical to create industry-academic liaison offices within research institutions to facilitate matchmaking between researchers and businesses.

Recommendation: Create an incentive package to attract private actors to engage in PPPs between universities, research institutions, and industry players.

Finding 5: Councils do not have requisite expertise in managing PPP projects

Recommendation: Councils should be supported to build their capacity in managing PPPs by establishing a functional department for this purpose. They should also have in place mandatory private sector co-participation requirements in research proposals, ensuring that private firms actively engage in project design and implementation.

Finding 6: Lack of adequate testing facilities for innovation

Recommendation: Develop and enable access to common testing facilities for prototypes and new technologies deriving from PPP projects.

Finding 7: Lack of objective assessment of Technology Readiness levels

Recommendation: Conduct an objective assessment of Technology Readiness Levels to tailor technical and financial support accordingly.

Finding 8: Lack of clear incentives to motivate the private sector

Recommendation: Provide clear incentives to the private sector to make it attractive and lucrative for them to participate in the PPP arrangements.

CONTENTS

ABBREVIATIONS

AEC	ADEAN Economic Community
AI	Artificial Insemination
APASTI	ASEAN Plan of Action on Science, Technology, and Innovation
ASEAN	Association of Southeast Asian Nations
ATP	Advanced Technology Program
AUTM	Association of University Technology Managers
BOT	Build-Operate-Transfer
CBOs	Community-Based Organizations
COSTI	Committee on Science, Technology, and Innovation
DBFO	Design-Build-Finance-Operate
FDI	Foreign Direct Investment
FLC	Federal Laboratory Consortium
GDP	Gross Domestic Product
IP	Intellectual Property
IPMO	Intellectual Property Management Office
IPRs	Intellectual Property Rights
MoUs	Memoranda of Understanding
NEPAD	New Partnership for Africa's Development
NGO	Non-Governmental Organization
NRC	National Research Council
NTTC	National Technology Transfer Center
PPP	Public-Private Partnership
PPPs	Public-Private Partnerships
PRIs	Public Research Institutes
R&D	Research and Development
RIM	Research and Innovation Management
RTP	Research Triangle Park
SBA	Small Business Administration
SDGs	Sustainable Development Goals
SGCI	Science Granting Councils Initiative
SMEs	Small and Medium Enterprises
SPV	Special Purpose Vehicle
STI	Science, Technology, and Innovation
STISA	Science, Technology, and Innovation Strategy for Africa
TLO	Technology Licensing Organization
TRL	Technology Readiness Level
TTO	Technology Transfer Office
UICRCs	University-Industry Cooperative Research Centers
UN	United Nations
UNCST	Uganda National Council for Science and Technology
UNBS	Uganda National Bureau of Standards

1. BACKGROUND AND CONTEXT

1.1 Introduction

The Science Granting Councils Initiative (SGCI) in Sub-Saharan Africa is focused on strengthening the capacities of councils to support research and evidence-based policies that will contribute to economic and social development in the region. During 2020-2023, twelve SGCs (Botswana, Burkina Faso, Cote d'Ivoire, Malawi, Mozambique, Namibia, Rwanda, Senegal, Tanzania, Uganda, Zambia and Zimbabwe) participated in Theme 3 of phase two of the Science Granting Councils Initiative (SGCI-2) focusing on strengthening Science Granting Councils (SGCs) to manage research competitions for impact and development). The goal of this project was to increase the capacity of the Councils to manage research calls, predominantly through learning by doing. Four indicators were used to track and assess the progress towards achieving this goal: number of projects funded, addressing the needs of private sector, mainstreaming gender and inclusivity in research, and managing collaborative calls and projects. The objectives of SGCI include strengthening the ability of science granting councils to:[1]

- **i.** Manage research.
- **ii.** Design and monitor research programmes based on the use of robust STI indicators.
- **iii.** Support knowledge exchange with the private sector.
- **iv.** Establish partnerships between councils and other science system actors.

The SGCI has played a pivotal role in strengthening the research and innovation ecosystem across Africa. The second phase of the initiative supported numerous projects between 2020 and 2023, fostering collaboration among researchers, institutions, and industry while advancing national and continental development agendas. As many of these projects have concluded, synthesizing their key outcomes and impacts is essential to generate evidence for policy and funding decisions, improve research implementation, and enhance knowledge-sharing among stakeholders. As explained earlier, PPPs play a vital role in fostering innovation and bridging the gap between research and industry. These collaborations leverage the strengths of both public and private sector stakeholders to drive impactful research and contribute to national and regional development priorities.

1.2 Objectives of the Synthesis

This report is part of a broader synthesis exercise that aims to shed light on the implementation of PPP and related outputs and outcomes deriving from SGCI-2 investments with a view to providing insights that could potentially inform the design of similar projects in future. It aims to review the characteristics, structure and performance of PPP research projects as the basis for generating practical insights for improving implementation of similar projects. Specifically, the synthesis aims to:

1. Examine the characteristics of PPP projects under SGCI-2 research initiatives.
2. Evaluate the performance of PPP projects under SGCI-2 research initiatives.
3. Identify best practices, lessons learned and challenges arising from the implementation of PPP research initiatives under SGCI-2.
4. Provide practical recommendations to strengthen PPP models in driving innovation and sustainable development.

1 African Technology Policy Studies Network (ATPS) & The Scinnovent Centre, 2017.

1.3 Key Synthesis Questions

Public–Private partnerships (PPPs) financed through the second phase of the ScienceGranting Councils Initiative (SGCI-2) were designed to catalyze commercially relevant research, accelerate technology diffusion and deepen collaboration between Africa's sciencegranting councils, universities and industry actors. Based on this premise, the synthesis focused mainly on the questions outlined below:

1. What types/categories of private sector actors were involved in implementation of PPPs under SGCI-2?
2. How were the private sector actors identified, and what role did they play?
3. How many PPP projects transitioned from SGCI-2 to Research and Innovation Management (RIM) Project?
4. What was the status/technology readiness of the PPPs implemented under SGCI-2 projects?
5. What were the most attractive sectors for PPPs and what were the key outputs?
6. What were the challenges impeding Implementation of PPPs under SGCI-2, what were the best practices and what lessons can be learned?

1.4 Methodology

The synthesis was mainly based on desk review of progress reports prepared by the beneficiaries and the Councils for projects funded under SGCI-2. This was mainly done by aggregating and integrating existing data from SGCI-2 projects including technical and project reports, policy briefs, blogs. Literature review was undertaken to provide context and understanding of PPPs especially how it relates with commercialization and technology transfer of research outputs under SGCI-2 projects.

1.5 Scope and Limitations

This synthesis report, therefore, focuses exclusively on the role of PPPs in technology transfer and commercialization of research outputs under SGCI-2. In this context, the private partners not only include businesses/companies or investors but also non-government organizations (NGOs) and/or community-based organizations (CBOs) as well as cooperative societies and producer organizations. It is important to note that this synthesis was mainly based on technical reports by the councils to IDRC and not specific project reports, which could have more detailed information about the PPP actors.

2. CONTEXTUALIZING PUBLIC PRIVATE PARTNERSHIPS

Public-Private Partnerships (PPPs) embraces a range of structures and concepts, which involve the allocation of risks and responsibilities between the public and private sectors. Although the field of PPPs continues to rapidly evolve, considerable differences in the definition and application of terminology remain. Essentially, PPP refers to a wide variety of contractual arrangements through which the public and private sectors collaborate towards a common purpose. According to Witters et al. (2012), PPPs are relationships in which public and private resources are blended to achieve a goal or set of goals deemed to be reciprocally beneficial both to the private entity and to the public. Meanwhile, Nijkamp et al. (2002), defines a PPP as an institutionalized form of cooperation of public and private actors, who based on their own indigenous objectives, work together towards a joint target. Thus, PPPs are a means of public sector procurement using private sector finance and best practice; thus, they can involve design, construction, financing, operation and maintenance of public infrastructure and facilities, or the operation of services to meet public needs.

The term is usually assigned different meanings depending on the jurisdiction in question. For example, in South Africa, a PPP is defined as a contract between a public-sector institution and a private party, where the private party performs a function that is usually provided by the public sector and/or uses state property by agreement. In Nigeria, a wide range of contract forms fall within the scope of a PPP. It can be said to include outsourcing and partnering, performance-based contracting, design - build, finance - operate (or build - operate - transfer) contracts and, sometimes, concessions. In Ghana, for instance, the PPP Act of 2020 defines a PPP as a form of contractual arrangement to provide “public infrastructure” or “public services”. The interpretation of “public service” is narrower than “service”.[2]

PPPs present a framework that – while engaging the private sector – acknowledge and structure the role for government in ensuring that social obligations are met and successful sector reforms and public investments achieved. A strong PPP allocates the tasks, obligations, and risks among the public and private partners in an optimal way. The public partners in a PPP are government entities, including ministries, departments, municipalities, or state-owned enterprises. The private partners can be local or international and may include businesses or investors with technical or financial expertise relevant to the project. Increasingly, PPPs may also include non-government organizations (NGOs) and/or community-based organizations (CBOs) who represent stakeholders directly affected by the project. Effective PPPs recognize that the public and the private sectors each have certain advantages, relative to the other, in performing specific tasks.[3]

The government’s contribution to a PPP may take the form of capital for investment (available through tax revenue), a transfer of assets, or other commitments or in-kind contributions that support the partnership. The government also provides social responsibility, environmental awareness, local knowledge, and an ability to mobilize political support. The private sector’s role in the partnership is to make use of its expertise in commerce, management, operations, and innovation to run the business efficiently. The private partner may also contribute investment capital depending on the form of contract. The structure of the partnership should be designed to allocate risks to the partners who are best able to manage those risks and thus minimize costs while improving performance.[4]

2 Public-private partnerships, Legal & Institutional Frameworks in Africa: A comparative analysis: chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://ppp.worldbank.org/sites/default/files/2024-03/2024-02-20%20-%20Survey%20PPP%20Legal%20%26%20Institutional%20Frameworks%20in%20Africa%20%28EN%29.pdf)

3 chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://www.adb.org/sites/default/files/institutional-document/31484/public-private-partnership.pdf

4 chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://www.adb.org/sites/default/files/institutional-document/31484/public-private-partnership.pdf)

Although there are several definitions of PPPs, they share common characteristics. The common features of PPPs involve the interaction or partnership between the public and private sectors. The public entity could be a government ministry, state-owned enterprise or local authority. On the other hand, private companies could involve a consortium or any other private investor. In a PPP partnership, each side contributes specific resources to the venture.[5]

2.1 Types of Public Private Partnerships

PPPs range from the simplest ways of involving the private sector in public structures to more complex forms of PPP in transferring more risk from the public to the private partner. The main models provided by the European Commission are outlined below. (Applied technologies and Innovation, 2024).

Service agreement – Service agreements such as agreements between a public agency and a private sector, specifically adapted for simple, short-term operational requirements. This is a very limited form of PPP where the private partner, operates and maintains a facility for a short period of time. Responsibility for managing and investing in the project remains in the public sector, which bears the financial and residual risks, but benefits from the technical expertise of the private operator and saves money without transferring control over the quality of the final products. Service agreements are often used for services in collecting toll taxes, supply and maintenance of vehicles and other technical activities.

Operation and control agreements – arrangements under which the responsibility for operation and management of the facility is transferred to the private sector. Duration is generally short, but it is possible to arrange longer periods. The private partner is paid on a flat rate or based on accomplished initiatives with premiums relating to specific performance targets

Lease Agreements – With lease agreements, the private partner buys income streams, generated by publicly owned facilities in exchange for fixed lease payments and the obligation to operate and maintain the facility. Given that the commercial and demand risks of the service are transferred to the private sector, the private partner's interest is to achieve operational efficiency. The private partner benefits only if it can reduce operating costs by achieving the expected service levels.

The operation "TURNKEY" or Build - Operate – Transfer (BOT) is an integrated type of partnership in which the private partner assumes responsibility for the design, construction and operation of the facility. This integrated scheme requires that the private operator considers the cost of operating the facility during the design phase and operation and thus promotes better planning and management of the service itself. Here again, the public partner bears the financial risk: despite what can be seen in other types of PPP, the public partner yields its control of important phases of the lifecycle of the facility. Since ownership of the facility as a whole remains public, the specifications of the quality of the final products is vital to achieving the desired results.

Design-Build Finance-Operate (DBFO) - are PPP arrangements where the private partner designs a service or a facility as required by the public participant, provides and finances construction/development of the facility/service after the design phase, and finally operates the facility. At the end of the PPP agreement, the service or facility can be left back to the public sector under the original PPP agreement, otherwise the agreement is renegotiated.

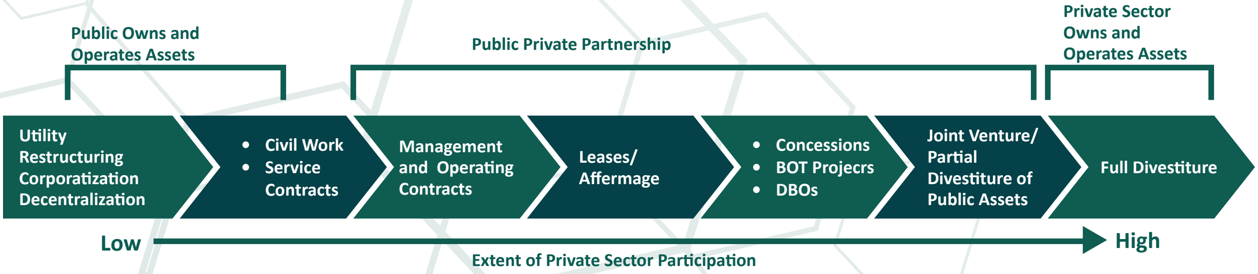

Fig. 1: Extent of Private sector Participation
Source: https://ppp.worldbank.org/public-private-partnership/agreements

5 https://www.tandfonline.com/doi/full/10.1080/23311975.2024.2401627#d1e246

There is a need for greater communication between private and public sectors about the value of different types of research. Greater consideration could be given to the variety of ways in which the private sector could be encouraged to fund and engage with public sector and joint funding initiatives. The type of engagement and activity will also vary across sectors. However, there will be aspects of research that may have relevance and use and although actual private sector spend may remain limited, greater involvement will lay the basis for sustained and growing collaboration[6].

2.2 Key Success Factors for PPPs

Public-private partnerships need carefully developed strategies and well-thought-out contractual basis in line with respective stakeholder communication. Frequently, PPPs are established by a small number of partners but extended at later development stages requiring a seamless and transparent partner selection procedure. Equally important is a sustainable financial agreement which allows mid-term and long-term work by the public-private partnerships. Moreover, in the course of globalization, the regulatory requirements for public private partnerships in countries and regions are becoming increasingly important. Therefore, in addition to statutory regulations, human resources, scientific excellence, and infrastructure are important determinants for locations which aim at providing attractive framework conditions for public-private partnerships. Finally, it must be noted that two different research cultures meet in public-private partnerships: Synergies have to be found between basic academic research and applied industrial research, and they have to be used for mutual added value. Before establishing public private partnerships formally, particular attention must be paid to so-called competing values. These must be regulated in a contract, and transparent control and sanction.[7]

2.3 Significance of PPPs

By helping firms overcome various barriers to innovation, PPPs can contribute to the development of industrial processes, products, and services that might not otherwise be possible without the involvement of the government in one way or the other. In this way, PPPs also help in addressing government missions of raising the GDP of their countries and generating further employment for the population, including the poorest through an innovative private sector. Through PPPs, governments can also influence the direction of investments and innovation towards more socially relevant sectors of the economy, and achieve a much needed innovation policy goal of linking research carried out in public organizations to the activities of the productive sector[8]. However, many programs and policies have missed the point by putting more emphasis on the supply side of knowledge for innovation, i.e. on science and research (public R&D). The demand side of this knowledge, mainly driven by the private sector and which is more crucial for innovation, is often neglected.[9]

For governments, PPPs in Science, Technology and Innovation (STI) can help make research and innovation policy more responsive to the changing nature of innovation and to social and global challenges. For business, partnering with public research can help solve problems, develop new markets or generate value through co-operation and co-production. For governments, PPPs are an attractive tool to address both market and coordination failures in research and innovation activities and leveraging private investment in STI activities. PPPs are also key instruments in addressing societal challenges of the coming decades – such as climate change, green growth or energy efficiency[10]. In this case the public-private partnership agenda is driven by public organizations that seek complementary (private) funding, and by private entities that seek to profit from knowledge and technology provided by public R&D services. On the part of the

6 Joanna Chataway et al., 2017, p. 43
7 https://link.springer.com/article/10.1007/s13132-015-0310-3
8 https://www.orfonline.org/research/the-role-of-public-private-partnerships-in-innovation-for-development-lessons-from-africa)
9 ibid
10 https://read.oecd-ilibrary.org/science-and-technology/oecd-science-technology-and-industry-outlook-2014/strategic-public-private-partnerships_sti_outlook-2014-8-en#page1

government in question, this is normally pursued not only for financial support from the private sector, but also as a policy tool for connecting research outcomes to use.[11]

PPPs can help build innovation capabilities, improve connectivity between national innovation systems and provide compatible incentives to all stakeholders. (OECD, 2015). This can be achieved by optimizing expertise among government, academic, and industry researchers. One special peculiarity with PPPs in STI is that many of the public assets are intellectuals such IP, databases, human capital or software with characteristics. The process is also complex as it involves standard settings, management of IPRs and consumer acceptance. Specifically, PPPs can add value to research projects through:

- **i.** Leveraging public support to business R&D by sharing costs and risks.
- **ii.** Fostering commercialization of research results from public research.
- **iii.** Internalizing knowledge spillovers and overcome informational and behavioral barriers typically limiting the interactions between public research and the business sector, and
- **iv.** Securing higher-quality contributions from the private sector to government mission-oriented R&D and increasing opportunities for commercialization of public research.

The efficiency and success of PPPs is dependent on strong governance, project management structures on both sides, and the integral role of a neutral innovation-enabler at the interface between public and private stakeholders.[12] The role of PPPs in STI and commercialization of technological innovations (TIs) can be summarized below:[13]

- **Innovation risks sharing preceding research** – sharing risks in the development and commercialization of TIs.
- **Facilitating commercialization of innovations** – PPP's enable the quality and cost of TI's to be benchmarked against the prevailing international market standards, thereby helping to secure efficiency improvements within the economy.
- **PPPs drive innovation** - They help governments become more inventive by creating a space outside the government structure that allows innovation to flourish. They also help to inject a broader set of skills and talents, as well as a more diligent and responsive work culture into the government machinery and to create a solid foundation for innovative thinking and creativity
- **Use of private sector expertise** - Besides provision of quicker and long-term private financing options (NCPPP, 2003), PPPs ensure the use of the private sector expertise in terms of technology, marketing, management, and customer service for implementation of the public sector objectives
- **PPPs improve economic competitiveness and modernizes national infrastructure** - The concept of PPP's recognizes that there are some activities that the public sector does best and other activities where the private sector has more to offer. Through permitting each sector to focus upon what it does best the Government can provide the quality services that the public expect of them.

2.4 PPPs in Technology Transfer and Commercialization

Commercialization of research results is the foundation of cooperation between science and business/ industry. By joining resources and expertise through a PPP, public and private stakeholders can reduce R&D costs/burden, share risk and help each other capture greater value from scientific discoveries. The efficiency and success of PPPs is dependent on strong governance, project management structures on both sides, and the integral role of a neutral innovation-enabler at the interface between public and private

11 https://www.orfonline.org/research/the-role-of-public-private-partnerships-in-innovation-for-development-lessons-from-africa)

12 (https://sciencepolicy.ca/posts/public-private-partnerships-as-drivers-of-research-translation-and-innovation-outcomes-in-healthcare-commercialization/)

13 chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://www.virtusinterpress.org/IMG/pdf/cocv13i4c4p4.pdf

stakeholders[14]. In general terms, commercialization is the process of creating added value for ideas, research results, technologies and new products, the spread of innovations within economies and industry sectors. It is building a business model for a current or future organization based on new technologies or new products. Commercialization of public research results refers to turning publicly funded research into a product or service that can be sold in the market. This process promotes the use of public research results to create better products and services that ultimately promote competitiveness, create new jobs, and benefit society. Governments often encourage the commercialization of public research results to increase business competitiveness. Policies can, for example, support the transfer of academic inventions by providing regulatory frameworks, institutional conditions, and incentives for the sale, transfer, or licensing of intellectual property to firms or new ventures, such as academic spin-offs. Institutional incentives include initiatives such as technology transfer offices and licensing offices at universities and public research institutes (PRIs).[15] In many African countries, the emphasis towards commercialization of research has resulted in a number of institutional and organizational realignments in the universities and public research institutes. For example:[16]

- **i.** New structures in the form of technology transfer offices (TTOs) or intellectual property management offices (IPMOs) have been created.
- **ii.** New offices and titles have been introduced into the university management structures, for example, the office of Deputy Vice Chancellor (Research and Innovation).
- **iii.** New companies attached to or owned by universities.
- **iv.** Science and technology parks and incubation centres.

A study on PPPs in Zimbabwe established that research institutes engaged in PPPs had relatively fewer commercialization challenges for their output as compared to those who were not engaged. However, it emerged that there are limitations regarding observance of the critical success factors, thereby hindering progress of the prevailing PPPs. The findings of this study imply that there are limited understandings surrounding the value that could be unlocked in commercializing research institutes' innovations through PPPs. To the few existing PPPs, there is lack of integrative frameworks for the management of, and success of the PPPs. The theory of PPPs and their increasing applicability in especially the provision of public facilities and services has commanded some research interest worldwide. However, not much attempts have been made to unlock the value in the PPP's capability in enhancing commercialization of technological innovations.[17]

According to Witters et al., (2012), the PPP legal construction can cover three types of arrangements, and these go a long way in facilitating commercialization of technological innovations (TIs.) "...first, it can be used to introduce private-sector ownership into state-owned businesses through a public listing or the introduction of an equity partner. Second, it can become a private finance initiative, where the government takes advantage of private-sector management skills by awarding long-term franchises to a private-sector partner, which assumes the responsibility for constructing and maintaining the infrastructure and for providing the public service. Third, it can cover the selling of government services to private-sector partners, which can better exploit the commercial potential of public assets. In these three arrangements, the private-sector consortium typically forms a special company, called a 'special purpose vehicle' (SPV) – to develop, build, maintain, and operate the assets for the contracted period. In cases where the government has invested in the project, it is usually – but not always – allotted an equity share in the SPV).

14 https://sciencepolicy.ca/posts/public-private-partnerships-as-drivers-of-research-translation-and-innovation-outcomes-in-healthcare-commercialization/

15 https://stip.oecd.org/stip/interactive-dashboards/themes/TH43 https://stip.oecd.org/stip/interactive-dashboards/themes/TH43

16 https://nru.uncst.go.ug/server/api/core/bitstreams/c2787047-07f8-4391-a3ae-59673714adeb/content

17 Enhancing commercialization of technological innovations through Public-Private-Partnerships (PPPs) in Zimbabwe's research institutes https://www.researchgate.net/publication/287280169_Enhancing_commercialization_of_technological_innovations_through_Public-Private-Partnerships_PPPs_in_Zimbabwe's_research_institutes/link/595254e4a6fdcc218d27ffae/download?_tp=eyJjb250ZXh0Ijp7ImZpcnN0UGFnZSI6InB1YmxpY2F0aW9uIiwicGFnZSI6InB1YmxpY2F0aW9uIn19)

2.4.1 Commercialization of Research Outputs

Research outputs can be commercialized either directly or indirectly. The methods are outlined below:

Direct Commercialization

According to the National Center for Research and Development, direct commercialization is a process in which the right to R&D results grants a license directly to the entity implementing these results, e.g., for production according to a patent and using know-how, or sells rights. In direct commercialization, the creator of a new solution makes it available to other people or companies (i.e., he gives ownership rights to the innovation that is protected by a patent). Then, these companies or people introduce the new idea into practice on their own (the market is exploited and benefits from the competitive advantage offered by this innovation are taken). The consequence of direct commercialization is that the results of scientific research gain contact with the market - they are offered to third parties (buyers, licensees) for use or purchase. Through this form of commercialization, the entity that exclusively uses the results of scientific research is not only the scientific unit that produced them. Direct commercialization has many benefits, but also carries certain risks. The formula of this form of commercialization enables the "cross" benefit from different specializations that are held by both parties. And so, the creator of innovation (innovator) gains access to future income, which is generated by the entity undertaking the market exploitation of innovation (licensee), and the licensee has access to innovation, which he would not be able to produce himself or such production would require disproportionately large expenditures[18].

Indirect commercialization

Indirect commercialization is a more complex and advanced process than direct commercialization. In this commercialization, the creator of the innovation (originator) is involved in the process of implementing this innovation on the market by creating a business entity (the originator launches it alone or with partners), through which the given solution will be implemented in business practice. The goal is to start market production, which is based on an innovation that is the intellectual property of its creator. In this way, the "intermediary" (licensee) is avoided, which stands in the case of direct commercialization between the creator of the innovation and the market. The creator of the innovation takes responsibility for the course of all stages of the commercialization process, which results in successfully introducing the innovation to the market, developing it and maintaining it on this market for a certain period of time. The creator of innovation should have new skills and qualifications and be aware that risk is a feature of commercialization. Indirect commercialization takes place through established companies. Shares in companies are subscribed for or purchased, or subscription warrants are subscribed for, which entitle to subscribe for shares in companies. The goal is to implement or prepare for implementation the results of scientific research, development works or know-how related to these results.[19]

2.4.2 Technology Transfer

Technology transfer (TT) can be broadly defined as the process of converting scientific findings from research organizations into useful products by the commercial sector. TT is also known as "knowledge transfer or knowledge sharing." This is the process whereby an enterprise converts scientific findings from research laboratories and universities into products and services in the marketplace. TT can take three main channels: creation of new companies (spin-outs), which often involves some transfer of personnel (mobility of researchers); collaboration between universities, research organizations and industry notably via research contracts; and/or Licensing of IP[20]**.**

Basically, it is a way to describe the overall cycle of bringing knowledge and technologies to society through actions such as commercialization and publication. However, to get from the lab to the marketplace, there is a lot of effort and collaboration that needs to take place. Government agencies and businesses in the private sector need to form partnerships to help expedite the process. This requires technical areas, as well

18 https://www.researchgate.net/publication/373593540_Commercialization_of_Research_Results_-_Overview_of_Assumptions_and_General_Definitions

19 ibid

20 https://www.eif.org/news_centre/publications/eif_wp_2009_002_financing-tt_fv.pdf

as the capabilities of bringing these innovations to market. It's at this stage that public funded technology can begin the process of moving into the private sector. Industry can then ramp up operations and turn the technologies into products that can be used, or improve operations, for organizations and/or individuals. These collaborative efforts between government and industry allow the country to stay on the cutting edge of innovation and to foster industrial competitiveness, which in turn helps the economy grow.[21].

Technology transfer should be seen in terms of achieving three main objectives: first, introduction of a new technology by investing in new products, improvement of existing techniques and generation of a new knowledge (Hoffman and Girvan, 1990). Technology transfer could also be seen as transfer of scientific and technical information from the fundamental science through application and development in the fields of manufacturing and services. Generally, the transfer of technology may be carried out under three conditions:

- **i.** The method must have a source.
- **ii.** Technologies must be manufactured or fabricated.
- **iii.** The technologies should be applied or used in some socially or economically beneficial ways.

Effective university/research institution-industry relationship is essential for transfer of knowledge and innovation from university to industry. On the one hand, scientists should collaborate with industry, and on the other - industries can be a source of funding for research and innovation at the university, and sometimes - a source of ideas. Results of research carried out by universities should be transferred to industry and integrated with its activities including products and services, thus making available new types of products and services to intervene on the standard and quality of life and society. For this interconnection, an important condition for technology transfer is also the public private partnership. It is used to: identify effective technologies, build capacity and infrastructure for technology transfer, select the potential risks as well as ensure return on investment and allow for various forms of dissemination of knowledge in the broadest sense - licensing, know-how. (Applied technologies and Innovation, 2024.

Technology Transfer Models

Technology is intangible. It flows easily across boundaries of countries, industries, departments or individuals provided that the channels of flow are established. There are three types of channels that allow the flow of technologies: (IJMET, 2018).

- General Channels, the technology transfer is done unintentionally and may proceed without the continued involvement of the source. A channel of this type of transfer includes education, training, publications, conferences, study missions and visits.
- Reverse Engineering, this is a powerful method for technology development adopted by many agencies and is the fastest route for duplication of any existing technology without going through formal TOT process.
- Formal Channels (planned Channels) this technology transfer is done intentionally, according to a planned process and with the consent of technology owner. There are several types of agreements that are used to affect planned transfers. They permit access to and use of technological know-how. The different types of planned channels are given below:

- **i.** **Licensing**, the receiver purchases the rights to utilize someone else's technology. This may entail an outright purchase, or a payment of an initial lump-sum amount plus a percentage of sales.
- **ii.** **Franchise,** this is a form of licensing the sources usually provide some type of continual support to the receiver. This is a channel commonly used in food chains and service organizations such as Mc Donald's, pizza hut, etc.
- **iii.** **Joint Venture,** two or more entities, combine their interests in a business enterprise in which they can share knowledge and resources to develop a technology or a product or use their know-how to complement one another.

21 https://www.nist.gov/news-events/news/2022/01/what-tech-transfer

iv. **Turn key project,** a country buys a complete project from an outside source and the project is designed, implemented and delivered ready to operate special provisions for training or continued operational support may be included in the agreement between the parties i.e. equivalent to buying or selling the machine.

v. **Foreign Direct Investment (FDI),** a corporation usually a multi-national, decides to produce its products or invest some of its resources overseas. This permits the transfer of technology to another country, but the technology remains within the boundaries of the firm (i.e still controlled by the firm). This type of investment has advantages for both the investors and the host country. The investor gains access to a labour force, natural resources, technology or markets. The host country receives technological knowhow, employment opportunities for its people, training for the work force and investment capital that adds to the development of its infrastructure.

vi. **Technical consortium on joint R&D project**, here two or more entities are collaborated in a large venture because the resources of one is inadequate to affect the direction of technological change. Typically, this type of venture takes place between two or more countries or two large conglomerates. All these cooperative projects aim to advance research, develop technology and transfer of knowledge to participating member states.

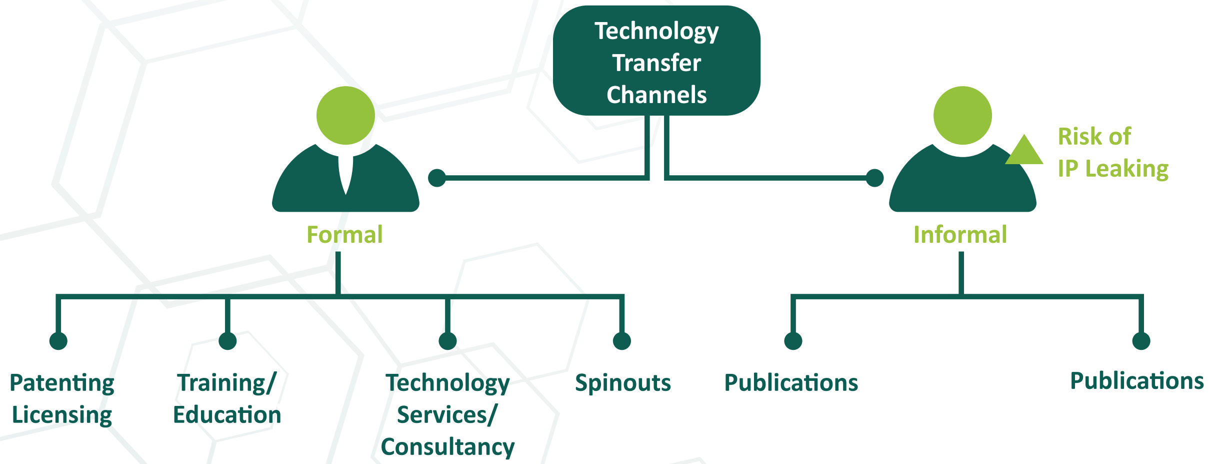

Fig. 2: Technology Transfer Channels

2.5 Emerging Trends and the Future of Technology Transfer

As economies move toward knowledge-based and green growth models, technology transfer is no longer viewed solely as the linear movement of inventions from research labs to industry. Instead, it is becoming more dynamic, participatory, and open, involving multiple actors, pathways, and tools. For Africa and other emerging economies, understanding these trends is crucial for shaping future technology and innovation strategies.

Globalization

Globalization has amplified the spread of technology across borders in two ways. First, globalization allows countries to gain easier access to foreign knowledge. Second, it enhances international competition - including as a result of the rise of emerging market firms - and this strengthens firms' incentives to innovate and adopt foreign technologies. The positive impact has been especially large for emerging market economies, which have made increasing use of the available foreign knowledge and technology to boost their innovation capacity and labor productivity growth. But interconnectedness per se is not enough. The assimilation of foreign knowledge and the capacity to build on it most often requires scientific and engineering know-how. Investments in education, human capital, and domestic research and development are thus essential to build the capacity to absorb and efficiently use foreign knowledge.[22]

22 https://www.imf.org/en/Blogs/Articles/2018/04/09/globalization-helps-spread-knowledge-and-technology-across-borders#:~:text=Our%20research%20in%20Chapter%204,has%20intensified%20because%20of%20globalization.

Digitization

The United Nations 2030 Agenda for sustainable development, explicitly recognizes the potential of information and communications technology for global interconnectedness and to accelerate human progress:

> *"The spread of information and communications technology and global interconnectedness has great potential to accelerate human progress, to bridge the digital divide and to develop knowledge societies, as does scientific and technological innovation across areas as diverse as medicine and energy."*[23]

Digitization has had great impact in technology transfer through the following ways:

- **Speed**: Instead of physical equipment or manuals being sent, the farmer downloads an app, plugs in IoT sensors, and gets real-time data.
- **Scalability**: A single software update can improve the system for thousands of farmers at once.
- **Localization**: Through AI and remote sensing, these tools are adjusted for regional climate and soil conditions.
- **Capacity Building**: Many platforms include training modules or virtual assistance in local languages, helping farmers understand and apply the tech.

Open Innovation and Co-Creation

One of the most significant global trends in technology transfer is the move from closed to open innovation models. In this paradigm, firms, universities, and research institutions no longer rely solely on internal resources to develop innovations but actively collaborate with external partners - startups, users, government, and other institutions - to co-create and commercialize technologies. This trend is particularly relevant for Africa, where collaborative innovation can help overcome resource constraints and accelerate local adaptation of technologies.

Localization of Technologies

Localization of technology transfer refers to the process of adapting and integrating transferred technology to suit the local context – such as the culture, language, economy, infrastructure, regulations, and environmental conditions – of the recipient region. In Africa, this often means modifying imported technologies so they are more *affordable, durable, maintainable*, and *relevant* to local needs and capabilities. There is growing recognition that effective technology transfer must go beyond importing technologies. Future-focused strategies emphasize capacity building, local manufacturing, and contextual adaptation.

South–South Cooperation and Decentralized Innovation Flows

South–South Cooperation (SSC) is defined as the collaboration and sharing of knowledge and skills between countries of the Global South: a partnership of equals based on shared experiences and understanding. Reciprocal knowledge-sharing among peers who face similar challenges speeds up learning and capacity-building, and helps in scaling up the outcomes of successful projects. SSC for knowledge exchange (KE) stems from a belief that development solutions work best when they are designed with peers and partners who have faced, or are facing, similar challenges. It provides decision makers with practical insights about approaches that work and pitfalls to avoid. This trend is expected to expand, particularly as Africa strengthens trade and innovation ties through the African Continental Free Trade Area (AfCFTA).

Technology Transfer and Sustainable Development

Chapter 34 of Agenda 21, adopted at the 1992 Rio Earth Summit, focuses on "Promoting Sustainable Development through the Use of Technology". It highlights the crucial role of technology transfer in achieving sustainable development, particularly for developing countries. The chapter emphasizes the

23 https://blog.isa.org/technology-localization-and-its-role-in-economic-development#:~:text=This%20is%20when%20new%20technologies,the%20demands%20of%20the%20market.

need for equitable and effective technology transfer to developing countries, acknowledging its potential for promoting sustainable development. The chapter encourages the development and use of technologies that promote sustainable production and consumption patterns, reducing environmental impacts. The chapter has formalized a definition of 'environmentally sound technologies' as technologies which protect the environment, are less polluting, use all resources in a more sustainable manner, recycle more of their wastes and products, and handle residual wastes in a more acceptable manner than the technologies for which they are substitutes.24

2.6 Global and Continental Policies on PPPs

2.6.1 PPPs and Sustainable Development Goals (SDGs)

Public-Private Partnerships (PPPs) are directly or indirectly linked to several Sustainable Development Goals (SDGs), particularly those that require collaboration between governments, businesses, and civil society. PPPs are directly linked to Goal 17 of SDGs which is about revitalizing the global partnership for sustainable development. It calls for action by all countries – developed and developing – to ensure no one is left behind. It requires partnerships between governments, the private sector, and civil society. Specifically, **Target 17.17** Encourages promotion of effective, public-private, and civil society partnerships, building on the experience and resourcing strategies of partnerships. This is the most explicit SDG target that directly calls for PPPs as a means of achieving sustainable development. Also, **Target 9.5** calls for enhanced scientific research, upgrade technological capabilities, and encourage innovation.

Africa's Agenda 2063

Public-private partnerships are central to infrastructure, economic growth, skills development, industrialization, and regional integration within Agenda 2063. The framework acknowledges that mobilizing private sector resources and expertise is crucial to achieving Africa's development ambitions. The framework outlines the African Union's long-term strategic framework for transformation and development. PPPs are crucial in achieving many of its aspirations, goals, and flagship projects. Specifically, PPPs are related to the following agenda 2063 goals:

- **Goal 2: Well educated citizens and a skills revolution** - Public-private collaboration in higher education, vocational training, and technology transfer.
- **Goal 9: Key infrastructure projects** - Large-scale public-private investments in transport, energy, ICT, and regional trade infrastructure.

The Science, Technology, and Innovation Strategy for Africa 2024

The Science, Technology, and Innovation Strategy for Africa 2024 (STISA-2024) is a 10-year strategy designed to place science, technology, and innovation (STI) at the center of Africa's socio-economic transformation. It is aligned with Agenda 2063 and aims to drive Africa's transition to a knowledge-based and innovation-driven economy. The strategy outlines six priority areas, four pillars, and a governance framework for its implementation. It also emphasizes the role of Public-Private Partnerships (PPPs) in driving investments, innovation, and the commercialization of research. Several sections of the strategy emphasize collaboration between the public and private sectors to accelerate STI development. The strategy calls for governments, private sector players, academia, and civil society to collaborate in implementing STI programs that will drive Africa's socio-economic transformation in the following ways:[25]

- The need for investment in research facilities, innovation spaces, broadband infrastructure, and energy systems.
- PPPs are seen as essential to mobilizing resources for upgrading STI infrastructure.
- collaboration between governments and private entities is encouraged to establish shared research

24 https://www.gdrc.org/techtran/techtran-sustdev.html
25 https://au.int/sites/default/files/newsevents/workingdocuments/33178-wd-stisa-english_-_final.pdf

facilities, technology hubs, and innovation incubators.

- Technology transfer, commercialization of research, and co-development of new products require active engagement from both sectors.
- Private companies are encouraged to fund and support start-ups that leverage STI for economic growth.
- National governments are urged to set aside at least 1% of GDP for R&D, with complementary funding from the private sector and international donors.
- The private sector is expected to work closely with universities and research institutions to drive applied research that meets market needs.
- The private sector is expected to contribute funding, expertise, and technology for STI-related projects.

Alongside recognition of the need for STI in order to achieve sustainable growth and development, global leaders are increasingly articulating the need to form PPPs in order to achieve STI goals. African governments, have reiterated the role of PPPs and the desire to strengthen collaborations with public and private sector partners through various policy initiatives and forums, including the New Partnership for Africa's Development agenda (NEPAD, 2013) and the Second Ministerial Forum on Science, Technology, and Innovation in Rabat on 17 October 2014[26].

2.7 Legal and Institutional PPP Frameworks in Africa

A country's "PPP Framework" consists of the policies, procedures, institutions, and rules that collectively define how PPPs will be identified, procured, monitored, and accounted for and who will be responsible for these tasks. As of 2024, statistics indicate that 42 of the 54 African countries have a law on PPPs.[27]

List of countries that have enacted a ppp law and year of adoption

26 https://sgciafrica.org/wp-content/uploads/2022/03/Discussion-Paper-Towards-Effective-Public-Private-Partnerships-in-Research-and-Innovation-A-Perspective-for-African-Research-Granting-Councils.pdf

27 Public-private partnerships, Legal & Institutional Frameworks in Africa: A comparative analysis: https://ppp.worldbank.org/sites/default/files/2024-03/2024-02-20%20-%20Survey%20PPP%20Legal%20%26%20Institutional%20Frameworks%20in%20Africa%20%28EN%29.pdf

Country Name	Year of Adoption
Mauritius	2004
Nigeria	2005
Cameroon	2006
Zambia	2009
Egypt	2010
Liberia	2010
Tanzania	2010
Malawi	2011
Mozambique	2011
Niger	2011
Côte d'Ivoire	2012
Burkina Faso	2013
Morocco	2014
Sierra Leone	2014
Burundi	2015
Cabo Verde	2015
Madagascar	2015
Somalia	2015
Tunisia	2015
Uganda	2015
Zimbabwe	2015

Country Name	Year of Adoption
Benin	2016
Gabon	2016
Mali	2016
Rwanda	2016
Chad	2017
Djibouti	2017
Guinea	2017
Mauritania	2017
Namibia	2017
DRC	2018
Ethiopia	2018
Sao Tome & Principe	2018
Angola	2019
Central African Republic	2019
Ghana	2020
Guinea Bissau	2021
Kenya	2021
Senegal	2021
Sudan	2021
Togo	2021
Congo	2022

Table 1

Source: Public-private partnerships, Legal & Institutional Frameworks in Africa: A comparative analysis: chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://ppp.worldbank.org/sites/default/files/2024-03/2024-02-20%20-%20Survey%20PPP%20Legal%20%26%20Institutional%20Frameworks%20in%20Africa%20%28EN%29.pdf

In the 42 countries that have enacted laws for Public Private Partnerships, some regional variations emerge. Western and central Africa have the largest proportion of economies that have enacted specific PPP laws. Except for The Gambia and Equatorial Guinea, all Western and Central Africa countries have enacted such laws. On the other hand, countries in Eastern and Southern Africa have enacted the least specific PPP laws. Of the 12 countries that comprise the southern Africa region, 4 remain without a PPP law, namely Botswana, Lesotho, South Africa, and Eswatini. Other African counqtries that have not enacted specific PPP laws include Comoros, Eritrea, Seychelles, South Sudan in East Africa, and Algeria and Libya in North Africa[28]. On the other hand, countries in Eastern and Southern Africa have enacted the least specific PPP laws. Other African countries that have not enacted specific PPP laws include Comoros, Eritrea, Seychelles, South Sudan in East Africa, and Algeria and Libya in North Africa. Out of the countries that have not enacted a PPP law as at 2024, the Gambia was considering a draft PPP legislation. In South Africa, a review exercise of the PPP legal framework was undertaken but the recommendations are yet to be implemented. Seychelles, worked on a draft PPP law in 2017, but this has yet to be adopted.

The first country to enact a specific PPP law in Africa was Mauritius in 2004 while the latest is the Republic of Congo in 2022. This is the case in countries like Botswana, Comoros, Lesotho, Seychelles, South Sudan and Eswatini. This is the case in countries like Burkina Faso, Burundi, Mali, Mauritania, Mauritius, and Morocco. In South Africa, instead, PPPs are governed by the Public Finance Management Act. Overall, 24 out of 54 African countries (43%) govern PPPs through their public procurement regimes. They do so by directly governing PPP contracts or by regulating more specific aspects of the PPP process, such as penalties or enforcement regimes, through their public procurement laws and regulations.

28 Ibid

Since PPPs are increasingly important for procuring and financing infrastructure projects in Africa, countries without specific PPP legislation tend to govern PPP contracts through their public procurement regime. This is the case in countries like Botswana, Comoros, Lesotho, Seychelles, South Sudan and Eswatini. This is the case in countries like Burkina Faso, Burundi, Mali, Mauritania, Mauritius, and Morocco. In South Africa, instead, PPPs are governed by the Public Finance Management Act. Overall, 43% of African countries govern PPPs through their public procurement regimes. They do so by directly governing PPP contracts or by regulating more specific aspects of the PPP process, such as penalties or enforcement regimes, through their public procurement laws and regulations. The PPP units in Africa with project approval functions are commonly located within Ministries of Finance, whereas PPP Units that provide technical assistance may be housed centrally. Instead, PPP Units with a promotion focus are typically part of investment promotion entities. In Senegal, the Directorate of Finance and Public Private Partnerships (DFPPP) serves as the primary operational unit within the Ministry of Finance for managing PPPs. The DFPPP participated in the development of state policies, guidelines, instructions, and dissemination of best practices for the financing, design, implementation, and management of PPP projects. Other key governmental stakeholders involved in PPPs include contracting authorities, being the entities empowered by the legal framework to enter into PPP arrangements with private partners.

2.8 Technology Readiness Levels (TRLs)

Having reviewed the legal and institutional frameworks for PPPs in Africa, it is also important to consider the technological readiness of innovations that often underpin such partnerships. This is captured through the concept of Technology Readiness Levels (TRLs. Originally developed by NASA in the 1970s for space exploration technologies, TRLs assess the maturity level of a technology throughout its research, development and deployment phase progression. TRLs are based on a scale from 1 to 9, with 9 being the most mature technology. Many organisations have implemented TRLs for their own purposes, with certain organisations, such as the European Union (EU), further normalising the NASA readiness-level definitions, allowing for easier translation to multiple industry sectors – not just space exploration. This is described in the next page: [29]

Table 2: Technology Readiness Levels

TRL	Description	Examples
1	Basic principles observed	Scientific observations made and reported. Examples could include paper-based studies of a technology's basic properties.
2	Technology concept formulated	Envisioned applications are speculative at this stage. Examples are often limited to analytical studies.
3	Experimental proof of concept	Effective research and development initiated. Examples include studies and laboratory measurements to validate analytical predictions.
4	Technology validated in lab	Technology validated through designed investigation. Examples might include analysis of the technology parameter operating range. The results provide evidence that envisioned application performance requirements might be attainable.
5	Technology validated in relevant environment	Reliability of technology significantly increases. Examples could involve validation of a semi-integrated system/model of technological and supporting elements in a simulated environment.
6	Technology demonstrated in relevant environment	Prototype system verified. Examples might include a prototype system/model being produced and demonstrated in a simulated environment.
7	System model or prototype demonstration in operational environment	A major step increase in technological maturity. Examples could include a prototype model/system being verified in an operational environment.

29 https://www.twi-global.com/technical-knowledge/faqs/technology-readiness-levels

TRL	Description	Examples
8	System complete and qualified	System/model produced and qualified. An example might include the knowledge generated from TRL 7 being used to manufacture an actual system/model, which is subsequently qualified in an operational environment. In most cases, this TRL represents the end of development.
9	Actual system proven in operational environment	System/model proven and ready for full commercial deployment. An example includes the actual system/model being successfully deployed for multiple missions by end users.

Source: https://www.twi-global.com/technical-knowledge/faqs/technology-readiness-levels

Essentially, based on the above model, there are three main stages are outlined below:

- **Research/Ideation** – **TRL 1-3:** the process of generating, developing, and refining ideas for new products or features. Generating ideas through research
- **Development and Testing**- **TRL 3-6**: Conduct thorough testing to ensure the product meets quality standards and user requirements, including functional testing, usability testing, and performance testing.
- **Deployment/Uptake** – **TRL 6-9**: putting the product in the market - including pricing, distribution channels, marketing, and sales. This involves finalizing production processes, setting up distribution channels, developing marketing and sales strategies, and launching the product to the market.

2.9 Challenges Facing PPPs in Africa

Currently, over two-thirds of African countries have STI policies and strategies; the last decade has seen an increase in research fund commitments from national governments, the emergence of new organizations funding STI, and increased rates of scientific production, innovation activities, and cross-regional research collaboration.[30] Many African countries, however, lack the requisite capacity to optimize the potential of STI to enhance the structural transformation of their economies**.** The majority have "underdeveloped STI institutions and fail to effectively generate and deploy knowledge and technological innovations for socioeconomic growth"[31]. In one study focusing on research institutes engaged in PPPs, it emerged that there are limitations regarding observance of the critical success factors, thereby hindering progress of the prevailing PPPs**.** The findings of this study imply that there are limited understandings surrounding the value that could be unlocked in commercializing research institutes' innovations through PPPs. To the few existing PPPs, there is lack of integrative frameworks for the management of, and success of the PPPs. Anchored on promoting ideal collaborations in which all key values are honored, the study proposes a framework that emphasizes a collaboration in which the public research institute concentrates on research and development, while the private firm partner uses her market analytics to focus on getting the product to the market[32]. Despite the importance of PPPs in actualising research findings in Africa, they face multiple challenges as outlined below. (Bengesi et al, 2016).

1. Lack of comprehensive policy, legal and institutional frameworks that provide clear guidelines and procedures for development and implementation of PPPs.
2. Lack of analysis capacity to assess investment proposals leading to poor project designs and implementation.
3. Inadequate enabling environment, which includes lack of long-term financing instruments and appropriate risk-sharing mechanisms.
4. Insufficient capacity in negotiations, procurement, implementation and management of PPPs.
5. Inadequate risk-sharing mechanisms that often lead to the public sector carrying the full burden of potential risks.
6. Inadequate mechanisms for recovery of private investors' capital as well as impact on national development programmes that depend on the projects' performance.
7. Lack of public awareness about PPPs and their benefits.

30 African Technology Policy Studies Network (ATPS) & The Scinnovent Centre, 2017.
31 The African Capacity Building Foundation, 2017
32 chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://www.virtusinterpress.org/IMG/pdf/cocv13i4c4p4.pdf

2.10 Overview of PPP Models in the Developed world

2.10.1 PPP Models in Europe

During 2007-2013, the European Commission focused on the development of a society based on knowledge and creates a so-called triangle of knowledge - education, research and innovation. In the new programming period 2014-2020, the trend of increasing the importance of PPPs as a key factor for competitive development of the base element - technology transfer. The public-private partnership is a key element of European innovation policies with close coordination of public research, technology transfer, private innovative companies and appropriate policy frameworks. There is a building of industrial networks, technology platforms and initiatives which consist of long-term relationships between knowledge generators, consumers and suppliers of goods and services with a variety of options and other mediator units. This model of partnership usually stipulates the development of research joint-ventures with equal distribution of costs and return of investments, information and knowledge sharing. Such a model can lead to development of technologies or practices from the private sector in public scientific structures and, as a result, a reliable institutional capacity is built or increased.

The private sector provides added value by implementing technology transfer based on cooperation measures which ensure the effectiveness of the technological base. The overall innovation process (application of technological solutions) is in the middle of an interaction between the private and public sectors for implementing effective technology transfer. Unlike the traditional model for delivery of public services, the development of schemes for the implementation of PPPs offers several new moments for accomplishment: - PPP - outcome oriented - the public sector aims to improve the quality of public services and guidance to its final result. The means and ways to achieve this task are delegated to the private sector partner who can also offer innovative solutions. The main responsibility of the public sector is to develop the necessary standards and quality of services of the product or service provided by the private sector (Applied Technologies and Innovations, 2014).

Technology Transfer Offices (TTOs)

The widespread establishment of Technology Transfer Offices (TTOs) in Europe was influenced by the desire to replicate the success of U.S. universities in promoting technology transfer. The core activity of Technology Transfer Offices (TTOs) has been to promote technology transfer by commercializing the research results of universities. TTOs are generally expected to perform as commercialization intermediaries. Firstly, TTOs are actively involved in protecting knowledge produced by university researchers through intellectual property rights (IPR). They assist in assessing the potential 'patentability' of new knowledge generated by university researchers, and they initiate, manage, and fund procedures for patent filing and licensing. The specific tasks of TTOs may vary depending on the stages of the patenting process they engage in, due to differences in national legislation regarding the ownership of academic research outcomes by universities and/or professors. Secondly, TTOs serve as advisors to academic entrepreneurs, aiding them in gaining initial human and financial resources or actively advocating for university spin-offs. Thirdly, TTOs are also involved in science and technology entrepreneurial education (STEE), functioning as entrepreneurship trainers for faculty and students.[33]

The European TTO CIRCLE combines the technology transfer offices of 25 large public research organisations with the aim of increasing the market and societal impact of publicly-funded research. Priority areas identified include the development of financial facilities for technology transfer and the reduction of Intellectual Property (IP) barriers to collaborative research. The TTO CIRCLE is expected to promote a culture of innovation and entrepreneurship among the partners involved, allowing for the reinforcement of their scientists' skills and competences through specific training and good practice exchanges. The initiative is being led by the Joint Research Centre (JRC), the European Commission's in-house science service[34].

33 https://www.sciencedirect.com/science/article/pii/S0040162523008429
34 https://etn.global/news-and-events/european-technology-transfer-network-launched/

Thematic Technology Transfer (TTT) in Netherlands

In Netherlands, The Thematic Technology Transfer (TTT) programme enables researchers to take their research ideas to the next level, validate them and found a successful spin-off. Combining the strengths of the four technical universities in the Netherlands with that of TNO, TTT stimulates, supports, and expedites the development of promising spin-offs. By identifying potential at an early stage and assisting researchers with the valorisation of their research. Bringing together the expertise of the partners in TTT will increase effectiveness. The complementary knowledge of various domains is easily accessible and stimulates cross-over collaboration. The joint focus on key themes and the financial support TTT offers in both early and follow-on stage, provide a powerful impulse to prospective entrepreneurs who want to assess and capitalize on the market opportunities available to them. At the moment, Circular Technology and Smart Industry are the central themes. TTT MedTech, which focuses on medical technology innovations, will also start soon. Wageningen University and Research is leading the Circular Technology theme. The collaborating knowledge institutes in the TTT programme are: Delft University of Technology, Eindhoven University of Technology, the University of Twente, Wageningen University and Research and TNO. Funding partners are Innovation Industries and SHIFT Invest.

2.10.2 PPP Models in Asia

In the Association of Southeast Asian Nations (ASEAN), the Committee on Science, Technology, and Innovation (COSTI) has been established to facilitate cooperation and collaboration in Science, Technology, and Innovation (STI). COSTI's initiatives include promoting R&D, supporting innovation and entrepreneurship, and enhancing human capital development in STI. The work of COSTI is guided by the ASEAN Plan of Action on Science, Technology, and Innovation (APASTI), which is a strategic framework that guides ASEAN's efforts to use STI to support sustainable development and regional integration. APASTI aims to support the ASEAN Economic Community (AEC) blueprint by fostering innovation, increasing productivity, and enhancing competitiveness in the region. Its priorities include enhancing human capital in STI, promoting R&D, facilitating technology transfer and commercialization, and strengthening STI governance and infrastructure.[35]

There is an existing plan of action which strengthens strategic collaboration among academia, research institutions, networks of centers of excellence, and the private sector to create an effective ecosystem for capability development, technology transfer and commercialization. The current APASTI is the fifth one covering 2016 till 2025. The Plan of Action is mapped out along four big thrusts. The first thrust targets public-private collaboration and seeks to strengthen strategic collaboration among academia, research institutions, networks of excellence, and the private sector to create an effective ecosystem for capability development, technology transfer and commercialization.[36]

2.10.3 United States of America

The US is the first country in the world to have achieved great success in the transfer of technology from universities and public research institutes. To overcome the severe recession of the 1980s, the US government decided to begin by building up mechanisms that would encourage researchers at universities and public research institutes to compete to undertake new and innovative research. It then established mechanisms to encourage industry to actively utilize the results of that result. The US government did this by enacting the Bayh-Dole Act in 1980 and the Federal Technology Transfer Act in 1986.[37]

There are a great number of technology transfer organizations and offices supporting the commercialization of federal R&D. At the federal-wide level, there are the Federal Laboratory Consortium (FLC) and the National Technology Transfer Center (NTTC). FLC was established to serve as a liaison between individual federal laboratories and nonfederal entities interested in developing technologies with the purpose to

35 Feasibility Study on Technology Transfer Models for Projects Related to SDGs, chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://cdn.misti.gov.kh/documents/202308141691995714.pdf

36 Ibid

37 chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://www.jpo.go.jp/news/kokusai/developing/training/textbook/document/index/Technology_Transfer_by_Public_Research_Organizations.pdf

strengthen technology transfer nationwide. The Consortium was established in 1974 and was assigned a formal role by the Federal Technology Transfer Act of 1986. The NTTC was created to help business and industry gain access to marketable technologies, expertise, and facilities located within NASA and other federal laboratories with the purpose to strengthen the competitiveness of U.S. industry. The Center also promotes collaborations between U.S. companies and federal laboratories to commercialize technologies. (ITPS, 2004).

Bayh-Dole Act

The Bayh-Dole Act, passed in 1980, has been a foundational piece of U.S. legislation that allows universities, small businesses, and non-profit organizations to retain ownership of inventions developed with federal funding. Starting with the Morrill Act of 1862 establishing the land-grant college system, cooperation between universities and industry has a long history in the U.S. with defense related R&D during World War II and the rivalry with the Soviet Union in the Cold War as major drivers. A new era of collaboration started in 1980 with passage of the Bayh-Dole Act that clarified the roles between industry, government and universities. The Act accelerated technology transfer and is considered instrumental in the creation of the biotechnology industry and commercial advances in other technological intensive industries. Other forces supporting collaboration are the growth of science-based industries and the need for American companies to seek ways to improve their competitiveness through alliances with universities. The closer research ties between academia and industry have created many forms of collaborative R&D. There are more than a thousand university-industry R&D centers in the U.S. For example, at the Stanford University Center for Integrated Systems (CIS), company researchers from several firms participate in formulating and carrying out joint research activities with academic researchers. Company researchers participate directly in the research activities on a rotating basis. Some of these R&D centers, called Industry-University Cooperative Research Centers, receive support from the National Science Foundation. The government also provides direct funding to universities through other types of alliances with industry with the purpose of enhancing national competitiveness. The Advanced Technology Program (ATP), the dual use program of the Department of Defense, various small business programs managed by the Small Business Administration (SBA) and NASAs Centers for the Commercial Development of Space are examples of federally sponsored programs that mandate university-industry collaboration. The presence of government funding of centers and programs is usually seen as increasing the status of research. activities and may provide the needed signals to attract additional private investments (NRC 2003). Other types of university-industry relationships include industry-sponsored research, technology licensing, regional clusters and startup companies[38].

The connection between innovative research and regional economic development has led to the establishment of science and technology parks, innovation networks and clusters, often around a national laboratory or research facility. Examples are the high-tech companies that emerged around the government laboratories and major universities in the Boston area and Silicon Valley where multiple private industries interacted with a major university combined with substantial federal funding. According to the OECD, the most successful industry-science partnerships involve links between publicly financed research organizations and a cluster of local industries. This means that resources are focused around existing regional centers of excellence working within specific academic-industrial sectors[39].

Famous examples of the successful sharing of university research results with society through licensing include Google (with cumulative royalties estimated at over USD300m) and gene recombination technologies (with cumulative royalties estimated at over USD200m), both of which were developed by students at Stanford University. These two examples of university-based research have resulted in considerable economic effects and employment opportunities and have had a huge impact on the US economy and society. Although universities and public research institutes are more focused on sharing the results of their research with society than on earning royalties, the magnitude of such royalty earnings serves as an indication of the economic effects that research can produce. Those earnings can cover expenses incurred by universities and public research institutes with regard to the employment of experts and other staff engaged in making applications for and maintaining and administering patents and other

38 Ibid
39 OECD (2002) Benchmarking Industry-Science Relationships.

intellectual property rights, technology transfer operations, and contract administration. In this way, continuing to promote technology transfer activities can create a positive synergy of development in which increasing results are subsequently produced.[40] One of the most successful planned science parks, the Research Triangle Park (RTP) in North Carolina is defined by three universities: the North Carolina State University in Raleigh (NCSU), the University of North Carolina at Chapel Hill (UNC-Chapel Hill) and Duke University in Durham. Together they form the foundation of the regions knowledge-based economy by providing research facilities and a critical mass of scientists, researchers and technicians. The entire park encompasses about 150 organizations employing more than 45,000 people in two significant and successful clusters: telecommunications and biotech/pharmaceuticals.

Association of University Technology Managers

The Association of University Technology Managers (AUTM) was founded in 1974 as the Society of University Patent Administrators with the objective of addressing a concern that inventions funded by the U.S. government were not being commercialized effectively. It is a nonprofit organization involved in technology transfer in the academic and research sectors. It offers professional development, networking, and resources for licensing technologies and commercializing research. It serves professionals in the technology transfer field, including those in academic research and corporate partnerships. Through the years AUTM has grown beyond this single objective and now provides professional development and networking opportunities for technology transfer professionals at all career levels and from established and newly forming organizations worldwide.[41] AUTM has international membership of more than 3,000 technology managers and business executives. AUTM members come from more than 300 universities, research institutions and teaching hospitals as well as numerous businesses and government organizations.[42]

2.10.4 PPP Models in Japan

In Japan, for a significant period, government policies discouraged universities to seek collaboration with the industry sector. To overcome previous regulatory barriers that had impeded industrial collaboration, the government introduced various boundary-spanning organizations within universities since the late 1980s. Notable initiatives include the establishment of University-Industry Cooperative Research Centers (UICRCs) in 1987, the creation of Approved Technology Licensing Organizations (TLOs) in 1998, the formation of Intellectual Property Headquarters (IPHQs) in 2003. Each of these institutions focused on promoting different aspects of UIC. Additionally, the 1998 enactment of the Act on the Promotion of Technology Transfer from Universities to Private Industry (the "TLO Act") resulted in numerous joint research projects and an increase in patent applications.[43]

Following the 1980s, Japan entered the severe recession of the 1990s, sometimes referred to as the lost decade. To overcome this recession, the Japanese government implemented a rapid series of measures to encourage industry to utilize the research conducted by universities and public research institutes. The government pushed through the Act on the Promotion of Technology Transfer from Universities to Private Business Operators (commonly known as the TLO law) in 1998, the Act on Special Measures for Industrial Revitalization (commonly known as the Japanese Bayh-Dole) in 1999, the Industrial Technology Enhancement Act in 2000, and the Intellectual Property Basic Act in 2002. The TLO law stipulates that the Japanese government will support the establishment of TLOs engaged in the transfer of research results developed by universities or governmental testing or research agencies to private business operators and will provide them with assistance in order to accelerate this type of technology transfer.[44]

Since this law was enacted, a steady stream of university-owned invention patents has been created. Coupled with the TLO law, the Japanese Bayh-Dole is undoubtedly contributing to the promotion of the technology transfer from universities to industry in Japan. In addition, the Industrial Technology

40 https://www.jpo.go.jp/news/kokusai/developing/training/textbook/document/index/Technology_Transfer_by_Public_Research_Organizations.pdf

41 https://www.gaipalliance.org/ip-careers-resources/2021/7/15/association-of-university-technology-managers-autm-wwwautmnet

42 https://whcf.org/project/association-of-university-technology-managers/

43 Ibid

44 Technology Transfer By Public Research Organizations, Japan Patent office 2010

Enhancement Act stipulates a fee reduction or exemption for universities filing patent applications and allows university faculty to concurrently hold positions in newly launched venture companies based on university research. Universities and public research institutes are actively engaged in basic research and other R&D activities in a variety of areas that lead to creative inventions that are difficult for private companies to develop solely through their own R&D activities. In addition, because universities and public research institutes are non-private organizations, they are not affected or controlled by any specific company or corporate group and are therefore expected to perform their functions impartially. Since the Fundamentals of Education Act of Japan was amended in 2006, as their third role, Japanese universities have been required to share their research results with society. The results of basic and innovative research conducted by universities and public research institutes will almost certainly help revitalize industry if such results can be successfully used in cooperation with industry players. The process explained in this paragraph shows one path for technology transfer, that of academia-industry cooperation.[45]

Following the incorporation of Japanese national universities in April 2004, the ownership of university inventions is now similar to that in the USA. However, in contrast to the USA, joint research projects involving close collaboration with company researchers who are frequently named as co-inventors are common. A large proportion of university discoveries are passed directly to established companies under joint research agreements. This perpetuates the pre-2004 situation. It also raises concerns that large companies are pre-empting publicly funded discoveries and decreasing opportunities for new company formation. An analysis of inventions reported to a major national university indicates that one-third are attributed to joint research, and, among those inventions for which patent applications are filed, the proportion is still higher. The corresponding proportions at most other major universities are probably even higher than at this university. Pre-emption by large companies is more common in engineering and materials/chemistry than in the life sciences. Further cross-national comparisons are needed to assess the impact on innovation and basic research of the Japanese and US models of university—industry cooperation, and to guide policy[46].

2.10.5 PPP Models in China

Before 1978, Chinese universities primarily served as educational institutions with limited emphasis on research or collaboration with industry. The reform and opening-up policies of the late twentieth century marked a shift towards integrating research and production, driven by the need to modernize the economy. During the 1980s and 1990s, the Chinese government introduced policies encouraging universities to engage in applied research and develop partnerships with industries. Key milestones included the establishment of university-run enterprises and the creation of technology transfer offices. By the early 2000s, China's UIC efforts were further institutionalized through the establishment of science parks and incubators linked to universities. Apart from such research-oriented UIC, the last decade has witnessed the rapid growth of a new type of UIC in China for the purpose of strengthening talent cultivation in higher education, namely teaching-focused UIC. Research shows that China's UIC traditionally is characterized by strong government intervention and support, with central and local governments playing a critical role in setting the agenda for UIC, providing funding, and facilitating policy frameworks. In recent years, the government has stepped back to some extent and allowing for more social forces to participate in the agenda.[47]

According to Wu, Weiping (2017), to promote university-industry linkages, various national and local policies have been implemented, such as providing financial and legal services for faculty and student startups, strengthening patent laws, encouraging the establishment of university-based science parks, and building high-tech development zones near major universities. During the early years of economic reform, the business sector had been a weaker actor in China, particularly in comparison to public research institutes. Industry-specific research institutes within different ministries were responsible for solving specific applied problems as well as introducing new technology into enterprises. But what is striking is the

45 Ibid
46 https://www.robertkneller.com/pdf/New_Japanese_technology_transfer_system_and_entrepreneurship.pdf
47 https://link.springer.com/article/10.1007/s12564-024-10033-y

fact that none of the major forms of university technology transfer enjoyed much growth in volume since the mid-2000's, during which time China's high-tech sectors enjoyed double-digit growth. In fact, the share of technology contract values has been declining in recent years, becoming less significant as a revenue stream for universities. (Wu, Weiping and Yu Zhou. 2012.

Besides the conventional forms of transfer of technology and innovation discussed above, university-affiliated enterprises received much attention early on. China had some success in creating large university-affiliated computer companies in the 1980s and 1990s. During that time, waves of spin-off were created by major universities and public research institutes, in part to commercialize their R&D results and in part to supplement budget shortfalls caused by shrinking central government spending on research. Some of China's leading hightech companies emerged during this time, such as Lenovo (affiliated with Chinese Academy of Science), Founder (affiliated with Peking University), Ziguang (affiliated with Tsinghua University), Tongfang (affiliated with Tsinghua University), and many others. Those in Beijing formed the backbone of China's first science park – Zhongguancun. The commercial success of these companies in the 1990s generated considerable optimism for major roles universities could play in China's high-tech development. Yet, the momentum seemed to have dissipated in the new millennium. Overall, university enterprises are declining in numbers and contributing less to academic R&D revenues. This may be signaling a gradual shift in university technology transfer from affiliated spinoffs into more flexible institutional arrangements, such as joint R&D, contract research, sharing research labs, licensing, and technology sales. (Wu, Weiping, 2012).

3. THE FINDINGS

3.1 Introduction

This section sheds light on the review and analysis of Public-Private Partnerships (PPPs) focusing mainly on key aspects arising from their implementation and associated results, specifically on technology transfer and commercialization**.** PPPs play an important role in bridging the gap between research institutions and private sector actors, fostering commercialization of research outputs. This synthesis report, therefore, provides an in-depth review and analysis of **29 PPP** projects under SGCI-2 implemented across **10 sub-Saharan African** countries spanning **five** main sectors: agriculture and food security, renewable energy, biotechnology, health and mining. **Eight (8)** of the projects were bilateral (implemented in two (2) countries) while 3 were trilateral (implemented in 3 countries). The projects showcase different approaches to implementation. This synthesis highlights challenges facing implementation of the PPP projects, key outputs and outcomes, lessons learned and best practices. In a nutshell, this synthesis seeks to provide valuable insights for structuring and managing PPPs as well as highlight areas requiring further investment and policy support to enhance their effectiveness.

3.2 PPPs Research Projects by Country

The number of PPP research projects in each country is documented in the table below:

Table 3: Number of PPP projects per country

#	Country	No. of PPPs
1	Uganda	6
2	Tanzania	4
3	Rwanda	4
4	Mozambique	2
5	Burkina Faso	2
6	Malawi and Zimbabwe	6 (joint projects)
7	Zambia, Malawi and Mozambique	3 (joint projects)
8	Mozambique and Namibia	1 (joint project)
9	Zimbabwe and Botswana	1 (joint project)
	Total	29

Types of PPPs under SGCI-2

As defined in the previous section, the PPPs implemented under SGCI-2 attracted different types of private sector partners including business enterprises, non-government organizations (NGOs), cooperative societies, producer organizations and/or community-based organizations (CBOs). The types of private sector partners for some projects could not be identified. The categories and numbers of PPPs under SGCI-2 are shown in the table below:

Table 4: Types of Private Sectors Actors Under SGCI-2

Type of Private Sector	Number
Businesses	9
Business Associations	3
Non-government organizations (NGOs) and civil society organizations (CSOs)	3
Community-based organizations/cooperative societies/Agro dealers	9
Unidentified	8

SGCI Projects that Transitioned to the Innovation Management (RIM)

It is important to note that five projects transitioned from SGCI-2 to the Research and Innovation Management Project (RIM), a follow-up initiative. This transition provides valuable insights regarding how projects can be supported progressively from a lower technology Readiness Level (TRL) to the next. The five projects outlined below exemplify this funding showcasing how initial research initiatives have progressed into targeted interventions focused on commercialization. They are listed below:

Table 5: SGCI-2 Projects that Transitioned to Research and Innovation Management (RIM)

#	SGCI 2	RIM
1	Harnessing Biotechnology to enhance the productivity of indigenous livestock (goats and chickens) in Malawi and Zimbabwe	Promoting use of artificial insemination (AI) to enhance productivity of local goats and chickens in smallholder farming communities.
2	Piloting the production and distribution of low-cost protein and micro-nutrient rich cricket feed from food waste in Kampala	Establishing a small-scale food waste up-cycling facility for cricket feed production and marketing in Kampala
3	Development of Novel Nano-Engineered Reagents for Mineral Froth Flotation	Commercialization of the development of novel nano-engineered: reagents for mineral froth flotation project
4	Identification of standards and gaps in the bakery and Confectionery Industries	Up scaling and Commercialisation of Maize Bran and Germ value added products in Uganda
5	Fruit processing for pulps and juice production for cooking	Community empowerment through value addition and agro-processing of indigenous fruits in Mozambique and Botswana

See Annex 2 for the details of projects that transitioned from SGCI-2 to Research and Innovation management Project (RIM).

3.3 Attractive PPP Investments

An analysis of PPP research projects implemented under SGCI-2 highlights a clear sectoral focus. Majority of these projects are concentrated in a few strategic areas that align with national and regional development priorities. The projects span across five sectors: agriculture and food security, renewable energy, mining, health, and biotechnology. The distribution of PPPs across these sectors is detailed in Table 5 below.

Table 6: Number of PPPs by sector

#	Sector	No. Of PPPs
1	Agriculture and Food security	18
2	Renewable energy	5
3	Health	3
4	Biotechnology	1
5	Mining	2
	Total	29

Based on the data above, agriculture and food security clearly emerges as the top priority, with 18 projects, possibly reflecting:

- A high dependency on agriculture for livelihood.
- Food security concerns.
- Government interest in modernizing the agricultural sector.

The relatively low numbers in biotechnology (1) and mining (2) may indicate:

- Less emphasis or limited private sector interest.
- Higher barriers to entry, such as capital intensity or regulatory complexity.

(***See annex 3 of specific PPP research projects in the different sectors)***

3.4 Technology Readiness levels of SGCI-2 Projects

Technology Readiness Levels (TRLs) provide a standardized framework to assess the maturity of innovations. Under SGCI-2, PPP projects fall into three categories: research/ideation, development/testing, and deployment/uptake. This classification helps researchers, policymakers, and investors evaluate progress, identify support needs, and prioritize funding. This can help researchers, investors and policymakers make informed decisions about development, funding and deployment. It is also important to note that projects at different levels requires different kinds of support. For example, projects in the research/ideation require more research and development support, whereas those in testing and upscaling are closer to full commercialization. Understanding these support requirements could help in identifying investment opportunities, policy interventions and potential collaborations to drive these innovations to market success. Several technologies are close to commercialization, but many remain at the development/testing stage due to funding constraints and limited early-stage private sector interest. TRLs offer a universal scale (from TRL 1 to TRL 9) that researchers, investors and commercialization partners can use to understand how far along technology is, what development steps remain and whether it's ready for real-world deployment.

The table below summarizes the number of projects under each category of readiness: research/ideation, development/testing and deployment/uptake.

Table 6: PPP Technology Readiness Levels

#	Stage	No. Of PPPs
1	Research/Ideation	6
2	Development/Testing	17
3	Deployment/Uptake	6
	Total	29

3.4.1 Research/Ideation Stage

This is the conceptual phase where projects are still in the brainstorming, research, and feasibility study phase. The projects represent early-stage innovations at the ideation or research phase, corresponding to the initial levels of the technology readiness scale. These initiatives are primarily exploratory in nature, focusing on concept development fundamental research, and feasibility studies. The projects span a range of sectors – including agriculture, biotechnology, renewable energy, and waste management – and are being undertaken in Rwanda, Malawi, and Zimbabwe. Each project demonstrates a strong emphasis on scientific discovery and potential technological breakthroughs aimed at addressing pressing local challenges such as post-harvest losses, sustainable energy, and climate-resilient agriculture.The focus is on identifying gaps, potential opportunities and expected outcomes.

Example of SGCI-2 project at this stage of TRL projects include two projects in **Rwanda**, focusing on sustainable solutions for agriculture and energy: a mobile solar-powered cold storage system aimed at reducing post-harvest losses, and another project exploring the use of landfill gas from municipal solid waste for cooking. In **Malawi and Zimbabwe**, several projects target agricultural biotechnology and aquaculture. These include studies on microbial consortia for bio-fertilizer production, genetic improvement and breeding of key fish species, and research into indigenous soil microbes that support legume crops. Another project at this stage is investigating the rhizosphere microbiome associated with sorghum, aiming to enhance drought and heat tolerance in crops. Collectively, these projects represent promising scientific inquiries with potential for long-term technological impact.

3.4.2 Development/Testing Stage

At this stage, projects move beyond theoretical concepts and develop initial working models or prototypes. The goal is to create tangible solutions that can be tested for viability. **In Uganda***,* the project on commercialization of essential oil crops for sustainable public health products developed 5 prototypes: 2 essential oil products; 1 cough mix; 1 body herbal jelly and liquid soap. Also, a project on piloting the production and distribution of low-cost protein and micro-nutrient rich cricket feed from food waste in Kampala developed cricket feed prototypes with commercial potential. Another project in Uganda developed four promising rust resistant wheat lines with yields between 2-3 t/ha selected after completion of advanced yield trials (AYT2) while simplified bread and cake standards were created and translated into pictorial formats and three languages. This format of baking standards has been adopted by the Uganda National Bureau of Standards (UNBS). Meanwhile twenty-two (22) bakers were trained in their implementation, thereby enhancing both standards and productivity. In **Zimbabwe and Botswana**, the project on development of novel nano-engineered reagents for mineral froth flotation conducted floatation tests of nano-floatation reagents. Validation tests were also done. **In Tanzania**, a project developed a prototype of a sunflower oil mini refinery with a capacity of 1000 L per day. Fabrication of a prototype for commercialization of a suitable avocado oil mini-extraction plant was also completed. Development of Minimum Viable Product (MVP) was to follow. In addition, a sunflower thresher in sunflower harvesting, threshing and Improvement of oil processing was developed. Other projects under development/testing stage include:

- Tanzania: Mechanization technology for sunflower harvesting and oil processing.
- Rwanda: Development of biological control solutions for managing invasive insect pests.
- **Malawi:** Assessing solar drying technology for reducing post-harvest losses.

3.4.3 Deployment/Uptake Stage

These are projects that successfully passed the development stage and are now being commercialized and expanded for widespread adoption. **In Burkina Faso**, three cooperative societies are already producing biofertilizer under the project on sustainable bio-fertilizer Inoculum while women are already producing local beer developed through conservation technologies. **In Uganda**, under the project on commercialization of propolis powder and infused tea bags, two products propolis infused body cream and tea bags – are already in the market. Under products from fractionation of Ugandan shea butter into commercial Shea stearin and Shea Olein for industrial food and cosmetic application, are also in the market. In this project, three (3) shea butter based products have been developed – Nilo soap, Nilo cream and Nilo body lotion. **In Mozambique,** under the project on fruit processing for pulps and juice production for cooking, are already producing juices for sale. In **Malawi**, under the project on harnessing biotechnology to enhance the productivity of indigenous livestock (goats and chickens), goat breeding population has been established at Lilongwe University of Agriculture and Natural Resources and at farms in the community; natural breeding has started to roll out production of goats and chickens in communities. (**See Annex 4 for specific projects under each Technology Readiness Level)**

Significance of Technology Readiness Levels of SGCI-2 Research Projects

The different TRLs for specific projects indicate the need for stage-appropriate funding and partnerships – governments and investors can prioritize according to both opportunity and risk. SGCI's classification enables better matchmaking between innovators and collaborators as well as focused capacity building depending on maturity stage. Early-stage projects need foundational research support, while later-stage initiatives need help with scaling and commercialization. Academic partners are better suited for lower TRLs, whereas industry and government stakeholders are more relevant for higher TRLs where commercial viability is key. TRLs guide the technology development path by setting clear milestones and expectations, helping organizations plan next steps in R&D, testing, or manufacturing. When transitioning a technology from a lab to industry, TRLs clarify whether a technology is ready to license or still needs more validation; it also helps align the expectations of inventors, technology transfer offices, and industry partners, allowing for structured progress tracking and evaluation. Finally, TRLs help potential collaborators or licensees determine the timing for engagement, the resources needed for further development and the commercial potential of the innovation.

3.5 Bilateral and Trilateral Projects

Several bilateral and trilateral collaborative research initiatives were implemented under SGCI-2 specifically in Botswana, Zimbabwe, Malawi, Mozambique, and Zambia. These collaborative projects provided platforms for interaction, knowledge exchange and implementation of joint activities, which contributed to strengthening research ecosystems in the regions. These joint projects facilitated knowledge sharing and skills transfer among researchers and created working relationships between SGCs.

3.5.1 Key Bilateral and Trilateral Activities

The SGCs involved in bilateral and trilateral projects conducted joint activities to enhance collaboration. These activities are highlighted below:

RCZ (Zimbabwe), BIH (Botswana), NCST (Malawi), and FNI (Mozambique) issued joint calls in mineral technology, agriculture biotechnology, and renewable energy. The guidelines, screening checklists and adverts for these calls were co-developed and adopted jointly.

The councils also formed joint independent panels of reviewers with members from each participating country. Reviews were jointly conducted and rankings were used to select proposals. The councils also prepared joint feedback letters to the applicants. According to a report of RCZ to IDRC:

"Based on the review ranking of the Proposals received, RCZ and NCST (Malawi) made a selection of the top three projects to be jointly funded on agriculture biotechnology. RCZ and NCST jointly prepared feedback letters to all applicants who submitted proposals," said the report.

There were also reciprocal exchange visits between RCZ and BIH for monitoring project progress. A team of researchers visited Malawi to share experiences especially as the former had implemented PPP projects before. The visits mainly focused on sharing of knowledge and project monitoring.

Apart from joint calls and reviews, virtual meetings were also held among SGCs to discuss logistics, updates, and planning. There were weekly meetings between RCZ and BIH during proposal phases as well as virtual check-ins and joint MEL activities.

Whereas SGCs were individually responsible for disbursing grants, they coordinated their efforts for optimal results. In some instances, there were joint project funding arrangements; a good example was a project between Zimbabwe and Botswana.

3.5.2 Gaps and Challenges in Bilateral and Trilateral Projects

Divergent regulatory and compliance frameworks between collaborating countries complicated joint projects. This issue contributed to at least one collaboration between Zambian and Mozambican teams failing. As a resolution, the Zambian team proceeded independently but committed to sharing results with Mozambican counterparts, illustrating the importance of harmonized cross-border research regulations. Another notable challenge was the language barrier, particularly in the bilateral project between Zambia and Mozambique. Communication difficulties hampered effective collaboration between research teams, causing delays and misunderstandings that ultimately weakened the outcomes of joint initiatives. Other significant challenges are highlighted below:

- **Cross-border sample sharing delays**: Transferring research materials across borders was problematic, particularly from Zimbabwe to Botswana, where a process taking 3 days in Botswana took up to 3 months in Zimbabwe.
- **Cross-border payments**: Delays in funding transfers, especially from Zimbabwe to Botswana, disrupted activities. Misalignment in payment timelines and processes led to halted or slowed collaborative efforts.
- **Different research management systems** across partner councils influenced project timelines and the ability to smoothly execute planned activities.
- **Varied levels of capacity** across countries and institutions sometimes led to uneven contribution and reliance on more experienced partners.
- **Different levels of resources**: Each SGC was responsible for securing and disbursing funds independently, which sometimes led to unequal resource availability or mismatched funding cycles.

3.6 Approaches to Partner Identification

This section outlines the processes and examples of how partners were identified for PPP) projects under the SGCI-2.

The first method of identifying private sector entities was through structured calls for proposals, where Councils required project teams to include a private sector entity. This was best exemplified in Uganda where the National Council for Science and Technology (UNCST) advertised a structured call for research proposals with a mandatory requirement for private sector partnerships. The call also required that:

- The co-principal investigator (Co-PI) had to be from the private sector.
- Support letters from both the academic and private sector heads were mandatory.
- Evaluation criteria included the ability of the project to address significant industrial challenges and the strength of proposed partnerships.

Secondly, project teams also approached private sector partners based on specific needs. For example, In **Botswana**, one of the project teams directly engaged with industry players for support. The Botswana Chamber of Mines and Khoemacau Copper Mine were approached to assist with industrial testing of a newly developed reagent. There were also industry needs driven partnerships where projects identified critical industry needs from the private sector and devised solutions for the same. In **Burkina Faso,** partnerships were formed by first identifying critical industry needs, such as improving the precision and hygiene practices in dolo (a traditional beer) production. The research was then tailored to address these challenges, leading to training initiatives and the provision of equipment to dolo producers.

A third approach to identifying private partners involved project teams both developing technologies and selecting specific private partners to support their deployment. For instance, in Tanzania, the Sunflower project created affordable, appropriate technologies for small and medium-sized enterprises (SMEs). This strategy ensured that research outputs were directly applied to address industry needs.

There was also an online system for identifying private partners. The Uganda National Council for Science and Technology (UNCST) developed an Online Gateway (Technomart) to link academia with industry, thus enhancing techno-preneurship and collaborative research. This platform provided avenues through which projects could find relevant partners.

Improving Private Sector On-Boarding

Based on the process of identifying private sector entities describe above, several actions can be adopted to enhance on-boarding of private sector partners. This could include:

- Mandate private sector involvement from the proposal design stage and require detailed roles for each partner, including post-project activities, to deepen commitment and alignment.
- Issue problem-based calls for proposals that are co-developed with industry representatives to attract relevant and committed private sector players.
- Provide legal support for drafting MoUs and contracts at the inception of the project to prevent disputes and ensure equitable benefit-sharing.
- Invest in digital platforms that connect research institutions and businesses, making it easier to identify partners, track progress, and share outputs.
- Define and enforce active roles for private partners – such as providing data, technology, and market linkages – beyond just being listed as collaborators.
- Vet private partners for readiness and provide translation or orientation support where necessary to ensure meaningful involvement.
- Include mechanisms in project design for sustaining collaboration, such as innovation hubs or continued technical support post-funding.

3.7 Role of the Private Sector in PPPs

The private sector actors under PPP arrangements in SGCI-2 projects served not only as a beneficiary of research but also as a co-implementer, resource provider, validator of research outcomes and pathway to commercialization, thereby enhancing the relevance and impact of research projects on industrial and social development. The private sector acted as a key partner in the implementation, commercialization and application of research outputs across different countries involved in SGCI Phase 2.

In **Botswana**, private mining companies such as the Botswana Chamber of Mines, Khoemacau Copper Mine, Botswana Premium Nickel Resources, and Motheo Sand Fire contributed to the transition from research to industrial application by providing ore samples and facilitating industrial testing of new reagents. Their involvement was crucial for validating research outputs and preparing them for commercialization.

In **Uganda**, the private sector's role was deeply integrated into research projects. For example, under the "*Commercialization of Propolis Powder and Infused Tea Bags"* project, TUNADO (the apex body for beekeepers) collaborated with Makerere University to mobilize beekeepers for mass production, which facilitated product development and catalyzed commercialization efforts. TUNADO also mobilized additional funding (UGX 100 million) for capacity building, product development, and commercialization - demonstrating financial commitment. Similarly, private companies like PKM Reliable Enterprise in **Uganda** made their production facilities and equipment available to research teams, aiding practical application.

Meanwhile, the private sector provided real-world challenges for academic research, ensuring that outputs were market-driven and immediately applicable. Private actors in **Uganda** were instrumental in identifying real-world industrial challenges for researchers to solve, ensuring research was demand-driven. The bakery and confectionery industry, for example, saw close collaboration between Makerere University and private bakeries to establish quality and safety standards for baked products. In **Burkina Faso**, the private sector (in the form of dolo beer producers) helped define research priorities by highlighting hygiene and equipment needs in traditional brewing. This led to direct interventions such as training on good hygiene practices and provision of specialized equipment like "dolo barrels" and capping machines. These directly shaped research agendas, resulting in tangible benefits for small producers.

In **Tanzania**, the sunflower project saw SMEs from the oil processing sector working closely with researchers to refine and adopt affordable refining technologies, enhancing the competitiveness of sunflower oil products. Similarly, in **Rwanda**, partnerships were formed between aquaculture researchers and a cooperative of silkworm farmers to support low-cost fish feed production, demonstrating another model of how private actors helped bridge research and industry. Private cooperatives, farmers, supplied mulberry trees and collaborated in the domestication of common carp fish projects. They also provided essential inputs like silkworm pupae for sustainable feed development.

Private sector experts also worked hand-in-hand with researchers. For example, in Uganda, industry-based co-principal investigators (Co-PIs) worked alongside university researchers to ensure relevance, facilitate knowledge transfer, and promote sustainability of collaboration even beyond the life of funded projects.

In **Malawi**, for instance, PPP projects allowed sharing of best practices and site visits involving private actors, helping to refine project implementation strategies. The National Commission for Science and Technology (NCST) in **Malawi** collaborated with private partners in renewable energy projects especially by providing sites hosting for project demonstrations. In **Zimbabwe,** the private sector actors collaborated in bio-fertilizer production research by providing sites and practical challenges, thereby ensuring relevance and applicability of the research outputs.

3.8 Key Outputs of the Public-Private Partnerships

Public-Private Partnerships (PPPs) successfully delivered tangible outputs and promising outcomes across multiple sectors. These include new technologies, commercialization of research, job creation, food security and sustainable energy solutions.

3.8.1 Development of New Technologies and Commercial Products

First and foremost, PPPs facilitated the creation of new technologies, prototypes, and commercial products that address various social economic challenges. For example, **Malawi's** biogas commercialization project developed a biogas technology using vegetable and animal waste and established three pilot households and contracted a restaurant to use biogas as an energy source. A by-product bio-fertilizer was also successfully tested in maize fields under the same project. In **Tanzania,** a sunflower oil processing technology project developed a mini sunflower oil refinery and avocado oil extraction plants and supported small-scale edible oil processors to improve productivity. All the six PPP projects in **Uganda** have demonstrated positive outputs, some of which are already undergoing market testing, suggesting potential benefits for the productivity and competitiveness of the manufacturing sector in Uganda. For example, four successful shea butter-based products – body cream, lotion, and bath soap – were created by the shea butter fractionation project and are presently being sold under the brand Nilo beauty products. Additionally, the shea butter research team locally designed, optimized and fabricated a fractionation machine for commercial separation of olein and stearin fractions of shea butter, further improving the product quality and competitiveness. Meanwhile, propolis-infused tea bags and body cream, which are currently sold under the names Adlea Cosmetics and Ejim tea, respectively, were successfully developed by the bee propolis commercialization project. A bakery and confectionery project not only created simplified bread and cake standards but also translated them into pictorial formats and three languages (English, Luganda, and Swahili). The project on piloting the production and distribution of low-cost protein and micro-nutrient rich cricket feed from food waste in Kampala developed 4 prototypes of potential commercial cricket feeds from household and restaurant waste and being evaluated for efficacy, safety and economic feasibility.

In Burkina Faso, one project established three cooperative bio-fertilizer production units using mycorrhizal fungi and also improved soil fertility and crop production through organic farming solutions while in **Mozambique,** the solar drying technologies for post-harvest loss reduction project constructed a parabolic greenhouse solar dryer and engaged farming cooperatives to improve food preservation and reduce waste. **Zambia's** project on assessing the performance of solar drying and cooling technologies designed and developed a field scale solar drying technology for fruit and vegetable drying, while a project on upscaling and commercialization of biogas generation in **Malawi, Mozambique and Zambia** fabricated three bio-digesters: two for animal feedstock and one for human waste feedstock. A purification and bottling unit was also designed, built and tested. **In Malawi, Mozambique, and Zambia**, biogas commercialization projects were successfully piloted at the community-level while in **Zambia,** the solar drying and solar cooling technology project for post-harvest loss reduction was tested and found to be economically viable and ready for scale-up. In **Botswana and Zimbabwe**, nano-engineered flotation reagents for the mining sector demonstrated successful lab-scale results, requiring investment for commercial-scale production.

In Rwanda, a biological pest control project developed a biological control system to manage crop pests, reducing reliance on chemical pesticides. In **Zimbabwe**, the project developing nitrogen-fixing bacteria for groundnut farming created a Rhizobia-Bacillus subtilis formulation to enhance pod yields, supporting sustainable agriculture and smallholder farmers. In **Burkina Faso** – bio-fertilizer production & adoption increased organic fertilizer use, reducing dependency on synthetic fertilizers. In Malawi, Mozambique & Zambia, biogas technology for energy & fertilizer project introduced biogas digesters to convert organic waste into fuel. In **Uganda** – solar energy for food preservation project installed solar dryers to extend the shelf-life of fruits and vegetables.

3.8.2 Capacity Building and Training Programs

The PPP projects under SGCI-2 also made attempts to develop the capacity of various groups. In Namibia for example, women entrepreneurs and milk producers were trained in agro-processing in milk processing and financial management. In **Mozambique & Namibia,** traditional practitioners were trained in developing herbal remedies for malaria, HIV/AIDS, tuberculosis, and COVID-19. The project also promoted commercialization of traditional medicine for health interventions. In **Burkina Faso**, local beer producers were trained in hygiene and fermentation techniques and introduced modern packaging methods. In **Mozambique**, 31 traditional practitioners were trained in the development of herbal remedies for commercialization.

The project on harnessing biotechnology to enhance the productivity of indigenous livestock (goats and chickens) in **Malawi** and **Zimbabwe** trained local communities in collection of fresh semen from goats and chickens and in performing artificial insemination in goats and chickens. Interestingly, all these village groups/co-operatives were composed of women from female headed households. Meanwhile in **Namibia and Mozambique**, indigenous knowledge application in treating infectious diseases trained 31 traditional practitioners in herbal remedy commercialization. An assortment of laboratory equipment – bomb calorimeter; autoclave machines and freezers – were procured to support implementation of the research activities.

3.8.3 Job Creation and Income Generation

PPPs facilitated conversion of research outputs into commercial products, creating new market opportunities. Consequently, the projects provided direct and indirect employment opportunities, particularly in agriculture, energy and manufacturing. In **Tanzania** – Sunflower and Avocado Oil processing plants enabled SMEs and local farmers to improve production efficiency and created new jobs in oil refining and mechanized farming. In **Mozambique** – a fruit processing project linked local fruit suppliers with luxury hotels to promote natural juice production. In **Malawi**, the biogas technology commercialization project created entrepreneurial opportunities for local businesses using biogas in restaurants and households. **In Malawi,** a field scale parabolic greenhouse solar dryer was installed in Kundayi village in Salima District, Central Malawi. The developed drying system was expected to bring significant impact in terms of increased production capacity as well as increased income to the women group.

3.8.4 Strengthening Councils' Capacity in Research Governance

In **Uganda**, it was noted that the PPP research projects strengthened the country's manufacturing sector as well as the national council's research management capabilities, resulting in sustained collaboration between academia and the private sector. Platforms and tools were also created under the initiative which enhanced the capability of the national council's work in research management and technology commercialisation. As a result, Uganda's UNCST acquired a new server strengthening its capacity to better serve the research community with more reliable, effective and efficient digital services. The infrastructure provided an ideal platform for optimal utilization and continuous improvement of the upgraded grants management system among others. In **Zambia**, a framework for PPPs in research and innovation (R&I) was developed to ensure effective identification and implementation of PPPs in research and innovation. In **Rwanda,** the capacity of the national council staff was strengthened in research management as well as mobilization of research funds. As a result, the council mobilized over 1 billion Rwandan Francs.

3.8.5 Technology Transfer

One of the primary objectives of PPPs in research is to facilitate technology transfer from academia to industry, leading to commercialization. **Uganda's** TECHNOMART platform is a key example of how digital technology can facilitate technology matchmaking between academia and private enterprises. In **Tanzania,** sunflower oil mini-refinery and avocado oil processing plants were piloted at community-accessible sites, allowing small-scale producers and SMEs to test and adopt the technology. **Malawi's** solar drying technology project formed partnerships and worked closely with farmers' cooperatives and German Technical Cooperation (GIZ) to explore commercialization strategies. Also, **in Malawi**, the project on harnessing biotechnology for livestock productivity trained village cooperatives and private livestock farmers to apply biotechnology in breeding programs; while in **Mozambique**, the greenhouse solar dryer technology was installed at the Agrarian Institute of Research of Mozambique, around which there are agricultural community grouped in cooperatives. It was expected that the drying technology would bring significant impact in terms of fruit and vegetables preservation, increasing income to the household group.

Modes of technology transfer

The research projects under SGCI-2 engaged in several activities for the purposes of technology transfer to the target groups. These included:

The *Proveno Boost* project in **Uganda** exemplifies a value-chain-based transfer, where Makerere University partnered with TUNADO (a beekeeping association) to commercialize propolis-based health products. The collaboration included capacity building, quality assessments, and product development, integrating scientific research with local industry capabilities. In some cases, companies provided machinery and infrastructure to support academic research. PKM Reliable Enterprise in Uganda made its animal feed processing equipment available to a research team, directly contributing to product development and knowledge exchange. This mode of transfer involves tangible assets in addition to knowledge sharing.

In **Malawi**, the National Commission for Science and Technology (NCST) facilitated technology transfer through exchange visits with counterparts from Mozambique and Zimbabwe. These visits allowed participants to share experiences and lessons from renewable energy PPP projects. For instance, staff from Fundo Nacional de Investigação (FNI) and the Research Council of Zimbabwe (RCZ) visited Malawian project sites, enabling them to observe practical applications of technologies and engage in mutual learning

In **Botswana**, technology transfer occurred where a laboratory-developed reagent was tested by mining companies like Khoemacau Copper Mine and Botswana Premium Nickel Resources. This demonstrates a mode where technology developed in research institutions is validated before market entry. Other technology transfer mechanisms arising from SGCI-2 projects are highlighted below:

- In **Burkina Faso**, training on good hygiene practices and provision of specialized equipment like “dolo barrels” and capping machines.
- In **Tanzania**, SMEs from the oil processing sector worked with researchers to refine and adopt affordable refining technologies, enhancing the competitiveness of sunflower oil products.
- In **Malawi**, the National Commission for Science and Technology (NCST) collaborated with private partners in site hosting for project demonstrations.
- In **Uganda**, the private sector identified gaps (e.g., bakery and confectionery standards) and participated directly in designing research solutions.
- In **Mozambique,** the greenhouse solar dryer technology was installed at the Agrarian Institute of Research of Mozambique, around which there are agricultural community grouped in cooperatives.
- In **Tanzania,** sunflower oil mini-refinery and avocado oil processing plants were piloted at community-accessible sites, allowing small-scale producers and SMEs to test and adopt the technology.
- **Malawi’s** solar drying technology project formed partnerships with farmers’ cooperatives and German Technical Cooperation (GIZ) to explore commercialization strategies.
- In **Mozambique**, the greenhouse solar dryer technology was installed at the Agrarian Institute of Research of Mozambique, around which there are agricultural community grouped in cooperatives.

3.9 Key Gaps and Challenges in Implementing PPPs

Despite the promising progress across different countries under the SGCI program, the implementation of Public-Private Partnerships (PPPs) experienced some challenges. First, limited private sector engagement at the evaluation stage was identified as a major gap. For example, during some project proposal evaluations, there was no scoring criterion for the level of private sector involvement, leading to weaker industry participation. This oversight diluted the strength of the partnerships since stronger private sector involvement often correlates with greater technology transfer and commercialization success. And even in cases where it was mandatory to have a private sector partner, there was lack of clear, legally binding agreements concerning ownership of intellectual property. Without formal MoUs or contracts, there is a heightened risk of conflict once valuable outcomes are achieved.

Language also posed a challenge, particularly in the bilateral call between Zambia and Mozambique. Communication difficulties hampered effective collaboration between research teams, causing delays and misunderstandings that ultimately weakened the outcomes of joint initiatives.

Administrative and logistical hurdles also featured prominently, especially in Zambia where procurement processes for specialized research materials and equipment were bogged down by bureaucratic delays at host institutions. In response, the Council had to step in and procure on behalf of the projects – an unsustainable workaround that highlighted the need for more flexible institutional procurement systems.

Divergent regulatory and compliance frameworks between collaborating countries further complicated joint projects. This issue contributed to at least one collaboration between Zambian and Mozambican teams failing. As a resolution, the Zambian team proceeded independently but committed to sharing results with Mozambican counterparts, thus illustrating the importance of harmonized cross-border research regulations.

It also emerged that some private sector participants were newly established and lacked the operational capacity or industry experience to contribute meaningfully to project goals. For example, in Tanzania, the **e**xperience and maturity of a private sector partner was found to be wanting. This suggests a need for stricter criteria in selecting industry partners to ensure real engagement and value addition.

Further, the projects faced a general gap in capacity for IP management. Although efforts like training on intellectual property were conducted in Uganda, there remained a wider need for consistent legal and IP support across all project sites to protect innovations emerging from PPP collaborations.

Finally, not all projects systematically evaluated private sector involvement at the proposal stage (e.g., missing evaluation score for private sector engagement in some cases), suggesting that some partnerships were more tokenistic than strategic. Some projects just provide name of private sector without knowing their roles.

Specific Challenges are highlighted below:

Procurement challenges

Lengthy procurement processes and bureaucratic inefficiencies hindered project execution, delaying equipment acquisition and implementation. **Malawi and Zambia** reported delays in project execution due to complex procurement procedures. **Rwanda's** efforts in renewable energy, such as landfill gas-to-energy projects have faced implementation delays due to procurement challenges. Also, a project on mobile solar-powered cold storage to reduce post-harvest losses of agricultural products in **Rwanda** also faced delay in acquisition of project equipment for building the solar powered cold storage unit. In **Malaw**i, the parabolic solar dryer project was delayed due to contractor capacity issues and bureaucratic procurement processes. In **Zambia**, procurement delays and equipment breakdowns postponed the installation of a biogas purification and bottling unit. The project faced considerable challenges in procuring the required reagents which were finally acquired.

Lack of clear formal agreements on PPPs

Another challenge facing PPPs was the lack of clear formal agreements on PPPs. For example, in Malawi's PPPs projects did not have clear agreements among stakeholders (researchers, private operators, community members, funders) on the ownership of research results, equipment, and intellectual property developed during projects. Many of the projects also faced a similar challenge. In addition, private sector involvement remains limited at the ideation stage, often leading to a mismatch between research outputs and market needs.

Funding Challenges for Commercialization

Despite successful pilot projects, many PPPs struggle to scale innovations due to market barriers, regulatory constraints, and lack of business development support. Many research projects faced funding shortages, especially in transitioning from the research phase to commercialization. In **Zimbabwe**, despite successful biotechnology and minerals research, projects lacked commercialization grant opportunities to develop products beyond the proof-of-concept stage. In **Tanzania**, limited budgets restricted the number of engineering prototypes that could be developed for sunflower oil processing and avocado oil extraction. In the same country, it was noted that several engineering designs were developed during the design stage by research teams, however, due to the funding constraints only few plants were selected and fabricated. In **Zimbabwe's** biotechnology research on bio-fertilizers and improved crop varieties faced funding gaps in commercialization. In **Mozambique,** solar drying technologies for fruits and vegetables were implemented successfully, but commercialization faced challenges in expanding to other farming communities. Many PPP projects face financial constraints, limiting their ability to transition from research to commercial-scale implementation. The availability of funding from government grants, donor organizations, and private sector investments varies across countries. In **Tanzania's** sunflower and avocado oil processing projects highlight a need for additional funds to scale up prototypes into fully commercialized products while **Malawi's** biogas commercialization project successfully piloted biogas production but requires further investment for expansion.

3.10 Best Practices of PPPs under SGCI-2

There are several successful examples of Public-Private Partnerships (PPPs) under SGCI projects. This section outlines the best practices in implementing PPPs under SGCI-2, using specific examples and drawing lessons for future programming. Some of the best practices are highlighted below:

Structured Calls for Proposals

The Uganda National Council for Science and Technology (UNCST) implemented a structured call for research proposals with a mandatory requirement for private sector partnerships. Key features included:

- Each research project was required to have an industry partner.
- The co-principal investigator (Co-PI) had to be from the private sector.
- Support letters from both the academic and private sector heads were mandatory.
- Evaluation criteria included the ability of the project to address significant industrial challenges and the strength of proposed partnerships.

Testing and Validation of Research Outputs

In *Botswana*, a project that developed a chemical reagent was transitioning from research to commercialization. The research team engaged the Botswana Chamber of Mines and Khoemacau Copper Mine for industrial testing, while other mining companies like *Botswana Premium Nickel Resources* and *Motheo Sand Fire* provided *ore samples* to validate the reagent's efficacy. This example shows a direct involvement of the private sector in testing and validating research outputs under real-world industrial conditions.

Reciprocal Learning and Exchange Visits

The National Commission for Science and Technology (NCST) in Malawi capitalized on prior SGCI Phase one experience by facilitating learning exchange visits with the Fundo Nacional de Investigação (FNI) of Mozambique and the Research Council of Zimbabwe (RCZ). These visits allowed sharing of knowledge, monitoring, and joint inspection of renewable energy PPP projects. This approach fostered trust and strengthened collaborative ties, which are essential for successful PPPs. Similarly, in **Tanzania,** the sunflower oil refining project offered small and medium enterprises (SMEs) appropriate technology to refine sunflower oil, directly linking research outputs to improvements in food processing industries.

Use of Private Sector Infrastructure for Research

In some cases, companies provided machinery and infrastructure to support academic research. PKM Reliable Enterprise in Uganda made its animal feed processing equipment available to a research team, directly contributing to product development and knowledge exchange. This mode of transfer involves tangible assets in addition to knowledge sharing.

Industry-Focused Research Design

In Uganda, the Uganda National Council for Science and Technology (UNCST) mandated that all funded projects under SGCI-2 address challenges presented by the manufacturing sector. By requiring that proposals involve private sector actors and demonstrate industrial relevance, UNCST ensured that research outputs were market-driven and positioned for uptake. For example, Makerere University's bakery and confectionery project engaged three private sector partners and the Uganda National Bureau of Standards to enhance food safety standards.

Establishment of Online Platforms for Linkages

Uganda pioneered the development of an "Online Supermarket for Technology Solutions" – the Technomart Platform – to facilitate functional linkages between universities and industries. This digital innovation helped bridge gaps, promote techno-preneurship, and ease the sharing of internship and apprenticeship opportunities, thereby reinforcing collaboration between sectors.

Intellectual Property (IP) Training and Support

Training workshops on IP registration and exploitation in Uganda ensured that researchers and private sector actors understood *legal and procedural aspects of technology commercialization*, fostering a more informed and prepared innovation ecosystem. This initiative could ensure inventions and technologies developed through PPP projects were protected, thereby attracting more private sector interest and investment.

Direct Industry Contributions and Support

Several examples highlight active industry participation. In Rwanda, fish farmers partnered with the University for the Domestication of carp fish, while in Uganda, PKM Reliable Enterprise provided machinery for animal feed production research. Similarly, Botswana engaged mining companies to support the commercialization of a newly developed mineral reagent, showcasing the value of tangible industry contributions beyond financial support.

Private Sector-Initiated Research Problems

Several projects were designed around challenges identified by the private sector. In **Burkina Faso**, the traditional beer ("dolo") production process was improved through hygiene training and the provision of equipment like capping machines. This is a problem-driven mode of technology transfer, where research responds directly to industry needs. In **Uganda**, Identification of standards and gaps in the bakery and confectionery industry, where Makerere University worked alongside multiple private sector partners like Hot Loaf Bakery and Jovay School of Cookery, showing how PPPs can drive up food safety and quality compliance. In Burkina Faso, research teams addressed practical challenges in the traditional brewing industry by introducing better hygiene practices and donating preservation equipment, improving product stability and quality.

3.11 Enhancing the Impact of Public Funding on Commercialization

Public funding serves as a catalyst for advancing research and development (R&D) initiatives. However, the translation of research outputs into commercially viable products remains a persistent challenge, particularly in developing regions. To maximize the impact of public investments and ensure sustainable economic development, a more targeted and strategic approach is required. These are highlighted below:

Formalizing Partnership Frameworks

A key barrier identified in SGCI-2 initiatives was the absence of clear, formal agreements regarding intellectual property (IP) ownership and benefit-sharing. Public funding mechanisms must condition grant disbursements on the existence of standardized, enforceable PPP agreements. These should explicitly define IP rights, commercialization pathways, and revenue-sharing arrangements to prevent disputes and accelerate market entry of innovations.

Building Legal and Intellectual Property (IP) Support Systems

Research teams often lack expertise in navigating legal and regulatory landscapes. Public funds should be allocated to establish or strengthen institutional Intellectual Property Management Offices (IPMOs) and provide dedicated legal advisory services for PPP projects. Such support will ensure that research outputs are protected, correctly licensed, and efficiently commercialized, thus preserving public interests while incentivizing private-sector participation.

Strengthening Capacity through Training and Mentorship

Effective commercialization requires business acumen in addition to scientific expertise. Public funding should support mandatory training programs in IP management, entrepreneurship, regulatory compliance, and business development for researchers. Furthermore, early-career researchers should be paired with seasoned industry mentors to bridge experience gaps and enhance the commercialization prospects of research projects.

Integrating Private Sector Participation from Project Inception

One of the lessons from SGCI-2 was the importance of involving the private sector from the ideation stage rather than post-research. Public funding calls should require the inclusion of private-sector partners during proposal development and execution phases. This ensures that research agendas align with market needs, accelerates technology adoption, and enhances commercial viability.

Supporting Business Incubation and Post-Project Sustainability

Public funding programs must look beyond research completion and explicitly provide pathways for post-project commercialization. This includes facilitating access to business incubation centers, innovation hubs, venture capitalists, and angel investors. Dedicated funding windows could be established for prototype validation, pilot scaling, and go-to-market strategies, bridging the often fatal “valley of death” between lab success and market adoption.

Enhancing Access to Common Testing and Certification Facilities

A recurring commercialization bottleneck identified was the lack of testing facilities to validate and certify innovations. Public investment should prioritize the establishment of regional or national shared testing centers, equipped to support small and medium enterprises (SMEs) and research spin-offs. This would lower costs, ensure regulatory compliance, and enhance the credibility of new products entering the market.

Establishing Industry-Academic Liaison Offices

Universities and research institutes often struggle to engage meaningfully with industry. To overcome this, public funding should mandate the creation and strengthening of dedicated industry liaison offices within academic institutions. These offices would actively scout for commercialization opportunities, foster corporate partnerships, and coordinate technology transfer activities.

Incentivizing Private Sector Investment

Public funding programs should integrate co-investment models that incentivize private sector contributions. Matching grants, tax incentives, or equity-sharing schemes can encourage private enterprises to invest early in promising innovations, thereby spreading financial risks and amplifying the commercial potential of publicly funded research.

3.12 Sustainability of PPPs

One of the main challenges in implementing PPPs is ensuring their long-term sustainability. To make PPPs in science, technology, and innovation sustainable, several best practices have emerged from SGCI country experiences. These include mandating private sector engagement beyond the project lifecycle, formalizing agreements on IP and ownership, supporting technology transfer platforms, and incentivizing long-term institutional linkages rather than short-term partnerships.

3.13 Lessons Learned

1. Public-Private Partnerships have proven effective in bridging research and industry, enabling commercialization of innovations in agriculture, energy, and health.
2. Projects benefit when resources and support are tailored to their stage: early-stage projects need R&D backing, while later stages need market linkage and scale-up funding.
3. Prototypes alone are not enough: A significant number of projects remain stuck at the prototype (development) stage due to: Limited commercialization support; Inadequate funding for scale-up; and Weak business development services.
4. Many promising innovations failed to transition to commercial viability mainly due to lack of follow-on funding.
5. Many projects lack post-donor continuity strategies. Embedding *sustainability and scale-up plans* in early project stages is vital.
6. Embedding sustainability strategies - like community ownership, public-private scale-up plans, or revolving funds - is essential.
7. Co-creation with private sector partners from the start can enhance product-market fit and commercialization outcomes.
8. Projects struggle to move from pilot to market without targeted commercialization funding. *Innovation financing mechanisms* are a critical missing link.
9. Structured requirements for private sector involvement in research calls enhance meaningful partnerships.
10. Formal agreements regarding ownership of intellectual property and roles during and after project implementation are critical to avoid future conflicts.
11. Reciprocal learning visits and leveraging existing networks can strengthen long-term collaborative relationships.

4. CONCLUSION

The SGCI Phase 2 Public-Private Partnerships (PPPs) on technology transfer and commercialization have laid a critical foundation for leveraging research and innovation to address pressing development challenges across sub-Saharan Africa. These partnerships have demonstrated the potential of collaborative models to translate scientific research into tangible social, economic, and environmental outcomes. The concentration of projects in high-impact sectors like agriculture, renewable energy, and health reveals a strategic alignment with national and regional development priorities. Moreover, the progression of many projects from ideation through development and, in some cases, into deployment reflects a growing maturity in innovation ecosystems supported by SGCI. Tangible results - ranging from commercialized bio-fertilizers and herbal products to solar drying technologies and biogas systems – highlight the capacity of PPPs to deliver market-ready solutions and stimulate local industries. However, persistent challenges in procurement, funding, formal partnership frameworks, and private sector engagement continue to hinder the full realization of these innovations. Many projects remain stalled at the prototype stage, underscoring the need for stronger commercialization pathways, legal support, and sustainability planning. Moving forward, strengthening institutional capacity, embedding private sector participation from the outset, and fostering cross-country learning will be essential to unlocking the transformative potential of PPPs. With targeted policy reforms, structured investment mechanisms, and continued support from national councils, these partnerships can evolve into resilient engines of inclusive development, capable of driving long-term impact across the continent.

5. RECOMMENDATIONS

Formal agreements and partner engagement framework

Finding 1: *Lack of clear formal agreements and engagement frameworks*

One of the key learning aspects has been need for a clear formal agreement amongst the partners (researcher, private operator, community, funder etc) with regards to ownership of the results of the research, equipment and intellectual property of any new technologies that could arise from the research after the project has finished.

Recommendation 1: Councils need to ensure that PPP projects develop standardized PPP agreements outlining ownership rights, revenue-sharing mechanisms, and responsibilities of each partner.

Recommendation 2: The private sector/industry/regulatory authority or end user of the research output should be actively engaged right from the process from ideation to the dissemination of research output to ensure an uptake of research results as they are the early adopters of the technology/knowledge produced.

Recommendation 3: Calls for proposals should include specific requirements for private sector involvement, with clearly defined roles during the project implementation phase.

Legal support to PPP teams and institutions

Finding 2: *PPP project teams seem to have little knowledge on key issues around Intellectual Property, legal frameworks and regulatory compliance.*

Recommendation 4: Provide legal support to research teams and institutions during the drafting of MoUs between research institutions and private sector partners to ensure equitable sharing of benefits resulting from the research project and avoid conflicts that could emerge later if an interesting intellectual property (IP). In this regard, it is important to engage national IP regulatory bodies and to provide researchers and private sector partners with training on IP laws and patents, It is also important to strengthen partnerships with regulatory agencies is critical to ensure smoother commercialization.

Capacity building and mentorship for researchers on managing PPPs

Finding 3: *Seasoned and early-career researchers alike may lack expertise in initiating and managing PPP projects.*

Recommendation 5: Match early career researchers to seasoned researchers with skills and mentorship in initiating, managing and scaling PPP research projects in their respective technical areas. It would also be critical to provide internship and attachment opportunities to the students in PPP projects whose research would be valuable in managing these projects

Recommendation 6: Create a dedicated business mentorship program for early career researchers students in PPP to enhance their management skills in PPP.

PPP project scale-up and sustainability

Finding 4: *Many PPP projects lack clear post-project sustainability plans.*

Recommendation 7: Facilitate business incubation programs for PPP-generated innovations to guide startups in commercializing research findings. Inclusion of private sector/industry/regulatory authority or end user of the research output from ideation to dissemination of research output is crucial for uptake of research results as they are the early adopters of the technology/knowledge produced.

Recommendation 8: Councils need to mandate PPP projects to develop feasible sustainability plans in research project proposals, detailing how private sector partners and community-based organizations will continue project activities after funding ends.

Recommendation 9: Councils need to adopt milestone-based funding models where subsequent funding is based on viable research outputs.

Recommendation 10: Strengthen research-extension linkages by engaging cooperative and industry associations in promoting new technologies to end-users.

Funding of PPP projects

Finding 5. *Inadequate financial resources for full commercialization.*

Recommendation 11: Develop practical business plans and resource mobilization strategies to raise funds post the project and create awareness on existing sustainable financing opportunities, e.g venture capital involvement and angel investors where high-net-worth individuals invest early in exchange for equity;

Collaboration between academia and industry

Finding 6: *There are weak industry academic linkages in most universities and research institutions*

Recommendation 12: There is a need to create industry-academic liaison offices within research institutions to facilitate matchmaking between researchers and businesses.

Recommendation 13: Create an incentive package to attract private actors to engage in PPPs between universities, research institutions, and industry players.

Recommendation 14: Develop platforms for *joint R&D*, co-patenting, and shared infrastructure (e.g., science parks, innovation hubs).

Role of the councils in managing the PPP projects

Finding 7: *Councils do not have requisite expertise in managing PPP projects*

Recommendation 15: Councils should establish mandatory private sector co-participation requirements in research proposals, ensuring that private firms actively engage in project design and implementation.

Recommendation 16: Develop effective M&E frameworks to track key performance indicators (KPIs) of PPP research projects.

Common testing facilities

Finding 8*: Lack of adequate testing facilities for innovation*

Recommendation 17: Develop and enable access to common testing facilities for prototypes and new technologies deriving from PPP projects.

Technology readiness levels

Finding 9: *Lack of objective assessment of Technology Readiness levels*

Recommendation 18: Conduct an objective assessment of technology readiness levels so as to tailor technical and financial support accordingly.

Inceptives for the private sector

Finding 10: *Lack of clear incentives to motivate the private sector*

Recommendation 19: Provide clear incentives to the private sector to make it attractive and lucrative to participate in the PPP arrangements

6. REFERENCES

Applied Technologies & Innovations. (2014). The role of public-private partnership for effective technology transfer. *Applied Technologies & Innovations, 10*(3), 83–90.

Bengesi, K. M. K., Mwesiga, P., & Mrema, T. (2016). *Research report on the assessment of the public-private partnership (PPP) in transportation infrastructure in Tanzania: The way PPP is understood, challenges and the way forward*. Economic and Social Research Foundation.

Hoffman, K., & Girvan, N. (1990). *Managing international technology transfer: A strategic approach for developing countries*. International Development Research Centre.

International Journal of Mechanical Engineering and Technology. (2018). *International Journal of Mechanical Engineering and Technology (IJMET), 9*(6), 971–982. http://iaeme.com/Home/issue/IJMET?Volume=9&Issue=6

ITPS (Swedish Institute for Growth Policy Studies). (2004). *Commercialization of research results in the United States: An overview of federal and academic technology transfer*.

Nijkamp, P., van der Burch, M., & Vindigni, G. (2002). A comparative institutional evaluation of public-private partnerships in Dutch urban land-use and revitalization projects. *Urban Studies, 39*(10), 1865–1880. https://doi.org/10.1080/0042098022000011337

Witters, L., Marom, R., & Steinert, K. (2012). The role of public-private partnerships in driving innovation. In *The Global Innovation Index 2012* (pp. 81–87). INSEAD.

Wu, W. (2017). Research and innovation in Chinese universities. In V. V. Krishna (Ed.), *Universities in the national innovation systems: Experiences from the Asia-Pacific* (pp. 79–100). Routledge.

Wu, W., & Zhou, Y. (2012). The third mission stalled? Universities in China's technological progress. *The Journal of Technology Transfer, 37*(6), 812–827. https://doi.org/10.1007/s10961-011-9233-8

7. Annex 1: Summary of SGCI-2 PPP Research Projects

#	Country	Project	Public Partner	Private partner	Outputs	Stage	Sector
1	Uganda	Increasing wheat production and productivity through science based knowledge and innovations for a competitive wheat manufacturing value chain in Uganda.	Buginyanya Zonal Agricultural Research and Development Institute	Uganda Manufacturers Association	2 candidate wheat varieties with wide adaptability and high yields were developed and submitted to the Ministry of Agriculture, Animal Industry and Fisheries (MAAIF) for consideration for release. 1.5 tons of elite foundation seed of Narowheat 1, 2 and 3 were bulked and availed to uptake pathways and 0.5 tons of breeder seed pipeline materials multiplied. Four promising rust resistant wheat lines with yields between 2-3 t/ha selected after completion of Advanced yield trials (AYT2)	Development	Agriculture and food security
2	Uganda	Piloting the production and distribution of low-cost protein and micro-nutrient rich cricket feed from food waste in Kampala	Uganda Christian University (UCU)	PKM Reliable Enterprises Limited	Developed Crickets feeds Prototypes with commercial potential	Development	Agriculture and food Security
3	Uganda	Identification of standards and gaps in the bakery and Confectionery Industries	Makerere University	Hot Loaf Bakery, Jovay School of Cookery, Nakku Food Safety Consults Limited	Created simplified bread and cake standards but also translated them into pictorial formats and three languages. This format of baking standards has been adopted by the Uganda National Bureau of Standards (UNBS), and twenty-two (22) bakers were trained in their implementation, thereby enhancing both standards and productivity	Development	Agriculture and Food security
4	Uganda	Fractionation of Ugandan Shea butter into Commercial Shea stearin and Shea Olein for industrial food and cosmetic application.	National Chemotherapeutic Laboratories	Nilo Beauty Products Limited	Locally designed and Fabricated a Fractionation Machine for commercial separation of olein and stearin fractions from shea butter. An application for an Industrial Design for the fabricated pilot fractionating machine for shea butter being finalized for submission to the National Patent Office (Uganda Registration Service Bureau) Optimized the fractionation process for shea butter extracted by cold pressing method. Three (3) shea butter based products developed: Nilo Soap, Nilo Cream, and Nilo Body Lotion.	Deployment	Agriculture and food security

#	Country	Project	Public Partner	Private partner	Outputs	Stage	Sector
5	Uganda	Essential Oil crops commercialization for sustainable public health products development and rational promotion	Bishop Stuart University (BSU),	Afri-Banana Products Limited	5 prototypes developed: 2 Essential Oil Products; 1 Cough Mix; 1 body herbal jelly and liquid soap	Development	Health
6	Uganda	Commercialization of Propolis Powder and Infused Tea bags for Improved Health and Income in Uganda	Makerere University	Uganda National Beekeeping Development Organization	Two (2) products developed: Propolis infused body cream and Propolis infused tea	Deployment	Health
7	Tanzania Final report indicate all projects had a private partner, pg10	Development and commercialization of sunflower oil mini-refinery technology to enhance productivity and income of small scale edible oil processors -TEMDO	TEMDO	SME oil processors	A sunflower oil mini refinery with a capacity of 1000 L per day was developed and a prototype has been manufactured	Development	Agriculture and Food security
8	Tanzania	Development and Commercialization of a Suitable Avocado Oil Mini-Extraction Plant to Enhance Productivity and Quality of Avocado Oil in Tanzania - TEMDO	Tanzania Engineering and Manufacturing Design Organization	Mgolole Agro processing Company and Arusha Oli Processing company48	Fabrication of the prototype completed. Development of Minimum Viable Product (MVP) will be done after testing. Avocado mechanical mini extractor	Development	Agriculture and Food security
9	Tanzania	Mechanization Technology in sunflower harvesting, threshing and Improvement of oil processing	University of Dar es Salaam:		One sunflower harvesting machine A sunflower oil mini refinery with a capacity of 1000 L per day was developed and a prototype has been manufactured Sunflower thresher machine developed	Development	Agriculture and Food security
10	Tanzania	Gypsum processing technologies for small scale miners	University of Dodoma		Design drawings are ready for field sieving, washing and calcinations and manufacture of prototypes has started	Development	Mining
11	Rwanda Report indicate all projects were implemented by private sector partners (final Report page 6)	Development of modern biological control solutions for sustainable management of destructive invasive insect pests of maize and tomato for better food security, safety and nutrition in Rwanda"	Rwanda Agriculture and Animal Resources Development Board	Private plant protection partners. Agro dealers	Identify other collaborators in the field to ensure expanding collaborations	Development	Agriculture and food security

48 https://legacy.ippmedia.com/en/features/research-projects-promoting-tanzania%E2%80%99s-industrialisation-agenda

#	Country	Project	Public Partner	Private partner	Outputs	Stage	Sector
12	Rwanda	Pioneer Domestication of Common Carp Fish, Cyprinidae, In Rwandan Aquaculture Industry with Valorization of Silkworm Pupae for Low-Cost Nutritious Fish Feed	University of Rwanda	Cooperatives of fish farmers	They have contacted a cooperative of silkworm farmers and they agreed to partner in this project and they will provide marblery trees for silkworm. Delayed of approval of UR on the second agreement (2 contracts have been signed) Delayed to access funds from UR to request for the first installment (Implementation of the first instalment)	Development	Agriculture and food security
13	Rwanda	Mobile solar-powered cold storage to reduce post-harvest losses of agricultural products in Rwanda	University of Rwanda		The project activity plan is not on track because the acquisition of project equipment for building the solar powered cold storage unit was delayed by the procurement process. A new requisition with revised design and specifications of a mini cold storage unit powered by solar energy was submitted to the UR-SPIU procurement unit.	Ideation	Renewable Energy
14	Rwanda	Landfill gas for cooking from Municipal Solid Waste	University of Rwanda		The implementation delayed due to procurement challenges. Now, the tender of research equipment is published. The tender closed on 28th of April 2023	Ideation	Renewable Energy
15	Mozambique	Milk processing with native fruits for yogurt production		Milk producers and resellers	.	Development	Agriculture and food security
16	Mozambique	Fruit processing for pulps and juice production for cooking		Montebelo Indy, City Lodge, Southern Sun Maputo, Hotel Cardoso, White Pearl.	Luxury hotels Montebelo Indy, City Lodge, Southern Sun Maputo, Hotel Cardoso, White Pearl). KENMARE mining company for production of juices Instituto Superior Politécnico to produce a technological package for fruit in a small industrial unit for the production of juices on request from mining company	Deployment	Agriculture and food security
17	Malawi and Zimbabwe	Investigating diverse microbial consortia for production of bio-fertilizers	National University of Science and Technology Mzuzu University		Expected Outcome: the development of a Bio fertiliser	Ideation	Agriculture and food security
18	Malawi and Zimbabwe	Genetic improvement and mass breeding of Coptodon rendalli, Oreochromis shiranus and Oreochromis mossambicus for enhanced production and associated value chains in Malawi and Zimbabwe	University of Zimbabwe Mzuzu University		The RCZ has earmarked this project as one that can be assisted for commercialization Funding however seems to be limited under this initiative.	Ideation	Agriculture and food security

#	Country	Project	Public Partner	Private partner	Outputs	Stage	Sector
19	Malawi and Zimbabwe	Indigenous Microsymbionts for Food and Forage legumes: Deriving ecosystems services from Agricultural Biotechnology	Marondera University of Agricultural Sciences and Technology		The potential for commercializing both rhizobia and mycorrhiza inoculant are very high and financially attractive because currently available inoculants are only targeted at soybean. The demand for inoculants for all the other legumes grown by smallholder farmers is largely unmet because the imported sets have not been evaluated and weakly naturalize in local soils in Malawi and Zimbabwe. Expected outputs: To develop an effective nitrogen-fixing Rhizobia-Bacillus subtilis formulation for aflatoxigenic fungi exclusion and optimal pod yield production in groundnuts (Arachis hypogaea) in Malawi and Zimbabwe.	Ideation	Agriculture and Food Security
20	Malawi and Zimbabwe	Metagenomics study of the diversity and functional potential of the rhizosphere microbiome, associated with the roots of pre-release sorghum lines for tolerance to drought and heat in Zimbabwe and Malawi			Data to support the commercialization of the new seed variety.	Ideation	Agriculture and food security
21	Malawi and Zimbabwe	Harnessing Biotechnology to enhance the productivity of indigenous livestock (goats and chickens) in Malawi and Zimbabwe Dr Fortune Jomane, Lupane State University	Lupane State University Lilongwe University of Agriculture and Natural Resources	Co-operative groups	Goat breeding population has been established at Lilongwe University of Agriculture and Natural Resources and at farms in the community; Natural breeding has started as a role-out for both goats and chickens in communities.	Deployment	Biotechnology
22	Malawi and Zimbabwe	Development of a nitrogen-fixing Rhizobia-Bacillus subtilis formulation for aflatoxigenic fungi exclusion and optimal pod yield production in groundnuts (Arachis hypogaea) in Malawi and Zimbabwe	Natural Resources College of Lilongwe University of Agriculture and Natural Resources (NRC)	ICRISAT Malawi, University of Ghent and ISPA Research Institute in Italy		Development	Agriculture and Food security

#	Country	Project	Public Partner	Private partner	Outputs	Stage	Sector
23	Zimbabwe and Botswana	Development of Novel Nano-Engineered Reagents for Mineral Froth Flotation	Midlands State University, National University of Science and Technology, Botswana International University of Science and Technology	The Botswana Chamber of Mines and Khoemacau Copper Mine. Botswana Premium Nickel Resources (formerly BCL Limited) and Motheo Sand Fire provided ore samples. Mimosa Mine, Trojan Mine, Muriel Mine	Intellectual Property (IP) generation, commercialization and transfer of technology. The third phase of the project has commenced. In its Phase 2 the project was able to conduct floatation tests; undertake metallurgical simulations and optimize the synthesis process of nano-floatation reagents Validation tests performed	Development	Mining
24	Zambia, Malawi, Mozambique	Towards technology sustainability through upscaling and commercialization of biogas generation in Malawi, Mozambique and Zambia	University of Copper belt Eduardo Mondlane University (UEM) Malawi University of Science and Technology (MUST)	Local Hotel Mozambique (UNIDO) Local Company	Community engagements were done to assess their perspective of using biogas from animal and human waste. The communities were ready to adopt the technology. Three biodigesters were built; two for animal feedstock and one for human waste feedstock. . A Purification and Bottling Unit was designed and built and tested.	Development	Renewable Energy
25	Zambia, Malawi and Mozambique	Assessing the performance of solar drying and solar cooling technologies in reducing post-harvest losses of vegetables along the supply and value chains	University of Zambia Universidade Eduardo Mondlane Malawi University of Science and Technology (MUST)	Farmers Co-operatives,. German Technical Co-operation	A field scale solar drying technology for fruit and vegetable drying was designed and developed; Sensory testing of the dried tomato was conducted; the appearance, colour and taste were found to be very good and acceptable by consumers. The economic viability of the solar drying technology was assessed and found to be positive; Possible future support and Agreement were being negotiated Partnership for technology transfer and commercialization for vegetable solar drier	Development	Renewable Energy

#	Country	Project	Public Partner	Private partner	Outputs	Stage	Sector
26	Zambia, Malawi and Mozambique	Invasive Alien plants (IAPs) for eco-friendly energy: From environmental problem to economic asset	Copper belt University Lilongwe University of Agriculture and Natural Resources, Eduardo Mondlane University, Forest Engineering	Farmer Cooperative Societies	- The construction of the Greenhouse solar dryer was completed by the and of Dezember 2022, incluiding the construction of the trays and the stands. - The greenhouse solar dryer technology has been constructed and installed in Boane Distrit at the Agrarian Institute of Research of Mozambique, around which there are agricultural community grouped in cooperative.	Development	Renewable Energy
27	Burkina Faso	Co-Construction of a Sustainable Biofertilizer Inoculum Industry to Increase Agricultural Production and Food Security in Burkina Faso	Institute of Environment and Agricultural Research (INERA)	Cooperative Societies	High-quality biofertilizer inocula based on mycorrhizal fungi are locally produced by three cooperative units in different localities.	Deployment	Agriculture and food security
28	Burkina Faso	Cultural Assets and Promotion of Conservation Technologies for Local Beer in Burkina Faso	Institute of Social Sciences (INSS)	Local Producer Associations	Most producers and consumers favor modern packaging methods, as they enhance the attractiveness of dolo (local beer), increase clientele, improve production and profits, and ensure better preservation, hygiene, and quality. Production is mainly carried out by women, with an average age of 53 years, and 45.2% of producers are illiterate.	Deployment	Agriculture and food security
29	Mozambique and Namibia	Application of indigenous knowledge in the treatment of infectious diseases (Malaria, HIV/AIDS, Tuberculosis and COVID-19) in Manica and Tete provinces of Mozambique, and in the Linyanti and Sibinda constituencies in the Zambezi region of Namibia.	University of Namibia University - Faculty of Agrarian and Biological Sciences	Traditional Herbal Practitioners	31 traditional practioners were trained in the development of herbal remedies for commercialization in Manica and Sussundenga	Development	Health

8. Annex 2: Projects Ready for Commercialization: SGCI-2 to RIM

8.1 Science Granting Council Initiative 2

Project 1: Commercialization of Propolis Powder and Infused Tea bags for Improved Health and Income in Uganda

	Key aspects	Details
1	Project Innovation	Technology for production and processing of propolis powder and propolis infused tea bags
2	Target beneficiaries	Beekeeping farmers
	TRL	Deployment
5	Implementers	Makerere University Uganda National Beekeeping Development Organization
	Project Objectives	To design and pilot propolis extraction and processing equipment To develop propolis infused tea bags To protect the innovation through intellectual property rights To commercialise the innovations
6	Project achievements	Fabricated propolis equipment & initiated IP Developed mini-cottage and propolis products Developed prototypes of Solvent evaporator and propolis dryer pending fabrication
7	Budget	US$ 35,000
8	Country	Uganda

Project 2: Essential Oil crops commercialization for sustainable public health products development and rational promotion

	Key aspects	Details
1	Project Innovation	Integrating traditional herbal knowledge with modern product development.
2	Target beneficiaries	Aromatic crops farmers MSMEs in the food, beverage, nutraceutical and cosmetics sub sectors,
3	TRL	Development
4	Implementers	Bishop Stuart University (BSU), Afri-Banana Products Limited
5	Project objectives	To commercialize Essential Oil crops for sustainable public health products development and rational promotion
6	Project achievements	5 prototypes developed: 2 Essential Oil Products; 1 Cough Mix; 1 body herbal jelly and liquid soap
7	Budget	USD 29,430
8	Country	Uganda

Project 3: Fractionation of Ugandan Shea butter into Commercial Shea stearin and Shea Olein for industrial food and cosmetic application.

	Key aspects	Details
1	Project Innovation	Commercial Shea stearin and Shea Olein for industrial food and cosmetic application.
2	Target beneficiaries	Local farmers and MSMEs
3	TRL	Deployment
4	Implementers	National Chemotherapeutic Laboratories Nilo Beauty Products Limited
5	Project objectives	To optimize cold-pressed butter's fractionation
6	Project achievements	Locally designed and Fabricated a Fractionation Machine for commercial separation of olein and stearin fractions from shea butter. Three (3) shea butter based products developed: Nilo Soap, Nilo Cream, and Nilo Body Lotion.
7	Budget	USD 29,430
8	Country	Uganda

8.2 Research and Innovation Management (RIM) Project

Project 1: Scaling up post-harvest loss reduction technologies for horticultural crops using biomass waste packaging

	Key aspects	Details
1	Project Innovation	Production of paper from tomato biomas
2	Target beneficiaries	Small scale farmers SMES
3	TRL	Deployment
4	Implementers	Bio and Emerging Technology Institute (BETin)
5	Project objectives	To optimize the production process of sustainable packaging materials made from biomass waste for post-harvest loss reduction in horticultural crops To scale up the production of sustainable packaging materials made from biomass waste for post-harvest loss reduction in horticultural crops To transfer the postharvest technology to pulp and paper industry and small business companies (enterprises/SMEs, IAIP) following the dissemination plan
6	Project achievements	Commercial scale production of pulp and paper from tomato biomass has been successfully accomplished. Barguba Trading PLC, a private industry, is planning to use this technology to produce quality packaging product for fruit and vegetables export with greater water barrier properties.
	Budget	$39,600
7	Country	Ethiopia

Project 2: Scaling up of Agricultural By-Product Utilization Efficiency through the Application of Bio and Physical Feed Processing Technologies

	Key aspects	Details
1	Project Innovation	A novel multi-purpose feed processing machine is redesigned and fabricated
2	Target beneficiaries	Livestock producers SMEs
3	TRL	Development
4	Implementers	Bio and Emerging Technology Institute
5	Project objectives	To modify and produce one novel multipurpose agricultural by-product processing machine To disseminate biologically treated three types of crop residues To process and produce crop residues based complete diet formulation To produce physically processed crop residues To transfer crop residue chopping and grinding technologies by using a multipurpose feed process machine To create job opportunities for 260 individuals and for one small-scale enterprise through linking them to agricultural by-product processing techniques, complete diet production and product marketing activities within 24 months.
6	Project achievements	Multi-purpose feed processing machine was fabricated. The fabricated machine was tested by using raw materials Fungus spawns were prepared and ready for crop residues inoculation. A novel multi-purpose feed processing machine is redesigned and fabricated
	Budget	$39,576.63
7	Country	Ethiopia

Project 3: Commercialization of Maize Bran and Germ value added products in Uganda

	Key aspects	Details
1	Project Innovation	Commercialization of Maize Bran and Germ value added products in Uganda
2	Target beneficiaries	Millers, local small and large bakery and confectionery industries using maize bran and germ as ingredient.
3	TRL	Deployment
4	Implementers	Makerere University, Uganda National Bureau of Standards, Maganjo Grain miller Limited, Jovay cookery school / Breadmart.
5	Project objectives	Sensitize and create awareness on the maize bran and germ value added products among a wide stakeholder and the public at large. Undertake packaging design and branding of the different maize bran and germ value added products for market penetration. Identify and develop capacity of small scale and commercial processors on the production and use of maize bran and germ as substitution raw materials for processing of baked and confectionery products on large scale.
6	Project achievements	Three branded and packaged acceptable maize bran and germ value added products certified and commercialized. Consumer surveys and awareness have been conducted and the various product are acceptable hence of potential market value Three entrepreneurs (2 female and 1male proprietors), supported by the project through provision of small equipment to undertake production and commercialization of maize bran and germ value added products. The products have been tested among 200 consumers to get their views on the acceptability and willingness to purchase them. A number of value added products have been developed and packaged. Two quality control protocols for maize bran and germ value added product developed focusing of the process control and product quality controls, Forty local bakery factories/industries sensitized through demonstrations, Thirty maize millers (15 female and 15 male proprietors) trained certified by UNBS and mentored on the hygienic handling and production of maize bran and maize germ
7	Budget	USD 63,610
8	Country	Uganda

Project 4: Establishing a small scale food waste up-cycling facility for cricket feed production and marketing in Kampala

	Key aspects	Details
1	Project Innovation	A small scale food waste up-cycling facility for cricket feed production
2	Target beneficiaries	The youths collecting the waste from the sorting entities (households, restaurants, schools, etc
3	TRL	Development
4	Implementers	Uganda Christian University
5	Project objectives	Piloting sorted food waste collection/supply from households, markets, and food service centers Establishing and equipping a private sector pilot food waste up-cycling facility Training food waste handlers, feed retailers and users in good processing, handling and storage practices Enhancing the packaging, distribution, promotion, and marketing of a certified cricket feed product
6	Project achievements	Architectural design of the food waste processing facility completed The data about sorted waste collection has been collected and under analysis
7	Budget	USD 63,750
8	Country	Uganda

Project 5: Up-scaling the uptake of cocoa innovative technologies for enhanced value addition during primary processing

	Key aspects	Details
1	Project Innovation	Cocoa innovative technologies
2	Target beneficiaries	Cocoa farmers
3	TRL	Development
4	Implementers	Makerere University National Coffee Research Institute (NACORI) of the National Agricultural Research Institute (NARO)
5	Project objectives	To optimize the application of the single box for wider utilization during cocoa fermentation To assess the quality of artisan chocolate produced using validated protocols for market acceptability To establish market linkages for adoption and commercialization of cocoa innovations To develop capacity for cocoa research in Uganda
6	Project achievements	A new prototype of fermenting device with improved capacity, better drainage, strengthened cranck and easy empying have been designed, fabricated and distributed to the selected farmers in each PO in each district for fermentation trials. Three (3) local artisans have been identified who could multiply the boxes; Five (5) cocoa farmer cooperatives have been identified in each target district of Bundibugyo, Mukono, Hoima, Kagadi and Mayuge.
7	Budget	$85,000
8	Country	Uganda

Project 6: Adjustable Multi-Grain Seeding Machine (Power Tiller)

	Key aspects	Details
1	Project Innovation	Adjustable Mult-Grain Seeding Machine (Power Tiller)
2	Target beneficiaries	Small Scale Farmers
3	TRL	Deployment
4	Implementers	Rwanda Polytechnic Tech Adopters
5	Project objectives	Develop an Adjustable Mult-Grain Seeding Machine (Power Tiller) Set up a manufacturing workshop

	Key aspects	Details
6	Project achievements	A well-redefined power tiller designed A well-equipped workshop ready to start the manufacturing activities
7	Budget	RWF 50,000,000
8	Country	Rwanda

Project 7: Commercialization of Cassava Value Chain for Improved Food and Nutritional Security and Animal Feed Component

	Key aspects	Details
1	Project Innovation	Commercialization of Cassava
2	Target beneficiaries	Small scale cassava farmers
3	TRL	Development
4	Implementers	Masinde Muliro University of Science and Technology KALRO Kibabi University University of Eldoret Agro-Service Provider ASP Ltd
5	Project objectives	To enhance production of cassava through utilization of farmer-preferred disease-free planting materials To develop highly nutritious blended and fortified cassava products for human and livestock needs. To enhance empowerment of women and youth through engagement of private partners in the cassava value chain.
6	Project achievements	Project site secured and fenced Water and electricity infrastructure installed, Office renovated, security gate, Site plan approved and other approvals in progress Six key recipes for human food were validated and now prepared for production. The products are ready for submission to Kenya Bureau of Standards for certification and registration.
7	Budget	KES. 10,000,000
8	Country	Kenya

Project 8: Developing an all-in-one educational platform designed to address critical challenges in Sierra Leone's educational system.

	Key aspects	Details
1	Project Innovation	All-in-one educational platform designed to address critical challenges in Sierra Leone's educational system. The platform provides personalized and gamified learning experiences, with particular emphasis on local language support through Krio integration.
2	Target beneficiaries	Tertiary and Secondary school students
3	TRL	Deployment
4	Implementers	Easy Stem Limited
5	Project objectives	• Diagnose and quantify Sierra Leone's unique educational needs and create supporting cyberinfrastructure • Design, refine, and evaluate Sensebod for secondary and tertiary students • Explore and implement AI's potential for adaptive, development-oriented education • Foster cohesive learning communities through the platform
6	Project achievements	• Distributed and collected 1,000 survey forms (50 per school) • Established relationships with school administrators and teachers • Gathered detailed insights about student needs and preferences • successfully developed both web and mobile applications with key features: • Modular Monolith Django architecture has been successfully implemented • Implemented OpenAI integration (This has been tested with Gemini API as well as from anthropic). • Developed Krio language support • Created personalized learning algorithms • Implemented student progress tracking Developed adaptive difficulty adjustment • Implemented real-time collaboration tools, developed group chat functionality, created resource sharing system, implemented progress tracking dashboard and developed peer learning features
7	Budget	$38,750
8	Country	Sierra Leone

Project 9: Development of Novel Nano-Engineered Reagents for Mineral Froth Flotation

	Key aspects	Details
1	Project Innovation	Novel Nano-Engineered Reagents for Mineral Froth Flotation
2	Target beneficiaries	The mining sector/Industries
3	TRL	Development
4	Implementers	Midlands State University, National University of Science and Technology, Botswana International University of Science and Technology,
5	Budget	N/A
6	Project objectives	• Characterization of produced nano flotation reagent • Formulation of Material safety data sheet /Toxicology studies • Conduct Second flotation test in verifying the performance of the synthesized nano reagents • Conduct Pilot plant tests and project marketing
7	Project Achievements	• Generation of equipment design data which was merged with the chemical equipment manufacturers resulting in custom design of prototype plant process equipment.

9. Annex 3: PPP Projects and Related Sectors

#	Country	Project Title
Agriculture and food Security		
1	Uganda	Increasing wheat production and productivity through science based knowledge and innovations for a competitive wheat manufacturing value chain in Uganda.
2	Uganda	Piloting the production and distribution of low-cost protein and micro-nutrient rich cricket feed from food waste in Kampala
3	Uganda	Identification of standards and gaps in the bakery and Confectionery Industries
4	Uganda	Fractionation of Ugandan Shea butter into Commercial Shea stearin and Shea Olein for industrial food and cosmetic application.
27	Burkina Faso	Co-Construction of a Sustainable Biofertilizer Inoculum Industry to Increase Agricultural Production and Food Security in Burkina Faso
28	Burkina Faso	Cultural Assets and Promotion of Conservation Technologies for Local Beer in Burkina Faso
7	Tanzania	Development and commercialization of sunflower oil mini-refinery technology to enhance productivity and income of small scale edible oil processors -TEMDO
8	Tanzania	Development and Commercialization of a Suitable Avocado Oil Mini-Extraction Plant to Enhance Productivity and Quality of Avocado Oil in Tanzania - TEMDO
9	Tanzania	Mechanization Technology in sunflower harvesting, threshing and Improvement of oil processing
11	Rwanda	Development of modern biological control solutions for sustainable management of destructive invasive insect pests of maize and tomato for better food security, safety and nutrition in Rwanda”
12	Rwanda	Pioneer Domestication of Common Carp Fish, Cyprinidae, In Rwandan Aquaculture Industry with Valorization of Silkworm Pupae for Low-Cost Nutritious Fish Feed
15	Mozambique	Milk processing with native fruits for yogurt production
16	Mozambique	Fruit processing for pulps and juice production for cooking
17	Malawi and Zimbabwe	Investigating diverse microbial consortia for production of bio-fertilizers
18	Malawi and Zimbabwe	Genetic improvement and mass breeding of Coptodon rendalli, Oreochromis shiranus and Oreochromis mossambicus for enhanced production and associated value chains in Malawi and Zimbabwe
19	Malawi and Zimbabwe	Indigenous Microsymbionts for Food and Forage legumes: Deriving ecosystems services from Agricultural Biotechnology
20	Malawi and Zimbabwe	Metagenomics study of the diversity and functional potential of the rhizosphere microbiome, associated with the roots of pre-release sorghum lines for tolerance to drought and heat in Zimbabwe and Malawi
22	Malawi and Zimbabwe	Development of a nitrogen-fixing Rhizobia-Bacillus subtilis formulation for aflatoxigenic fungi exclusion and optimal pod yield production in groundnuts (Arachis hypogaea) in Malawi and Zimbabwe
		Renewable Energy
24	Zambia, Malawi, Mozambique	Towards technology sustainability through upscaling and commercialization of biogas generation in Malawi, Mozambique and Zambia
25	Zambia, Malawi and Mozambique	Assessing the performance of solar drying and solar cooling technologies in reducing post-harvest losses of vegetables along the supply and value chains
26	Zambia, Malawi and Mozambique	Invasive Alien plants (IAPs) for eco-friendly energy: From environmental problem to economic asset
13	Rwanda	Mobile solar-powered cold storage to reduce post-harvest losses of agricultural products in Rwanda
14	Rwanda	Landfill gas for cooking from Municipal Solid Waste
Health		

#	Country	Project Title
29	Mozambique and Namibia	Application of indigenous knowledge in the treatment of infectious diseases (Malaria, HIV/AIDS, Tuberculosis and COVID-19) in Manica and Tete provinces of Mozambique, and in the Linyanti and Sibinda constituencies in the Zambezi region of Namibia.
5	Uganda	Essential Oil crops commercialization for sustainable public health products development and rational promotion
6	Uganda	Commercialization of Propolis Powder and Infused Tea bags for Improved Health and Income in Uganda
Mining		
10	Tanzania	Gypsum processing technologies for small scale miners
23	Zimbabwe and Botswana	Development of Novel Nano-Engineered Reagents for Mineral Froth Flotation
Biotechnology		
21	Malawi and Zimbabwe	Harnessing Biotechnology to enhance the productivity of indigenous livestock (goats and chickens) in Malawi and Zimbabwe Dr Fortune Jomane, Lupane State University

10. Annex 4: PPP Projects and Corresponding Technology Readiness Levels

#	Project	Country
IDEATION		
1	Mobile solar-powered cold storage to reduce post-harvest losses of agricultural products in Rwanda	Rwanda
2	Landfill gas for cooking from Municipal Solid Waste	Rwanda
3	Investigating diverse microbial consortia for production of bio-fertilizers	Malawi/Zimbabwe
4	Genetic improvement and mass breeding of Coptodon rendalli, Oreochromis shiranus and Oreochromis mossambicus for enhanced production and	Malawi/Zimbabwe
5	Indigenous Microsymbionts for Food and Forage legumes: Deriving ecosystems services from Agricultural Biotechnology	Malawi/Zimbabwe
6	Metagenomics study of the diversity and functional potential of the rhizosphere microbiome, associated with the roots of pre-release sorghum lines for tolerance to drought and heat in Zimbabwe and Malawi	Malawi/Zimbabwe
DEVELOPMENT		
1	Increasing wheat production and productivity through science based knowledge and innovations for a competitive wheat manufacturing value chain in Uganda.	Uganda
2	Piloting the production and distribution of low-cost protein and micro-nutrient rich cricket feed from food waste in Kampala	Uganda
3	Identification of standards and gaps in the bakery and Confectionery Industries	Uganda
4	Essential Oil crops commercialization for sustainable public health products development and rational promotion	Uganda
5	Development and commercialization of sunflower oil mini-refinery technology to enhance productivity and income of small scale edible oil processors -TEMDO	Tanzania
6	Development and Commercialization of a Suitable Avocado Oil Mini-Extraction Plant to Enhance Productivity and Quality of Avocado Oil in Tanzania - TEMDO	Tanzania
7	Mechanization Technology in sunflower harvesting, threshing and Improvement of oil processing	Tanzania
8	Gypsum processing technologies for small scale miners	Tanzania
9	Development of modern biological control solutions for sustainable management of destructive invasive insect pests of maize and tomato for better food security, safety and nutrition in Rwanda"	Rwanda
10	Pioneer Domestication of Common Carp Fish, Cyprinidae, In Rwandan Aquaculture Industry with Valorization of Silkworm Pupae for Low-Cost Nutritious Fish Feed	Rwanda
11	Milk processing with native fruits for yogurt production	Mozambique
12	Development of a nitrogen-fixing Rhizobia-Bacillus subtilis formulation for aflatoxigenic fungi exclusion and optimal pod yield production in groundnuts (Arachis hypogaea) in Malawi and Zimbabwe	Malawi/Zimbabwe
13	Development of Novel Nano-Engineered Reagents for Mineral Froth Flotation	Zimbabwe/Botswana
14	Towards technology sustainability through upscaling and commercialization of biogas generation in Malawi, Mozambique and Zambia	Zambia, Malawi, Mozambique
15	Assessing the performance of solar drying and solar cooling technologies in reducing post-harvest losses of vegetables along the supply and value chains	Zambia, Malawi and Mozambique
16	Invasive Alien plants (IAPs) for eco-friendly energy: From environmental problem to economic asset	Zambia, Malawi and Mozambique

#	Project	Country
17	Application of indigenous knowledge in the treatment of infectious diseases (Malaria, HIV/AIDS, Tuberculosis and COVID-19) in Manica and Tete provinces of Mozambique, and in the Linyanti and Sibinda constituencies in the Zambezi region of Namibia.	Mozambique/Namibia
18	Commercialization of Propolis Powder and Infused Tea bags for Improved Health and Income in Uganda	
	DEPLOYMENT	
1	Co-Construction of a Sustainable Biofertilizer Inoculum Industry to Increase Agricultural Production and Food Security in Burkina Faso	Burkina Faso
2	Cultural Assets and Promotion of Conservation Technologies for Local Beer in Burkina Faso	Burkina Faso
3	Harnessing Biotechnology to enhance the productivity of indigenous livestock (goats and chickens) in Malawi and Zimbabwe	Malawi and Zimbabwe
4	Fruit processing for pulps and juice production for cooking	Mozambique
5	Commercialization of Propolis Powder and Infused Tea bags for Improved Health and Income in Uganda	Uganda
6	Fractionation of Ugandan Shea butter into Commercial Shea stearin and Shea Olein for industrial food and cosmetic application.	Uganda

African Centre for Technology Studies
2nd Floor, Konza Complex
Nairobi-Mombasa Road
P.O. Box 45917 - 00100
Nairobi, Kenya.

Email: info@acts-net.org
Tel: +254-710 607 210