FINAL REPORT

The subprogram

Fostering Innovation for Sustainable Socio-Economic Development
(2017 – 2023)

within the Sida-supported program *Building Systems for High Quality, Relevant Research, and Innovation in the Tanzania Program.*

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ABBREVIATION

CAMARTEC	
COSTECH	Tanzania Commission for Science and Technology
CRIM	Cluster Research and Innovation Model
FP	Food processing
HLI	Higher Learning Institution
HQ	Head Quarter
ICT	Information and Communication Technology

IP	Intellectual Property
IPR	Intellectual Property Rights
ISCP-EA	Innovation Systems and Cluster Program in East Africa
ISCP-TZ	Innovation Systems and Cluster Program in Tanzania
LGA	Local Government Authority
M&E	Monitoring and Evaluation
MAKISATU	National STI Competition
NFAST	National Fund for Advancement of Science and Technology
NGO	Non-Governmental Organization
R&D	Research and Development
REDESO	Relief to Development Society
SICD	Sustainability Innovations in Cooperation for Development
Sida	Swedish International Development Agency
SIDO	Small Industries Development Organization
SMEs	Small and Medium Enterprises
STI	Science Technology and Innovation
SUA	Sokoine University of Agriculture
TBS	Tanzania Bureau of Standards
TCCIA	Tanzania Chamber of Commerce, Industry and Agriculture
TCRA	Tanzania Communication Regulation Authority
TFRA	Tanzania Fertilizer Regulatory Authority
TIA	Technology and Innovation Assessment
TIRDO	Tanzania Industrial Research and Development Organisation
TRL	Technology Readiness Level
UNDP	United Nations Development Programme
VETA	Vocational Education and Training Authority
VINNOVA	Sweden's Innovation Agency

BACKGROUND

The Innovation Systems and Cluster Program in East Africa (ISCP-EA) was a university-led initiative initiated in 2004, operating collaboratively across three East African nations: Tanzania, Uganda and Mozambique. Coordinated and spearheaded within each country by the respective Faculties of Engineering/Technology at the Universities of Dar es Salaam, Makerere University and University Eduardo Mondlane, its primary aim was to ignite, catalyse, and foster the development of innovation systems and innovative clusters in the region and thereby facilitate speedy socio-economic development and poverty reduction. The program enabled universities to fulfil their mandate of actively engaging with and positively impacting societal development. By stimulating, catalysing, and promoting the generation of solutions to address the pressing challenges facing their respective societies, the universities transcended the traditional role of being mere 'ivory towers'.

Sida launched the Innovation Systems and Cluster Development Program in Tanzania (ISCP-Tz) in 2005 in partnership with the College of Engineering and Technology at the

University of Dar es Salaam. This program was succeeded by the Fostering Innovation for Sustainable Socio-Economic Development program, running from 2017 to 2023 at the Tanzania Commission of Science and Technology (COSTECH), with ongoing support from Sida. The program comprises two sub-programs: Innovative Clusters and Innovation Funding. These sub-programs aim to advance Tanzania's national socio-economic development by engaging research and knowledge institutions, SMEs and LGAs in nurturing, expediting, and bolstering the growth of innovative systems and clusters, thus contributing to building the National Innovation System in Tanzania. The ultimate goal is to promote innovations for sustainable development that align with the national five-year development plan (2020-2025) and the 2030 Agenda.

Throughout the entire development of the program, extensive collaboration has occurred with the Swedish partner SICD (Sustainability Innovations in Cooperation for Development). SICD's mission is to collaborate in fostering sustainable social and economic development. Since the early 2000s, SICD has maintained close partnerships with universities and other stakeholders in East Africa and Bolivia. These collaborative activities are centred on cluster and innovation system development, including research components, funded initially by Sida and VINNOVA. Currently, SICD is hosted by Lund University and Södertörn University.

PART 1: FUNDING INNOVATION

1.1. Introduction

The National Fund for Advancement of Science and Technology (NFAST) was established under the terms of Part V of Act No 7 of 1986 creating the Tanzania Commission for Science and Technology (COSTECH). The goals of NFAST include supporting local research and development (R&D), technology transfer, and Science, Technology, and Innovation (STI) initiatives following national priorities through grants and awards. COSTECH through NFAST provides grants to research, innovation, innovation support organisation and research infrastructure projects based on the requirements of the Research and Innovation COSTECH Grants Manual.

When established, NFAST was supporting research only. The Innovation Fund scheme was introduced in 2018 to create platforms for innovative activities by providing incentives for collaboration; promoting demand-driven and adaptive research and supporting innovation intermediation roles that improve dissemination of new technologies, productive partnerships, and links to markets. The scheme aims to bridge the gap in financing for innovation processes and to support innovators and their links to public institutions, private entrepreneurs, and other key factors such as producers and service providers.

1.2. Innovation Fund Management Mechanisms

1.2.1. Landscape of Funding Categories at COSTECH

The landscape of funding categories refers to the different types of fund support offered by NFAST to various innovative projects, initiatives, or businesses. Each funding category has its unique characteristics, requirements and objectives. The objectives influence design choices, including timeframe, grant size, and actors to be involved. For instance, digital innovation can be prototyped fairly quickly, while infrastructure is needed for hardware-based technologies to develop a prototype. Even more sophisticated facilities are needed for biotechnology, which requires numerous actors. For the change of innovation culture to become sustainable in organisations, it probably takes a long time.

Below are four funding categories offered by COSTECH according to its Research and Innovation Grants Manual.

1.2.2. Fund for Innovators (small and large grants)

This Fund aims to support innovators who wish to translate their ideas or inventions into a good or service that creates value for which customers will pay or for technical uses by intended beneficiaries. These innovations can take various forms, including new or enhanced products, services, or innovative organisational and managerial approaches. The support spans across different realms, encompassing industrial innovation, grassroots innovation and the traditional knowledge practices in our communities, which also form part of the innovation ecosystem.

COSTECH supports innovation according to the stages and types of requests brought by an innovator. The stages generally fall under three main categories of technology readiness level (TRL) as follows:

i. **Prototype Development**: this involves advancing research and technological outputs to develop prototypes, establish proof of concept and validate business cases. Attain a lab-scale product with low fidelity.
ii. **Technology Development:** this involves advancing technologies along the innovation value chain, from proof of concept/prototype to technology demonstration, that's, attaining minimum viable product tested in a real environment with high fidelity.
iii. **Technology Commercialization**: this involves market testing and validation. Connect technology innovators to onward business and investment opportunities. Proven product is taken to market.

Fostering innovation for sustainable socio-economic development (2017-2023) piloted the small grant (maximum of TSH 30,000,000/=) for small projects within one year and large grant (maximum of 130,000,000/=) for large projects within two years. Large grants were also used for the establishment or strengthening of innovation support organisations.

1.2.3. Upscaling of Research Results Towards Innovation

This fund is designed to support innovators who have developed minimum viable products with the goal of commercialisation through market validation and product demonstration. Its primary objective is to alleviate barriers to market entry by facilitating pre-commercialization activities, including the formulation of business plans, product piloting, and refinement based on market feedback and user/customer opinions, as well as obtaining necessary regulatory permits. Applicants may include those who have received previous innovation support from COSTECH and those who have been supported elsewhere. However, the success of this category of financing is very much dependent on the availability of conducive institutional policies and guidelines such as policies allowing the establishment of spinoff companies.

1.2.4. Funding for Innovative Cluster Initiatives

This fund is dedicated to providing grants to innovative clusters aiming to enhance competitiveness by developing or acquiring technology or common technical interventions. The predominant goal was to strengthen the market standing of cluster products through the application of relevant knowledge and skills generated by research and development institutions, or through solutions offered by technology providers. The innovative clusters to be supported are those coordinated by COSTECH via its Cluster Research Innovation Model (CRIM).

The CRIM initiative, spearheaded by COSTECH, focuses on supporting Small and Medium Enterprises (SMEs) organized in registered groups within specific value chains of products or services. Its objectives include facilitating access to technological solutions from research and development institutions and universities, as well as helping in overcoming technical barriers to trade by facilitating access to regulatory authorities within the Government. Experiences show that the optimization of CRIM is dependent on the operationalization of the Technology and Innovation Assessment (TIA) guideline.

1.2.5. Funding for Innovation Support Intermediaries

This fund is dedicated to supporting technology and innovation intermediary centres, encompassing innovation spaces, incubation centres, technology transfer offices maker spaces and the like, across both Tanzania mainland and Zanzibar. The program aims to assist these centres in addressing technical challenges within their ecosystems by issuing calls for intervention proposals. Through this initiative, the innovation intermediary can identify and tackle community technological hurdles, actively contributing to problem-solving efforts.

Grant applications must align with the set priority/thematic areas outlined in the call, which may evolve over time, while also adhering to specified eligibility criteria.

1.2.6. Designing the Fund Categories

Funding innovation involves providing financial support to ideas, projects, or initiatives that have the potential to bring about novel and valuable products, services, or processes. Several elements are involved in making funding innovation successful apart from money. These can vary depending on the context and the type of innovation being

supported. *The selection process for eligible project proposals is among the major elements that determine the success of any funding category.* Based on experiences, COSTECH / NFAST has established rigorously designed selection steps and criteria, which are well stipulated in the COSTECH Research and Innovation Grants Manual.

COSTECH visualised the selection process considering the entire spectrum of the innovation process from potential sources of new ideas to the expected societal impacts. It also has well-thought-out key players along the same innovation value chain and their characteristics.

This visualisation was important in designing the application form, which captures all needed information, from describing the innovation project to effective evaluation tools. Thus, the selection of instruments in the grant's manual focused on compliance with the technical requirements and desires of the actors in the subsequent stages of the innovation process.

As a result, *COSTECH's approach to funding innovation focuses as much on capacity building as it does on financial support.* Consequently, over the years, COSTECH experimented and refined the granting process, choosing different approaches for different categories of innovators depending on what is wanted to achieve.

In addition, the grant manual offers complementary support to make sure the fund support contributes not only to innovation and innovators but also to the building of the *innovation ecosystem* as a whole. This includes mentorship and coaching, showcasing and dialogues with key players in the ecosystems. The identification and justification for the need for this support is determined by COSTECH staff together with innovators at different steps of selection monitoring and evaluation such as due diligence (pre-award assessment) and technical field visits.

Outlined below are the steps involved in the selection process and an explanation of the key selection criteria for each step, embedded capacity-building components and outcomes.

1.2.7. Steps for selection of awardees of innovation fund

A total of nine (9) steps are involved in the selection process. These steps are designed in such a way that they complement each other, but apart from guiding the selection process it also provides room for training and coaching to applicants. The selection processes are well described in the COSTECH Grants Manual.

1.3. Various Platforms for Collaboration between Academia, Public and Private Sectors (formal and informal)

1.3.1. Background

According to Dzisah and Etzkowitz (2008)[1], among the current efforts to address the sustainable development goals of any country is through a close collaboration between local businesses, universities and government institutions through a structure known as Triple Helix. To attain this, the Triple Helix actors chosen in this project were cluster firms or individual SMEs (representing the business), Local Government Authorities (representing the government) and Universities & research institutes (representing academia). Triple Helix is the conscious attempt to organise key actors in innovation initiatives by engaging government, academia and the private sector. The Triple Helix configuration for collective action could be seen as an innovation in development dynamics. Note that sometimes the government may include both national and local governmental authorities but most important is the local government. Likewise, the academia may be a national or local research or training or vocational or extension Service institution.

1.3.2. Partnerships

The fund promoted collaboration by facilitating different partnership models between universities, research institutions, businesses, and government agencies. This network of collaborators implemented under innovative cluster initiatives, shares knowledge and resources, driving innovation collectively. By leveraging these partnership models, both universities/R&D institutions and innovative clusters enhanced their research capabilities, and their drive in commercialization efforts, and fostered the development of a vibrant innovation ecosystem. The following are some of the partnership models realised and their impacts on the broader innovation ecosystem

Joint innovation projects: A collaborative research project on “Automating the existing manual decortication machine” allowing CAMARTECH to work closely with Sisal clusters in solving real-world problems. The projects leverage the expertise of both R&D and cluster to drive innovation of the sisal decortication machine forward.

Integrated Knowledge (Technology) Transfer: Universities and R&D institutions often have valuable intellectual property (IP) resulting from their research activities. Partnering with innovative clusters allows them to commercialise this IP, turning academic discoveries into marketable products or services. For instance, a focal person from SUA coordinating innovation in the Morogoro Food Cluster, leveraged knowledge from five PhD research results to develop a “banana and breadfruit flour formulation free from aflatoxin”. That was possible only through leveraging each other's strengths, experience, expertise, and effective collaboration.

Shared facilities and resources: Universities often have state-of-the-art research facilities and equipment that can be shared with innovative clusters, reducing costs and

[1] Triple helix circulation: the heart of innovation and development, *International Journal of Technology Management & Sustainable Development,* Volume 7, Issue 2, p. 101 - 115

fostering collaboration on R&D initiatives. For Example, Leather cluster initiatives, through the use of laboratory facilities and researchers under attachment at TIRDO, succeeded in upscale PhD research results and developing a system for “Adopting and application of eco-friendly tanning technology”. The system managed to increase the efficiency and effectiveness of traditional tanning technology at Kiwango Leather Cluster in Mwanga District. Nevertheless, the cluster played a significant role in piloting the system and new business model which resulted in a fully functional model.

Joint Training and Education Program: Universities and R&D institutions can collaborate with innovative clusters to develop specialized training and education programs tailored to the needs of the industry. This helps to bridge the gap between academia and industry by ensuring that graduates have the skills and knowledge required by the job market. This was realised when Bee cluster partnered with VETA Babati to develop a short course on Bee management and incubation program. Under the agreement, members of the bee cluster will be responsible for training and mentorship support.

Strategic partnerships and alliances: partnerships between universities/R&D institutions and innovative clusters led to the formation of strategic alliances with other stakeholders, including government agencies, industry associations, and international partners. Cluster facilitators cultivate relationships, explore collaboration opportunities, and advocate for shared interests and goals.

1.3.3. Facilitation for Building Innovation Ecosystems

The fund facilitated access to innovation facilities available, expert mentors, advisors, and consultants, who guided innovators and start-ups in refining their ideas, building their businesses, and navigating challenges. The following were the main support provided to winners of the Innovation Fund:

The fund helps innovators to access to **prototyping facilities** such as maker spaces, or facilities within private and government institutions particularly universities and R&D which enables innovators to develop and refine their prototypes without incurring high equipment costs. For example, innovators were attached to relevant universities, VETA, SIDO and also private makerspace such as TWENDE. Through these attachments, the host institutions learned and understood the value of innovation culture and changed their instruments and strategies

Connecting innovators with **technical experts**, engineers, and designers can help them overcome technical challenges and optimize their prototypes for performance (value engineering), usability, and scalability.

Providing **guidance on intellectual property protection** strategies, and patent filing processes helps innovators safeguard their innovations and maintain a competitive advantage in the market. In the case of Sisal Cluster, for example, the joint ownership of IPR (utility model) of their new design of an automatic decorticating machine with the innovator allowed them to receive a share from each sale of the machine.

Assisting innovators in navigating **regulatory requirements**, obtaining necessary certifications, and ensuring compliance with industry standards which was essential for bringing innovative products to market safely and legally. For new innovations, it necessitated COSTECH to organise dialogues with responsible regulatory authorities to inform and develop a joint plan on how to establish guidelines for assessing the new innovation. A case example is HAKIKA organic fertiliser, the innovator under the supervision of COSTECH managed to collaborate with TBS and TFRA to develop guidelines for assessing organic fertilizers, which did not exist before.

Facilitating **connections** with industry partners, potential customers, investors, and collaborators expands the innovator's network, opens up opportunities for strategic partnerships, and increases access to resources and markets. This was implemented through participation in national exhibitions.

Offering access to the **accelerator program** provides startups and innovators with structured support, resources, and mentorship to accelerate their growth and increase their chances of success. This was done during pre-award training or under a special program before final selection.

Providing access **to testing and validation facilities** and pilot programs enables startups or cluster firms to validate their prototypes in real-world settings, gather user feedback, and iterate on their products before a full-scale launch. In some cases, particularly innovative cluster support was given to pilot new business modules dictated by upgraded technologies. As a result, a move to establish an official testbed or sandbox program has been started. For example, TCRA for ICT-based technologies and Bank of Tanzania for Fintech.

As a result, the fund directly and indirectly contributed to building the innovation ecosystem in Tanzania in different ways including establishing a conducive regulatory environment, building a pool of mentors for innovation in specific ecosystems, building a database of judges as well as mainstreaming innovation mindset and culture within university and RD communities. In addition, support for the establishment of workshops increases access to facilities for young innovators in their localities. For example;

- Adam Zacharia Kinyekile in Tunduma – manages to support the establishment of about 20 more workshops and about 100 students were trained during their field practical attachments.
- The late John Akan Fute (Mr. Pwagu) who worked on renewable energy innovations for over 2 decades was supported to capitalize on his workshop space and turned it into an **Innovation Clinic**. This is an Innovation space that conducts capacity-building programs on renewable energy technologies and mobilizes mentors for different programs of the space by establishing players in the innovation ecosystem in Njombe. With this capacity, Mr. Pwagu was able to conduct the 'Mchakato Wazo Program' (Idea processing program), which started with 10 youths who paid for the program for skills development, self-employment and other job creation.

- Innovators who were supported to procure working facilities/ instruments have the potential to produce more technologies beyond those approved by COSTECH. For example, Zaidu Mbwana from Tandahimba, Mtwara had above 80% of the approved budget allocated to procure workshop facilities; from which he has secured a tender to fabricate 350 units of cashew nut cracking machines from Cashew Nut Board.
- Some innovators hosted at different institutions received support beyond what was stipulated in the grant agreement through mentorship, attachment and outsourcing of expertise outside host institutions. For example;

  VETA Kigoma had to attach the grantee to a fellow innovator in order to share welding facility.

  MUST Mbeya had to attach three innovators at SIDO Mbeya to enable them utilize facilities which were not available at the MUST Workshop.

  SIDO Rukwa assisted the innovator in sourcing the expert for developing technical drawings from the SIDO Regional Office in Dar es Salaam.

We are now experiencing an increase in innovations from Universities and R&D which was not the case before the fund.

1.3.4. Innovation Intermediary Spaces

The fund supported the development of various innovation intermediaries thus creating physical spaces where innovators work, collaborate and access resources. Although innovation intermediaries often offer mentoring and networking services, there are differences in services attached to the names of intermediaries such as accelerators, incubators, maker space or innovation space. Incubators help new entrepreneurs and early-stage start-ups that have just been established. Innovation spaces/ hubs provide innovators with shared offices, a start-up community of like-minded individuals, and access to resources. On the other hand, Accelerators work with more mature start-ups that need to grow further and offer structured or scheduled programs.

Currently, 45 innovation spaces are supported by COSTECH and through other initiatives and programs. Out of them, 61.5% are identified as innovation spaces; 34.6% are accelerators; 30.8% are incubators; 19.2% are Maker's spaces; 11.5% are co-working spaces and the remaining 3.8% are innovative clusters. These are from independent private entities, Government-owned through Universities and R&D organizations and NGOs. Services offered by these innovation intermediaries include advocacy, building ecosystems, collaboration with other spaces or local government authority and Support network and system of innovators/entrepreneurs. These are presented and elaborated in the following table.

Table 1. Number of projects, type of support and outcomes

Year of support	Number of projects	Type of support	Output/ Outcomes
2018	15 innovation hubs	• Fund for establishment of innovation spaces	• Increased advocacy practices for startup and early-stage entrepreneurs (53.8%) • Access to physical working spaces and internet services

			• Investment and funding to start up or early-stage entrepreneurs

	15 innovative clusters	• Capacity building programs
		  ○ Trainings
		  ○ Workshops
		  ○ Mentorships
		  ○ Consultancy
		• Fund for technological interventions
		• R&D/ Industrial Linkages
		• Access to ownership (IPR) and product certification services
			• Enhanced capacity to promote, govern and manage innovative cluster interventions
			• Enhanced capacity in regional and local government authorities in the implementation of innovative clusters initiatives
			• Enhanced capacity to produce sustainable and competitive cluster products and services
			• Improved collaboration among clusters and academic/research institutions
			• Improved capacity to use, manage and utilize ICT tools to communicate cluster development

2020	10 FDCs	Capacity building to staff for establishment of innovation spaces	Increased participation in building innovation ecosystem • Relationship with LGA • Support network ecosystem of innovators
2021	Five (5) new innovation hubs from private and HLIs	Trainings, mentorship/support and linkage of enablers with government, potential stakeholders and innovators/ startups	Increased participation in building innovation ecosystem • Relationship with LGA • Collaboration with other spaces/industries • Linkage with R&D Institutions and • Support network ecosystem of innovators
2022	3 innovative clusters	• Fund for technological intervention • Linkages with government, potential stakeholders	Ongoing

1.3.5. Showcasing and exhibition of innovation

The fund supported organized innovation challenges, hackathons, and competitions that stimulated creativity and provided innovators with a platform to showcase their ideas. Showcasing and exhibitions of innovations at different levels of development can serve as powerful tools for building and nurturing an innovation ecosystem. COSTECH supported innovators to participate in four National Innovation Week. These events create opportunities to showcase innovative ideas, products, and technologies, foster collaboration among various stakeholders, and attract resources and support. The following is how these showcasing and exhibitions contributed to building an innovation ecosystem in Tanzania:

- Visibility and recognition of startups, entrepreneurs, and innovators, which attracted attention from potential customers, partners, and mentors, helping innovative ventures gain traction and credibility.
- Networking and collaboration at these events led to collaborations, partnerships, and knowledge sharing, which are essential for ecosystem growth.
- Demonstrating products and services to a broad audience led to new customer relationships, sales, and market hence market access.
- Feedback from a diverse range of stakeholders helped refine products, identify market fit, and validate the viability of innovations.
- Showcasing events served as a platform for policymakers and government agencies to engage with the innovation community. This interaction led to the development of supportive policies, and infrastructure improvements that benefited the entire ecosystem. for example, upscaling the national STI exhibition to become an annual event and later to be organised at the regional level. Also, the announcement of the government emphasizing for universities to establish institutional IP policies.
- Successful startups and innovative projects showcased at exhibitions served as role models and sources of inspiration for others within the ecosystem.
- The showcasing events provided a platform for innovators to connect, collaborate, and celebrate each other's achievements, fostering a supportive and cohesive ecosystem culture.
- Regularly hosting showcasing and exhibition events allowed COSTECH and other ecosystem stakeholders to monitor the ecosystem's progress over time. Measuring key performance indicators, such as the number of participants, innovations showcased, investments attracted, and collaborations formed provided insights into ecosystem growth and development and tracked progress over time.
- Showcasing events put a spotlight on innovative products, services, and technologies. This recognition boosted the visibility of start-ups and innovative projects, attracting potential customers, partners, and investors.

1.3.6. Innovation fund as a tool to increase capacity to innovate

Calls

In the year 2018, through Sida support, NFAST launched the first call for innovation grants. The overall objective of the call was to strengthen the innovation system in Tanzania by supporting innovations that could contribute to achieving the sustainable development goals (SDGs). Specifically, the call intended to

- increase the capacity to innovate among researchers, private entrepreneurs, SMEs and others that has a potential for social, economic and environmental development,
- increase capacity for collaborations between academia, public and private sectors (from both formal and informal) through various platforms,
- improved capacity for innovation fund management mechanisms.

Subsequently, NFAST launched calls for innovation funds annually for different target groups depending on the availability of funds. The funds were sourced from different development partners and the Government (Table 2).

Table 2. Sources of Innovation Fund and targeted groups

Sources of innovation fund	Programme and target group	Number of supported projects	Type of support
SIDA	Open call of innovation fund (small and large grant) – 2018.	17 (15 small and 2 large)	Prototype development, Technology development and commercialization of proven technologies
	Closed call to Innovative clusters – 2020/2021. Members of the cluster are SMEs in a specified sub-sector.	10 from 15 clusters)	Upgrading of technologies, technology transfer and acquisitions
	National STI Competition Award (MAKISATU) – 2020. All interested innovators from informal and formal sectors are eligible.	70	prototype development, technology development and commercialization of proven technologies
Human Development Innovation Fund (HDIF)	Innovation Fund support – 2018 open to all innovators from informal and formal sectors.	15	prototype development, technology development and commercialization of proven technologies
	Support to establishment of Innovation Spaces 2018.	15	support to technology and innovation intermediaries, from private and government institutions
Government of Tanzania	Closed Innovation Fund support – 2020 to researchers benefited from research fund from NFAST.	3	Upscaling research results
	Closed Innovation Fund support – 2021 to innovators previously supported from NFAST.	1	Upscaling of innovation projects
	National STI Competition Award (MAKISATU) 2019, 2021 and 2022.	59	Prototype development, technology development and commercialization of proven technologies

UNDP Funguo program	Buni Young Women Program. (Future FemTech 2022)	5	Seed grants to support prototype development.
	Total	**195**	

Seed Funding Achievements

The innovation fund proved to be a powerful tool to increase the capacity to innovate to individual innovators and organizations, particularly innovative clusters. It provided financial resources and support to foster a culture of innovation and drive the development of new ideas and technologies.

The fund provided seed capital to start-ups and early-stage ventures, helping them turn their concepts into market-ready products or services. These seed funding were critical during the early stages of innovation.

Innovations towards the market

The fund supported efforts to bring new products and solutions to the market, including market research, product development, and marketing.

Societal Impact

COSTECH supports technology development from prototype to commercialization of technologies. Despite prevailing challenges surrounding the implementation of projects, some projects have created a noticeable impact on products and services produced, revenue generated and contribution to the innovation ecosystem.

Table 3. Project and reported societal impact

	Project	Societal Impact	Remarks
1.	JV-BIO-TECH	Currently in mass production with a contract on the pipeline to take over a municipal plant	
2.	KYARO WHEELCHAIR	The innovator has successfully raised funds for production of other assistive technologies and is currently commercially viable	
3.	Mtambo wa kutenganisha mawese mekundu na ya njano katika mnyororo wa kuongeza thamani zao la Mchikichi	1. Improving health for its unique red palm oil and other associated product. 2. Wealth creation particularly to farmers of raw materials 3. Commercialization and exploitation of the palm and its products	
4.	Avomeru group limited Avocado Oil Processing	• Currently exports the Avocado Oil as well as sells the technology for extraction of Avocado Oil • Installed three avocado processing machines.	The President of Tanzania was impressed by the business during

		• Improved working environment and product branding	Nanenane event
5.	SUCJET SPRINTER	Is a commercially viable product with several users and having been featured in numerous trade fairs	

IP issues

Innovation often involves creating intellectual property. The fund assisted innovators in securing patents, copyrights and trademarks, protecting their innovations and encouraging further development.

By strategically deploying financial resources and support, an innovation fund can increase the capacity to innovate and contribute to economic growth, competitiveness, and the development of cutting-edge technologies. It nurtures a culture of innovation and provides the necessary resources for individuals and organizations to explore, experiment, and create solutions to societal challenges.

PART 2: INNOVATIVE CLUSTERS

The subprogram of innovative clusters has since its start in 2005 been aimed at creating platforms needed for collaborative and inclusive innovation. Clusters are seen as meeting places for innovation actors from the private sector, academic institutions and governmental authorities referred to as the Triple Helix approach.

2.1. Objectives

The overarching objective of this innovative cluster subprogram was to pioneer a replicable framework for fostering the growth and expansion of competitive and innovative clusters within Tanzania's evolving knowledge-driven society. This initiative was designed with five distinct objectives:

- Improved capacity for COSTECH and SIDO to promote, govern and manage innovative cluster interventions to promote cluster development.
- Enhancing capacity of regional and local government authorities in the implementation of innovative cluster initiatives
- Enhance sustainable competitiveness of relevant innovative cluster products and services

- Implementation of cluster research and innovation model (CRIM) among clusters and academic/research institutions

- ICT support as an enabler for cluster development

2.2. Concepts and model used

Innovation
It is crucial to be clear about the distinction between an invention and an innovation. An invention involves the initial creation of something entirely new, often as a result of research, while an innovation takes place when an invention is effectively introduced to the market or applied in a practical and valuable way.

Innovative cluster
A cluster consists of specialized firms or farms co-located within a geographical area with linkages to suppliers, supporting organizations and knowledge institutions. Firms in a cluster can benefit from common assets such as natural resources, good infrastructures, knowledge resources, and access to a specialized and qualified workforce. Trust among cluster firms and other cluster actors creates social capital, which is an important cluster asset.

To initiate a cluster is not to initiate a project. A cluster has a start but not a defined end. A cluster may be initiated by the government, academia, or a private sector development agency. Innovation-driven actors from different sectors aim to support the renewal and competitiveness of the cluster firms. A decisive factor for the development of a cluster is facilitation supporting the decision-making and collective action among the involved actors - all the firms and organizations that are linked together in value creation. To initiate a cluster is the conscious attempt to mobilize and organize actors and resources to make individual cluster firms more innovative and competitive.

The deliberate action of embracing innovation, knowledge application and sharing transforms a cluster into an innovative one. Innovation becomes the key driver for achieving competitiveness of the cluster. A cluster that embraces innovation, is an innovative cluster. An important condition for an innovative cluster is a conscious attempt to organize key actors in a cluster by engaging government, academia and the private sector in what is commonly referred to as the Triple Helix configuration for collective action.

Triple Helix approach
A Triple Helix approach is the conscious attempt to organize key actors in innovation initiatives by engaging government, academia and the private sector. The Triple Helix configuration for collective action could be seen as an innovation in development dynamics. Note that sometimes the government may include both national and local governmental authorities but most important is the local government. Likewise, the

academia may be a national or local research or training or vocational or extension service institution.

According to Dzisah (2008)[1], among the current efforts to address the sustainable development goals of any country is through a close collaboration between local businesses, universities and government institutions through a structure known as Triple Helix. To attain this, the Triple Helix actors chosen in this subprogram were cluster firms (representing the business), Local Government Authorities (representing the government) and Universities & research institutes (representing academia).

2.3. Improved capacity for COSTECH and SIDO to promote, govern and manage innovative cluster interventions to promote cluster development.

The implementing partners, COSTECH and SIDO, developed the capacity for managing and supporting innovative clusters. The approach employed was “learning by doing.” COSTECH and SIDO developed a model for promoting, governing, and managing innovative clusters. Part of the model application involved selecting clusters and conducting a baseline survey for the selected clusters.

2.3.1. Cluster selection

COSTECH and SIDO had worked with clusters from previous projects. These clusters provided a starting point for the selection of clusters to be included in the current subprogram. The clusters were selected based on several criteria, including their potential for innovation, opportunities to create and strengthen linkages within and outside the cluster (such as with government agencies and regulatory bodies), support from local government authorities and research institutions, opportunities for synergies in resource mobilisation, procurement, and market access, sustainability potential, accessibility, and gender consideration.

A call for proposals was made to sixty-two clusters that were previously supported by COSTECH and SIDO. Fifty-five proposals were received and evaluated, and twenty-three proposals were shortlisted. Due diligence was done on 23 pre-selected clusters. External reviewers, including local and international ones, re-evaluated the data to ensure a fair selection process. After the review, the final selection was done, and fifteen clusters were approved for the innovative clusters program.

2.3.2. Baseline Survey

Baseline surveys were conducted for the 15 selected clusters. The intention was to gather the current status of the cluster firms based on the social, economic and financial situation as well as regional factors of importance. Data was collected from a random sample of 244 firms from the 15 clusters in 10 regions of Tanzania mainland and Zanzibar, from program coordinators at COSTECH and SIDO, nine LGAs at Tanzania mainland, and from seven LGAs at Zanzibar.

The baseline survey was conducted sequentially through baseline survey design, development of working tools (questionnaires) for data collection, enumerators training

and actual fieldwork (data collection, analysis and reporting). Feedback to the 15 clusters from the analysis of the surveys was conducted in consultative workshops, which also enabled the cluster firms to provide comments and inputs. These contributed to the final baseline survey findings to be used for the formulation of project interventions.

2.3.3. Capacity Building for Coordinating Institutions

COSTECH and SIDO, who were the project coordinating partners, needed capacity building to fulfil their roles as support organizations and facilitators of the innovative cluster program. Clusters needed capacity building to improve their ability to analyse products and process innovation as well as to define market opportunities. Cluster members and facilitators were trained on how to manage their activities and attain competitive innovative cluster products and services.

Different tools were used to build capacity for the implementation. These tools were training, workshops and study visits. Some of the capacity-building trainings conducted included sensitization workshops, call awareness training, cluster facilitators training, enumerator's training on baseline survey, workshops on cluster research and innovation model, workshops on M&E framework, and partners' annual planning and reporting workshops. Study visits to other countries like Sweden and the Philippines exposed COSTECH technical staff to new experiences and lessons on approaches to promoting linkages and collaborations for competitive products and innovations.

Table 5 is a summary of capacity-building programs and interventions conducted, and their corresponding impact on the partners.

Table 5. Interventions and impact

Interventions value chain	Output	Outcome	Capacity gained
Cluster selection process	15 cluster selected out of 55 received applications	Enhanced capacity on; • Documents preparation, review, analysis, documentation, reporting and decision making • Planning and managing call preparation and selection process	Assessment of innovations potential for cluster and networking.
Training of cluster facilitators	30 facilitators were trained	Assessment of the current relationship between facilities and cluster members and solving existing disputed among them	Facilitation skills and roles of management in the cluster initiatives
Training workshops to SIDO staff on	30 staff from 15 SIDO Regional offices, five (5) staff form SIDO HQ and	SIDO staff have the knowhow on	Capacity to govern, manage and organize enhanced

innovative Cluster development initiatives	COSTECH participated the workshop	innovative clusters concept	
Partners Planning and feedback meetings and workshops	These meetings were used to plan and receive feedback (report) from previous activities	Lessons and learning from individual clusters. Developing more effective reporting formats	Qualitative and quantitative presentation of the information

2.4. Enhanced capacity in regional and local government authorities in the implementation of innovative cluster initiatives

This output aimed at increasing the capacity of local government authorities (LGA) officers to analyse the local environment, its development potential, and the extent to which the cluster approach can be used for job creation, value addition, and skills development.

During the implementation of this output, capacity-building trainings for 11 LGAs from 10 different regions across Tanzania mainland and Zanzibar were conducted. Participants included Regional and District commissioners, Councillors, Mayors, LGA staff, and other key stakeholders, making a total of 187 stakeholders involved. These trainings were undertaken to enhance their understanding of the cluster concept and gain ownership of their locality. In this way, the respective LGAs realized the potential of engagement and cooperation with relevant stakeholders to support the clusters and their firms. Notably, a significant stride was made for LGAs such as Manyara, Kishapu, and Babati, whereby cluster activities were integrated into the annual plans. In Babati, a full-time dedicated cluster facilitator was appointed, in addition to making available a double refinery sunflower worth TZS 150 million. Additionally, the Babati Regional Secretariat and TARURA built a road to the cluster common facility to ease accessibility of the facility.

Kishapu LGA's executives are well-informed about the sisal cluster that is found in their locality, and they provide technical support and advice in the administration of clusters. Kishapu LGA disbursed TZS 2 Million out of the 3 million required by the cluster to purchase a brushing machine for the sisal cluster. On the other hand, the cluster managed to push down the LGAs to reduce the sisal selling levy from 5% to 3%. There are budget guideline directives that each LGA should commit 10% of its budget from its own sources to support development activities of vulnerable groups, particularly women (4%), youth (4%), and people with disabilities (2%). Some cluster members benefited from this arrangement. Most LGAs in this subprogram support their respective clusters to participate in Nanenane & Sabasaba exhibitions.

2.5. The Guidelines

The main outcome of the cluster subprogram is the capacity of the stakeholders in cluster interventions to collaborate and co-develop for increased competitiveness of the cluster firms and to secure their contributions to regional and sustainable development. This outcome is demonstrated in the five developed cluster guidelines to be used for the

replication and scale-up of innovative clusters, namely concerning Cluster Research and Innovation Model, Technology and Innovation Assessment, Intellectual Property, Monitoring & Evaluation and Exports.

2.5.1. Guidelines for Development of Innovative Clusters

Five guidelines were prepared and piloted by five selected clusters for their effectiveness and relevance in operationalising the triple helix model:

i. Cluster Research and Innovation Model (CRIM): This framework provides a way of systematically thinking about establishing collaborations between academic / knowledge institutions, entrepreneurs and government authorities in a Triple Helix configuration. It consists of preconditions for effective collaboration, the CRIM guideline and possible strategic choice models.
ii. Technology and Innovation Assessment (TIA): Important steps in sketching a framework include mapping the different elements and links of a production process, formulating a product objective, assessing the market opportunities for the product objective and modifying it accordingly and setting out the boundary conditions for the technological or other upgrade.
iii. Intellectual Property (IP) issues between and within cluster stakeholders: The guidelines enhance and facilitate the engagement of cluster firms in design or prototyping. The cluster firms are guided on how to secure the needed IPR issues like pattern protection, trademark, copyright or patent.
iv. Guidelines for exports of cluster products: This guideline is used to enhance the capacity of cluster firms to analyse on a practical as well as abstract level concerning market opportunities for their products and services internally as well as externally.
v. Monitoring and Evaluation Framework (M&E): This is a method to monitor all interventions in the clusters and evaluate the results. The framework for monitoring and evaluation (M&E) is an instrument for testing hypotheses regarding cluster development. Regular use of this instrument will create opportunities for learning by doing and a continuous adjustment of the intervention plans.

Details of the five guidelines can be found in the *Handbook of Sustainable Innovation - Learnings from Innovative Cluster and Innovation Fund Initiatives in Tanzania,* in printed form as well as digitally to be downloaded at https://www.sicd.se/wp-content/uploads/2024/03/HANDBOOK-Final-V2.pdf

2.5.2. Piloting the Guidelines

The five clusters participating in piloting the guidelines were selected competitively and granted an innovation fund to implement their projects for the period of one year July 2021 – June 2022. The approach used was to launch an innovation fund call to the fifteen clusters as a motivation for cluster members to test and validate the guidelines. The granting process followed the COSTECH Grants Manual 2020. The five clusters out of 14 clusters, who applied for the fund, were granted forty million TZH each to implement their proposed projects. The following are the notable achievements after piloting the guidelines.

- There is an increased rate of business formalization whereby the number of firms that have been registered under BRELA has increased. For instance, there is an increased number of formalized firms at the KIWANGO leather cluster (2), Kishapu sisal cluster (5), and Bee Keeping cluster (3). This implies an opportunity for increased revenues for the formalised cluster firms and tax to the local and central government. KUNAMO records show that they paid taxes amounting to TZS 94.8 million in 2019 compared to TZS 50 million paid in 2014. The company also paid various fees (annual fee, service levy, penalties etc) to Morogoro Municipal Council amounting to TZS 1.2 billion in 2019.

- The upgraded technologies improved efficiency in production and quality of the products in the market. The automated sisal decorticator (Raspador) machine proved to be efficient and consistent in quantity and quality of sisal fibre processing, ranging from 500kg - 1000kg per day compared to the previous one, which produced 150kg - 300kg/ day. Adopting and applying eco-friendly tanning technology by the Kiwango cluster reduced the time of leather processing from 14 days to 5-7 days. Approximately forty women and youth are involved as workers or in trade-related activities in this cluster.

- Infrastructure support benefitted members of the innovative clusters supported by the subprogram. It has helped to improve the quality of products from the cluster firms. For instance, the grapes cluster acknowledged improved processing because of receiving a pressing machine and storage tank with a capacity of almost 100,000 litres. Following this intervention, the bulk wine price increased from TZS 1,450 to 2,500 per litre because of improved quality. Additionally, Zanzibar seaweed farmers and Mwanga Leather clusters received the support of 5 boats (worth TZS 7 million) and two drums, respectively. Some cluster firms acknowledged increased revenues, employment, and tax contributions to the government.

2.6. Enhancing Sustainable Competitiveness

To further elaborate on and link to the guidelines the following functions and strategies are presented.

2.6.1 Strengthened collaborations between clusters and universities

There has been a change from the traditional transfer of technology from university through technology extension to joint knowledge and technology production and co-developing innovation processes supporting more demand-driven innovation. During the piloting of the five guidelines, particularly CRIM, a focal person from the respective university for all five participating clusters was identified as a precondition for effective collaboration. The focal persons provided not only technical support to the cluster but also facilitated the accessing of important data and research results from the university needed to add value to the cluster projects. The engagements of focal persons were formalized through MoUs between the cluster and the university.

In addition, the focal person helped to provide cluster firms access and use facilities available at the universities. This indicates that cluster firms realize the value of the university as a source of important knowledge as compared to the results from the baseline survey in 2018 where only 23% of respondents (cluster members) acknowledged the university as an important source of information.

2.6.2. Researchers and postgraduate students in collaborative cluster research

A way to engage academia within this subprogram was by allowing postgraduate students in relevant disciplines to work with clusters during their research and/or when writing their thesis proposals. The purpose of engaging researchers in cluster-driven research is to stimulate interaction, in which respective university learns the needs and the demands of clusters in different sectors across Tanzania. At the same time, the cluster would have the opportunity to understand the knowledge and technology available within academia and R&D institutions.

The design of this intervention involved the identification of researchers from the universities or R&D institutions already collaborating with clusters. A total of 15 researchers were officially nominated by their respective institutions and assigned to their respective clusters for research in the respective clusters. Out of 15 researchers, 10 researchers were funded and 5 did not complete the signing of the contract and hence disbursement of funds was not achieved. The research themes were selected based on the specific cluster demand. Hence, they were developed by cluster facilitators in collaboration with COSTECH. Academic partners, researchers or students, participated in scientific validation of the experimental design and contributed with relevant research findings. For results see Table 6 below.

2.6.3. Demand-Driven Innovation

The experiences show that among the factors influencing knowledge sharing between universities, R&D institutions and firms (SMEs) include cultural aspects and shared goals. Another factor is social aspects in the form of trust. Consequently, the majority of innovators are focusing mostly on identified problems or what end-users expect, leading to demand-driven innovations. However, the uptake of the innovation might be hindered or delayed because of a lack of quality, safety and usability, compliance with regulatory requirements and even the absence of interested agents for the distribution of the end products or services.

The development of prototypes in the five clusters piloting the cluster guidelines is an experimental process, where design teams implement ideas into tangible forms**.** The projects were involving prototyping of varying degrees of fidelity to capture design concepts. It involved testing not only for users but also for researchers and regulatory authorities to refine and validate the designs.

An example is the case of the developed automated decortication machine (Table 1). This innovation project involved firms of the Sisal cluster in Kishapu District, an R&D institution (CAMARTECH), an independent innovator, an IP consultant, an NGO working on community development programs (REDESO) and TCCIA. A researcher from

CAMARTEC investigated the performance-cost effectiveness and recommended additional parts but also less costly materials.

The design process and prototyping included planned periodical technical meetings as well as following and testing the functions with the cluster firms. These meetings allowed the designer (innovator) to link science-based and experience-based knowledge while maintaining its functionality for cluster firm requirements. Thus, an automated sisal decorticator was designed according to the needs identified in the dialogue between the firms of the sisal cluster, innovators and researchers. Moreover, the steps of the TIA guideline reorganized the cluster business model in alignment with technological upgrading.

Table 6. Technology upgrading, source of ideas and support (facilities/data) from university

	Cluster	**Technology upgrading involved**	**Sources of Innovative idea**	**Facilities / data from University/R&D**
1	MECI Metal Engineering	Improved Vegetable and fruit solar drying technology to improvise external heating system.	Cluster member, the producer of fruit solar drying Other types of solar drying facilities	Data on post harvesting requirements from SUA- Hort department thorough FP Experience form Focal Person
2	Food Processors	Develop banana and breadfruit flours formulation free from aflatoxin susceptible ingredients	Data from research result, SUA- food science dept thorough FP	
3	SHIWAMKI Sisal	Automating the existing manual decortication machine and increasing networking in backward production	Cluster members, the user of existing manual decortication machine and the Innovators	REDESO NGO facilitated feedback meeting between cluster members and innovators Technical support from CAMARTECH
4	Babati Bee Keeping Cluster	Harnessing bee products considering value chain and productivity		VETA Babati is providing space for incubation
5	KIWANGO Leather Cluster	Adopting and application of eco-friendly tanning technology	● Researchers as part of PhD program ● Cluster members	● Laboratory facilities ● Researchers under attachment

Some results of the prototyping model are summarized in the table below.

Table 7. Contribution of different actors in each cluster during project intervention

SN	Cluster and project	Actors and their contribution to innovation processes	Outcome
1.	Sisal Cluster (automatic sisal decorticator)	• Observed challenges by cluster members were communicated to the external innovators. • The researcher provided technical advice on the quality of materials, drawings, and established user manual. • Expertise and experiences shared from designing to the end product from different actors during testing and demonstration. • Value engineering with expertise from CAMARTEC. REDESO supported in field testing. • Patent drafting and filing by IP expert.	• A working prototype of an automatic decorticator machine • The improved design is protected by the Utility Model.
2.	KIWANGO leather cluster	• Procedures in the form of a PhD thesis. • Lab facilities from the Tanzania Industrial Research Development Organization (TIRDO) • Skills, experiences and knowhow of cluster firms used in refining parameters. • Optimization of parameters for using maize bran, papaya and extractor design • Development and testing new system recipe for the tanning process of leather. • Dar Es Salaam Institute of Technology (DIT Mwanza) piloted the prototype.	• Leather processing system. • Optimum parameter for using maize bran and papaya, extractor design. • A new system recipe for the tanning process of leather.
3.	Morogoro Food Cluster	• The results of five PhD students' research confirmed the problem, indicated different aflatoxin-safe ingredients available, provided good manufacturing practices, selected	• Food formulation free from aflatoxin • Protocol for processing soya flour

SN	Cluster and project	Actors and their contribution to innovation processes	Outcome
		ingredients of less aflatoxin and gluten-free and identified crops easily affected by aflatoxin • SUA – lab facilities and expertise, for example, extruder, soya dehullers. Cooking parameters established by cluster firms • TBS – analysis and certification of the food formulation. Consumer feedback helped in the identification of reasons for an unpalatable test of the first formulation and led to the optimization of processing parameters.	• Protocol for processing cassava flour • MoU with SUA on accessing facilities.
4.	Babati Bee keeping cluster	• Design of existing devices from Tanzania Wildlife Research Institute (TAWIRI), Centre for bee product processing (Nashipai) at Makuyuni, District Moduli-Arusha, BDTL-Arusha, ABC-Usa River naMakuyuni and Bee Training College in Tabora. • Expertise from VETA Manyara. • Laboratory facilities at VETA MANYARA. • Experience of cluster members in the beekeeping industry	• Prototypes of the five devices. • Training curriculum for a short course on beekeeping • Incubation program

2.6.4. Quality Improvement and IP Protection

The knowledge and options for Intellectual Property (IP) issues are cost-effective solutions to structural and non-formal knowledge asset management. The IP guideline is meant to be used by cluster firms, cluster facilitators and innovators and with IP as a tool for sustainable economic growth in the Tanzanian context.

The IP knowledge used is based on an understanding of technological advancements enhancing the ongoing globalization progression to the extent that even SMEs have excess to market opportunities inside and outside countries. But competitive abilities remain to be the main precondition for success. In a competitive environment particularly in Tanzania, not only structural IP but also expertise and relations are becoming increasingly important to ensure success. This has been demonstrated through the experiences in this subprogram in supporting innovative clusters and

innovation projects in Tanzania. However, there is no doubt technologies and innovations "co-evolve" out of interactions in specific contexts. This implies the responsibility for where and how these technologies and innovations travel, with what value and use and to be a collective one - "innovation looks less and less like a pipeline if indeed it ever resembled one".

2.6.5. MoU

Collaborations between actors in the innovation clusters were cemented by a Memorandum of Understanding (MoU), Intellectual Property Rights (IPR), and joint knowledge/technology production. Three clusters, out of the five, signed MoUs with respective universities, and one signed with VETA Babati DC. The areas of collaboration included:

i. Training students for an active problem-solving attitude within a systematic industrial perspective
ii. Exchange and sharing of experiences in developing new technologies between researchers, cluster members and users of developed technologies.
iii. Joint research activities and joint knowledge and technology production

Table 8. Cluster collaborations through MoUs

SN.	Cluster	Collaboration with formal MoUs
1.	MECI	MoU with SUA for joint research, student attachments and sharing experience.
2.	MFPCL	MoU with SUA for joint research, student attachments and sharing experience. Collective ownership of the resulting food formulation necessitated a collective business model for commercialization.
3.	Babati Bee Cluster	MoU with VETA Babati for joint incubation program and training program on beekeeping. The MoU guides the sharing of financial benefits and knowledge from the two interventions between the cluster and VETA Babati.
4.	Sisal KISHAPU	The upgrade from the pilot project is protected by the utility model granted to the cluster and the innovator. Hence, apart from common ownership of the new machine, a small percentage of earnings is guaranteed for each new machine sold.
5.	Leather KIWANGO	MoU with NM-AIST. The increased potential of the newly developed system allows leasing to leather processors outside the cluster, hence new income. Also, the improved recipe can be sold as a product.

KIWANGO leather cluster collaborates with the Tanzania Education Authority (TEA) to

train students on leather processing technologies. Forty young women and men have attended a one-month course on vegetable tanning. Similarly, Morogoro food processing cluster has managed to train about 300 trainees from different places, including Morogoro, Kibaha, Lushoto, and Iringa. KONGUMO cloth cluster has also managed to train and mentor about 41 trainees in cloth making, some of whom have become members of the cluster.

MECI metal cluster managed to sign an MoU with the Natural Institute of the UK to formulate wet cassava into cassava flour. This cluster has also entered an MoU with TEMDO, SUA, DELPTH University, and NRI-UK and was then contracted to develop a cassava agro-processing machine. The KUNAMO cluster has MoUs with SACU, Health Care International, TECHNO Save, Food Information and Technology, and TANIKA.

In addition, the signed MoUs act as the recognition and enforcement of benefit sharing of non-structural IPR generated from collective efforts. For example, the MoU between the bee cluster and VETA Babati indicated how cluster members benefit from operationalizing a newly developed curriculum for a short course on bee management. Another means of collaboration is through IPR (utility model) generated from the co-developing innovation. The guideline on IPR, in addition to informing who owns what from contributions, also helped to unpack both non-structural and structural IPR that emerged from joint knowledge.

2.7. ICT Support for Cluster Development

This specific objective focused on laying out a foundation for ICT as an enabler to cluster development activities and market competitiveness. To implement ICT support a technical team was formed to design for ICT use of the clusters. The team developed the cluster database, the main cluster website, and individual cluster web pages for all fifteen clusters. The process involved several meetings with the team to plan the system architecture. System developers then analysed the pros and cons of each framework to be used in the development process. Each cluster was visited by two team members to collect system requirements and needs analysis from the cluster members. The actual designing and development were followed by system testing to make sure the system worked as expected. This was then followed by training conducted on selected cluster members to prepare them to process and update information on their individual cluster web pages.

The main website provides a platform to showcase the program, milestones, reports, and other relevant opportunities. In addition, it provides transparency and digitization of cluster initiatives and operations. Cluster's main web page can be accessed at https://clusters.costech.or.tz/.

It was evident that clusters that were able to effectively use ICT increased their market

share. In the case of SHIWAMKI (sisal), the cluster firms have international orders and now need to increase supply to meet the demand. The SHIWAMKI cluster was able to get a 50-tonne deal to supply sisal in Nigeria and China after their social media posts captured the attention of the buyers. This is beyond their current supply capacity and has challenged their production.

Website links are among the top of the search list showing that their presence means that the websites have been optimized for easy accessibility. Further addition of Google profiles ensures the digital presence

PART 3: LESSONS LEARNED AND RECOMMENDATIONS

3.1. Lesson Learned

Based on the outcomes obtained from the innovative cluster sub-program, it can be concluded that the program implementation was very successful. The following are some of the lessons learned from the program.

Innovation funds and innovative clusters can complement each other effectively to drive technological development, economic growth, and innovation. The complementarity between these two approaches lies in their ability to address different aspects of the innovation ecosystems and support different stages of innovation. Below are experiences-based examples, in which innovation funds and innovative clusters work together.

3.1.1. Knowledge exchange

Innovation fund focuses primarily on providing financial resources but may not have a mechanism in place for knowledge exchange or technology transfer. But clusters are hubs for knowledge exchange. They bring together SMEs, research institutions, and experts, creating an environment where knowledge and expertise can flow freely.

3.1.2. Ecosystem building

While they play a crucial role in providing financial resources, innovation funds may not focus on building the broader innovation ecosystem. Innovative clusters contribute to the overall ecosystems by connecting various stakeholders, fostering a culture of innovation, and supporting the growth of a regional innovation network.

Innovative clusters act as catalysts or play pivotal roles in technology acquisition, technology transfer, and innovation by facilitating collaboration, knowledge sharing, and access to resources. In practice, these concepts are interconnected, and clusters often engage in all three to varying degrees to stay competitive and foster technological

advancement. Technology acquisition and transfer provide the foundation for innovation, as organisations build upon existing knowledge and expertise to create innovative solutions. The concepts are distinct but closely related in the realm of technological development and progress. Here are the key differences between these terms.

Table 9. Concept, definition, technology source, purpose

Concept	Definition	Source / Nature of technology	purpose
Technology acquisition	The process of obtaining or acquiring new technology, often from external sources, to be used within an organization or for a specific purpose	Various means, such as purchasing or licensing technology from other companies or collaborating with research institutions	To gain access to existing technologies that can improve efficiency, competitiveness, or the development of new products and services
Technology transfer	The process of sharing or disseminating technology, knowledge, or know-how from one organization or entity (typically a research institution or company) to another for the purpose of commercialization or further development	Often involves the transfer of intellectual property rights, patents, or technical expertise from the source to the recipient	To bridge the gap between research and practical application, enabling the recipient to leverage the technology for economic or societal benefits.
Innovation	The creation, development, and implementation of new or significantly improved products, services, processes, or business models that bring added value to customers or society	It encompasses a wide range of activities, including research and development, creative problem-solving, and the introduction of novel ideas or concepts.	To improve existing solutions, address unmet needs, or capitalize on new opportunities. It often involves the integration of multiple technologies or the development of entirely new ones

Specifically, the three concepts differ in ownership, focus, direction, outcome and motivation.

Table 10. Concept, ownership, focus, direction, outcome, motivation

Concept	ownership	focus	direction	outcome	motivation
Technology acquisition	Obtaining technology from	Primarily concerned	Often one-directional	The acquisition	Desire to leverage

	external sources	with acquiring or disseminating existing technologies	processes, with technology moving from the source to the recipient	and application of technology,	existing knowledge and capabilities,
Technology transfer	Typically involves the sharing or licensing of technology developed internally or by a partner organization				
Innovation		Creating something new or improving upon existing solutions	Multidirectional process that may involve the synthesis of various technologies and ideas	The creation of new products, processes, or services	Driven by the quest for novelty, competitive advantage, or societal impact.

3.1.3. Cluster Guidelines

The five guidelines for fostering innovative cluster development extend their significance beyond just cluster facilitators and focal persons. They are equally relevant and valuable for all stakeholders involved, including LGA, SIDO, COSTECH as well as policymakers.

The guidelines are important as they offer concrete and practical assistance for the clusters. They provide essential tools to navigate the initial phases of cluster development and to enhance innovation capabilities as the cluster advances. Furthermore, they incorporate a monitoring and evaluation framework to track the progress of cluster firms. In the later stages, these guidelines also promote exports, if desired by specific cluster firms.

For other actors engaged in the process, these guidelines serve to clarify their roles and responsibilities, while also encouraging necessary organizational adjustments and transformations. This aspect is particularly relevant for the university and COSTECH, as it supports their efforts to adapt and thrive in the evolving innovative cluster landscape.

3.1.4. Contribution to Millenium Goals

The shift from 8-millennium goals to 17 SDGs impacted several issues in the innovation ecosystems. It demands a more systematic approach to identify and judge the innovation potential of the research results. Thus, innovative platforms like innovative clusters are needed where a collaboration of researchers and business people are jointly working together to find solutions. As a result, knowledge from research institutions is moved through an integrated knowledge transfer as opposed to traditional transactional

technology transfer. The research project is not designed/identified with the intention of future commercialization. The selection process of research does not consider societal impact thus the expected end result is a lab prototype (TRL).

Upscaling of research results involves technology development to achieve a functional prototype (costly), a measure of its commercialization potential needs a clear understanding of not only technical requirements but also business requirements and manufacturing requirements, which the researcher might not be relevant to develop eligible proposal/review for eligible proposal.

Concerning support to the Innovative clusters the innovation fund is strategically used for transfer of knowledge in a more integrated mode than in the traditionally linear one.

3.1.5. Stages of technology development

The subsequent stages after technology development might demand associated technologies and /or special requirements for easy processing of raw materials, application and mass production. All these need to be available, accessible and manageable. Experience showed that the majority of failed projects particularly upscaling projects were due to not fulfilling requirements. For instance, the subsequent requirements for manufacturing and mass production, hence, the loss of invention which would otherwise be saved.

The availability of raw materials should be adequate, and accessible for realizing commercialization. Compliance with regulatory requirements and procedures is also needed.

3.1.6. Intellectual Property Rights

Structured and non-structured forms of intellectual property rights (IPR) both play essential roles in innovation, but they serve different functions and have distinct impacts on the innovation process. However, identification of these IPs particularly non-structural is not easy at the sources of knowledge. The IP guideline for innovative clusters is equipped with tools to identify both forms of IP. The following is a breakdown of their roles.

Structured IPR

Structured IPR, which includes patents, copyrights, trademarks, and other legally recognized forms of intellectual property, provides creators and inventors with legal protection for their innovations. This protection serves as an incentive for individuals and organizations to invest time, effort, and resources in developing new ideas, technologies, and creative works.

Structured IPR allows innovators to *monetize* their intellectual property through licensing, selling, or using it as collateral for financing. This revenue generation can fund further research and development, leading to continuous innovation.

Structured IPRs establish clear *ownership* rights, which prevent unauthorized use, duplication, or infringement of intellectual property. This clarity in ownership encourages collaboration and partnerships, as parties are more confident in sharing their innovations.

In the event of infringement or disputes, structured IPR provides a *legal framework* for seeking remedies and damages, ensuring that innovators have recourse to protect their intellectual property.

Patents, in particular, can facilitate *technology transfer* through licensing agreements. Companies can license their patented technologies to other entities, promoting the diffusion of innovations across industries and regions.

Non-structured IPR

Non-structured IPR includes *tacit knowledge*, trade secrets, and know-how, which are often difficult to codify or protect through traditional legal means. These forms of knowledge are critical in innovation as they encompass practical insights, skills, and expertise that are essential for creating and refining innovations but not documented except for projects in Innovative clusters where a special tool for IP management is used.

Non-structured IPRs encourage *collaboration* and knowledge sharing within organizations particularly clusters and across innovation networks. The majority of innovators rely on informal knowledge exchange and experiential learning to develop innovative solutions and techniques.

Non-structured IPR is particularly valuable for *incremental innovation*, where small but significant improvements are made to existing technologies or processes. These improvements often arise from the collective experience and insights of individuals within an organization or cluster.

Trade secrets and tacit knowledge can provide organizations with a *competitive advantage* because they are not publicly disclosed. However, innovative cluster guidelines for protection and management are needed.

In some cases, non-structured IPRs are used to mitigate the risks associated with structured IPRs. For example, individual innovators may rely on trade secrets or proprietary knowledge to protect aspects of their innovations while seeking patent protection for other aspects.

3.2 Recommendations

- Government to allocate and release enough funds to support cluster development
- Continue conducting sensitization to various stakeholders about the innovative clusters to create a common understanding

- To mainstream cluster activity into government plans
- Continuation of the new program after phasing out of this program
- Monitoring and evaluation of the supported innovation clusters

Appendix: Description of Indicators for Impact

Indicators	Definition
Understanding and awareness	People become aware of/and understand an issue better than they did before
Attitudinal	A change in attitudes, typically of a group of people who share similar views, towards a new attitude that brings them or others benefit.
Economic	Monetary benefits, either in terms of money saved, costs avoided or increases in turnover, profit, funding, or benefits to group0s of people or the environment measured in monetary terms.
Environmental	Benefits to genetic diversity, species or habitat conservation, and ecosystems, including benefits that humans derive from a healthy environment.
Health and well-being	Better outcomes for the health of individuals, social groups or public health, including saving lives and improving people's quality of lives. Also includes wider benefits such as emotional, psychological and economic well-being and measures of life satisfaction.
Policy	Contributions to new or amended laws, regulations or other public mechanisms that help to meet a defined need or objective that delivers public benefit. This goes beyond simply influencing policy; to enabling those policies to deliver public benefits.
Cultural	Changes in the prevailing values, attitudes, beliefs, discourse and patterns of behaviour, whether explicit or implicit in organizations, social groups or society. These cultural changes deliver benefits to the members of those groups or those they interact with.

Capacity or preparedness	New or enhanced capacity (physical, financial, natural, human resources or social capital and connectivity) that is likely to lead to future benefits or make individuals or groups better prepared to cope with adverse changes and conditions.
Gender	Better outcomes for women and girls in terms of access to opportunities, access to capital, access to education and skills, participation in decision making and reduction of inequality.