TANZANIA COMMISSION FOR SCIENCE AND TECHNOLOGY

(COSTECH)

FOSTERING INNOVATION FOR SUSTAINABLE SOCIO-ECONOMIC DEVELOPMENT.

CLUSTER RESEARCH & INNOVATION MODEL (CRIM)

JULY, 2023

Abbreviations

CAPN	The Centre of Food and Natural Products
CBO	**Community-Based** Organization
CI	Cluster Initiative
CoET-UDSM	College of Engineering and Technology at University of University of Dar es Salaam
COSTECH	Commission for Science and Technology
CRIM	Cluster Research Model
EU	European Union
FAO	The Food and Agriculture Organization of the United Nations
IIDS	Integrated Industrial Development Strategy 2025
IMS	Institute of Marine Sciences
IPR	Intellectual Property Right
ISCP-Tz	The Innovation Systems and Cluster Development Program
KOICA	Korea International Cooperation Agency
KTH	Royal Technical University, Stockholm, Sweden
LGA	Local Government Authority
Mode 1 research	Disciplinary research
Mode 2 research	Transdisciplinary research including knowledge producers outside university/research institutions
MoU	Memorandum of Understanding
NMAIST	The Nelson Mandela Institution of Science and Technology
PDTF	The Program of Manufacturing Technology Development
R&D	Research & Development
R&D&I	Research & Development & Innovation
SDG	Sustainable Development Goals
Sida	The Swedish International Development Cooperation
SICD	Sustainability Innovations in Cooperation for Development
SIDO	The Tanzania Small Industries Development Organization
TH	Triple Helix
TCCP	The Tanzania Cluster Competitiveness Program
TIRDO	Tanzania Industry Research Development Organization
UDSM	University of Dar es Salaa
ZaSCI	Zanzibar Seaweed Cluster Initiative

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1. Introduction

Fostering Innovation for Sustainable Socio-Economic Development 2017-2020 is a Sida-funded program aiming at contributing to the build-up of the National Innovation System in Tanzania. The main focus is to establish collaboration between academic institutions, entrepreneurs and government authorities in a so-called Triple Helix configuration. Through this format, entrepreneurs will get assistance from research and higher education institutions to do science and technology-supported innovations. Involving governmental authorities in the cooperation safeguards a mutual alignment of innovations to policy goals and policies to facilitate innovation.

For a long time, there has been a gap between universities/research institutions and the community of entrepreneurs/innovators. The universities have often been perceived as "ivory towers" and are not possible for a community member to approach easily. This situation has also made it very difficult for research results produced by such institutions to be used by the people to improve their activities and livelihoods. The Sida-supported cluster program has enabled the closure of that gap by linking cluster members (communities) to research institutions/universities.

To make it easier for cluster firms and universities/research institutions to link and cooperate, the present program includes a module on a Cluster Research & Innovation Model (CRIM). Practical Guidelines are presented in this CRIM document followed by more detailed presentations of the know-how as well as the cause for the Guidelines.

The CRIM with the Guidelines is organized in such a way that it can be used by all involved stakeholders – cluster firms, cluster facilitators, involved academic and governmental partners, COSTECH and SIDO.

The main aim is to foster collaboration between research institutions, cluster firms and government authorities in a so-called Triple Helix configuration.

Through this format, cluster firms will get assistance from and cooperate with research and higher education institutions to do science and technology-supported innovations.

2. Guidelines

The guidelines are based on

- Experiences from the development of cluster initiatives in Tanzania, Uganda and Bolivia

- A cooperation approach inspired by the Triple Helix model and Mode 2 processes. This is a non-linear, bottom-up approach fostering more sustainable co-evolution among all involved partners.

The involved partners are the cluster initiatives with the cluster firms in specific sectors, governmental authorities (local, regional, national), universities and knowledge institutions, COSTECH, SIDO and SICD. The role of COSTECH is to fund, offer advice and training, coordinate, monitor and evaluate. The role of SIDO is to facilitate, train and monitor on the ground close to the involved cluster initiatives. The role of SICD is to develop and revise tools used in the program, offer advice and participate in training and evaluation.

Before the guidelines can be functionally used, there are some preconditions for the cluster initiatives to have in place. These preconditions are presented in 2.1.

The guidelines start with general guidelines at the levels of cluster firms, universities/knowledge institutions, government and COSTECH respectively. After these general guidelines, specific guidelines follow concerning intellectual property, funding, research areas and the sustainable development goals (SDGs).

2.1 Preconditions

i. Training of involved partners – involved staff at COSTECH and SIDO, cluster firms, involved staff at research institutions, involved government staff, and any closely involved partners when appropriate. Additional training for the facilitators of each specific cluster initiative.

ii. At the cluster firm level

   a) A common agenda created among the cluster firms based on situational analysis, identification of needs, problems, challenges
   b) Trust built among cluster firms with joint low-hanging fruit activities, particularly at the early beginning
   c) Leadership groups for every activity created depending on the needs
   d) Visits among the different cluster firms
   e) Apprenticeship of workers among cluster firms is encouraged.

iii. At the university/knowledge institution level

   a) A database of research and researchers or research resource lists, if existing
   b) Having an access point via COSTECH to the database or research resource lists
   c) A focal point at the university/knowledge institution i.e. interested university facilitator

iv. THE KEY is devoted to persons both in operational and decision-making positions. The cluster facilitator is extremely important. It is as important for the facilitator to have support from the cluster coordinating committee (Board) members. For the linkage processes and activities with the university/knowledge institution, the cluster committee member coming from academia has a special responsibility and critical function to support the facilitator.

The facilitator must be able, supported by the academic member of the cluster coordinating committee, to

- understand the knowledge needs in the cluster firms out of the voices of the firms.
- have knowledge about resources at the universities/knowledge institutions and have the ability
- to reach out to these institutions
- build reliable relations between relevant researchers and cluster firms
- identify and acknowledge opportunities for cooperation activities encountering both the
- needs of the cluster firms and the interest of researchers
- identify and document innovations within the Cluster Initiative (CI)
- identify (or lead the identification) and acknowledge possibilities for funding opportunities for projects encountering both the needs of the cluster firms and the interest of researchers.

2.2 Guidelines *general*

At the cluster firm level

i. develop contacts and relations with relevant units at universities/knowledge institutions - tasks for the facilitator
ii. make visits to relevant units at universities/knowledge institutions.
iii. depending on the situation, develop a plan/road map for the utilisation of relevant research results in the CI.
iv. use the CI boards / coordinating committees and the institutions, that are stakeholders in the cluster, to support and enhance linkages with academia.

At the university level

i. start a bottom-up pilot with interested researchers willing to cooperate with cluster firms
ii. involve master students in different cluster activities like

- assessments
- business plan activities
- pilot innovation projects

The master students might become interested in using cluster-related activities in their master theses.

iii. perform workshops and seminars on innovation and cluster development at the faculty level and later on a cross-university level

iv. build trust among researchers and cluster firms through joint visits, depending on the situation at the university/knowledge institution linked up with an interested university facilitator

v. develop an Innovation Team of interested researchers linked to the cluster program

vi. inform and develop agreements on the top leadership level about innovation strategies, where cooperation between researchers and cluster firms is one of the strategies requested

vii. customize (language) existing results for easy use by clusters.

At the government level

i. contact, inform and discuss the involvement of the local government (and central government where appropriate), to which the cluster firms belong

ii. perform workshops and seminars on innovation and cluster development with a special focus on the role of government and how to link research resources

iii. develop relevant agreements with the local government

iv. based on tangible and research-related results from the cluster program develop joint funding strategies.

At the COSTECH level

i. make sure the database of research groups and research projects from the involved universities and knowledge institutions are updated as much as possible and available for support to the CIs. As wanted information in these databases is difficult to get hold of or is invisible for different reasons, other ways to receive research information must be considered. One way is to get the information via proposals in calls (for example from the COSTECH Innovation fund and other types of research calls). Another way to find the requested research resources is to take the identified research-related need of the cluster and pinpoint relevant research fields present at the university/knowledge

institution followed by finding out what kind of resources exist for the specific need. The latter can be supported by the members of the cluster coordination committee (Board) coming from the academia.

ii. make information on research-related problems identified by the clusters available for Master (or other degrees) students

iii. develop a knowledge common at the cluster website including examples of challenges facilitators can meet and suggestions on solutions results from the cluster-academia cooperation.

At SIDO level

i. take the role of a collaborative platform at a local level for R&D&I projects, which cluster initiatives and researchers/students jointly conduct.

2.3. Guidelines *specific activities*

Intellectual Property (IP) issues
There is a spectrum of IP rights (IPR) for open innovations with the *patent* on the one side and *commons* (open source (compare gnu.org)) on the other side. In between several arrangements can be found in different kinds of agreements.

The experiences from Sida-supported cluster development tell us that the IP issues start with a focus on *branding* issues. If the cluster has a well-developed, joint brand, the benefits for a cluster firm have shown to be substantial. For agriculture-related clusters, the branding is closely linked with official *certification*. Access to analysis lab facilities at universities for certification is one of several ways for cluster firms to cooperate with universities.

➡ See Chapter 6.

Funding issues
As mentioned above the facilitator needs to identify (or lead the identification) and acknowledge possibilities for funding opportunities for projects encountering both the needs of the cluster firms and the interest of researchers.

In chapter 9 examples of funding possibilities are presented. They include experiences from

- Donor funding
- Government funding including LGA funding
- International funding
- Internal funding strategy

- Crowdfunding (revolving fund)

Research area issues

This guideline does not list specific research topics or fields to be focused on. As mentioned in 1.1. the identification of needs, problems, and challenges within the CI will help to identify the needs for research-related cooperation. These research-related activities can be very specific for the CI but can also be more general and requested by several CIs. One example of both can be researched on how to make identification of market opportunities in general as well as identification of market opportunities for the sector of the specific CI.

Please Note

Every research-related cooperation activity must consider in practice the SDGs with a special focus on

- gender dimension fostering quality in the cluster's innovation development as well as
- inclusion of women in cluster initiatives
- decent work agendas
- the environmental responsibility.

➡ See Chapter 10.

3. Background

The program concerns three important aspects of achieving Sustainable Development Goals[1] (SDGs). The innovative cluster approach aims at creating the platforms needed for collaborative and inclusive innovation. Clusters may be seen as meeting places for innovation actors from the private sector, governmental authorities, civil society and academic institutions, often referred to as the Triple or Quadruple Helix. Previous experiences of Cluster Initiatives in Tanzania indicate that they are job creators and that their products and processing enable improved agricultural productivity and poverty reduction.

There are various efforts to support SMEs to compete in the market. One such is the Cluster Initiatives (CIs) concept which is an organized effort to enhance the growth and competitiveness of SMEs. Innovative Cluster is a new concept in Tanzania. However, the concept is becoming increasingly popular, particularly concerning improving the competitiveness of entrepreneurial firms. Commission for Science and Technology

[1] https://sustainabledevelopment.un.org/sdgs

(COSTECH) uses clusters as a collaborative platform for technology transfer and promoting demand-driven research.

The experiences so far are:

- The Innovation Systems and Cluster Development Program (ISCP-Tz) (2006-2009).
- The Innovation Systems and Cluster Development Program (ISCP-Tz) (2010-2015).
- The Tanzania Cluster Competitiveness Program (TCCP) (2009 – 2013).
- Recently, the cluster concept is also used in the Integrated Industrial Development Strategy 2025 (IIDS).

A major challenge for COSTECH is to draw on previous experiences to contribute to the achievements of the IIDS and other Tanzanian development policies and strategies.

The cluster initiatives in Tanzania started with a collaboration between the College of Engineering and Technology at the University of Dar es Salaam (CoET-UDSM) and Swedish partners SICD from 2006 to 2010, before being transferred to COSTECH in 2010. The projects followed a Triple Helix Model in engaging academia, research and development organisations to stimulate, catalyse and promote the development of innovation systems and innovative clusters in Tanzania. The projects emphasized the need for building two types of capacities required to advance innovations:

- Top-down research-based policy recommendations and implementations to create or enhance an innovation-enabling environment using clusters.
- Bottom-up, enterprise-based skills and methods for a range of innovation areas, be it product-, process-, market-, management-, or business model- innovations.

The ISCP-Tz started by piloting eight (8) CIs in 2006. The ISCP-TZ project has so far identified a total of 67, of which 42 new cluster initiatives have been supported in various areas of training and equipment. The project has been supporting SME competitiveness through business support, training cluster facilitators, providing and/or advising new technologies or techniques for business development, providing entrepreneurship and business skills, benchmarking, monitoring and evaluation of Cluster activities and linking clusters to markets or financial sources. The ISCP-Tz approach to CI formation followed the development of triple helix cluster initiatives using five stages and twelve steps approach (Anderson et al, 2004). While different levels of success have been documented resulting from the first phase of the project, we acknowledge the fact that we don´t know the actual impacts due to limited

monitoring in the previous design. Likewise, the project recognizes that there are many different ways in which clusters might emerge, and how support could be provided.

The ISCP-Tz formed the National Steering Committee in 2006, with the role of identifying industries or sub-sectors or products and services believed to have the potential for development within innovative clusters. It also guided the cluster formulation and facilitation processes by using assigned cluster facilitators. The actual cluster facilitators were selected among the research community and/or successful entrepreneurs in the identified industries and took up the challenge of facilitating the development of triple helix cluster initiatives.

The Tanzania Cluster Competitiveness Program is another initiative that supported CI development in Tanzania under the Tanzania Private Sector Competitiveness Program, between 2009 and 2013. The program aimed to improve the competitiveness of key business sectors focusing on Food Processing, Horticulture and Tourism. This initiative used a combination of matching grants to leverage productivity investments, support for new enterprises and business development services. The program was funded by the World Bank International Development Agency and the UK Department for International Development and implemented by Cardno Emerging Markets (a US-based organization).

The program achievements are as follows.

- Nearly 500 local business and government leaders now have a good understanding of the benefits of competitiveness, the ability to articulate the approach in their communities and advocate for the next steps to continually expand their competitiveness.
- Sectoral maps of each of the Tourism, horticulture, and food processing clusters and value chains were developed.
- Fourteen industry associations with upgraded member services which in the medium term can be used to generate a steady revenue stream that will contribute towards the achievement of their sustainability.
- Five hundred and fifty farmers trained in global standards.
- A tourism Industry data collection system, the first in Tanzania allows collection and utilization of visitor statistics.
- One thousand smallholder horticulture farmers have improved their business acumen and for the first time were able to negotiate prices and contracts with buyers.
- 10 internationally certified tour guides trained by the World Federation of tour guides.

The Tanzania Small Industries Development Organisation (SIDO) has adopted a cluster development approach since 2006. In regions such as Mbeya and Kigoma, SIDO's industrial estates were developed in a way to promote particular sectors such as rice milling and oil processing. In fact, under the Sida-supported programs, SIDO played its role as an

implementing partner and at the same time benefited from the interventions. For example, 7 SIDO staff were trained as cluster facilitators.

The module Cluster Research & Innovation Model

The interaction of cluster firms with R&D Institutions shows signs of improvement in cluster products, processes and services.

For instance, the Mwenge Wood Carving cluster initiative is now in formal collaborations with the Fine and Performing Art Department of the University of Dar es Salaam (for technical support and R&D), and the University of Dar es Salaam Business School is working closely with this CI through capacity building in marketing and innovation skills development (Msuya 2011). The training the CI received from Business School was eye-opening, where now they are making carvings using different types of wood and have managed to capture a new market niche that has increased sales significantly. About 12 new products have been introduced in the market, which increases revenue for the CI.

Another example is the Zanzibar Seaweed Cluster Initiative (ZaSCI) which has been collaborating with the Institute of Marine Sciences of the University of Dar es Salaam (IMS-UDSM) and the Zanzibar Agricultural Research Institute (ZARI) where innovative seaweed farming technologies have been jointly developed and ZaSCI members are using the technologies to farm a higher valued seaweed. Equally, more than 50 seaweed value-added products have been produced and marketed through collaborations. Some members of ZaSCI are now trainers of other farmers from different areas in seaweed value addition. These have tremendously increased the revenue of the CI members. Additionally, studies on seaweed diseases caused by the impact of climate change have been carried out and recommendations from the studies are used by CI members to cope with the effects of climate change.

Since the implementation of the ISCP-Tz program, an increase in the number of firms and value-added products can be seen in many cluster initiatives. The research institutions that have been actively working with the cluster initiatives are the Institute of Marine Sciences of the University of Dar es Salaam and Kizimbani Agricultural Research Institute, both based in Zanzibar, and they have contributed to better cluster performance via training on value addition, research and seaweed farming technique.

The Zanzibar Seaweed Cluster initiative, for instance, has increased the number of new value-added products such as seaweed soap, body cream, scrub, jam, juice, noodles and cookies are currently produced. In addition, there has also been an increase in the number of cluster firms via the attraction of new members (20 members or 1 firm in 2006 to 3,000 members or 22 firms in 2013) as well as an increased number of value-added products from the seaweed plant. Another good example is the Manyoni honey and Morogoro food clusters that are now producing new products namely honey wine and nutritional juices respectively.

This module of a Cluster Research & Innovation Model in the present Sida-funded program will

- Explore the experiences of involving research from the seaweed cluster, the woodcarving, the mushroom cluster initiatives and possibly others.
- Extract similarities and differences in the approaches from these experiences
- Analyse the experiences of the relevant academic literature on the topic of cooperation and co-development
- Compile the findings in a Guideline for the cluster research model. This guideline should first be used by the cluster initiatives involved in the COSTECH/SIDO program but should be updated and used for scale-up at a later stage.
- Encourage and motivate researchers, heads of departments, deans etc. at Tanzanian universities to engage in cluster development based on the guidelines.
- Encourage and motivate cluster initiatives and local governments to make better use of co-development together with academic institution*s*

Another important issue is that the Cluster Research & Innovation Model also should make references to the Sustainable Development Goals. It is partly about the way universities could refine their role concerning the SDGs and the integration of the SDGs in a common Agenda 2030. There are opportunities to show how the universities can work multidisciplinary to cover, for example, the decent work agenda in goal 8, the environmental goals 12, 13, 14 and 15, and the goal 16 on peace and justice.

4. Mode 1 Research leading to Mode 2 Practices

Universities are relatively neutral bodies/platforms in political contexts that can differ profoundly. Please note relatively. The universities have to manoeuvre strategically, though, to be durable. In low-income countries with more or less stable political systems, the university is a vital asset for social, cultural and economic sustainability and development. The universities in these countries face challenging demands to have their outcomes used in society for economic growth, challenging for more reasons than e.g. in Europe. This means that the ‘voice of society’ in science argues for the use of the very limited public resources in ways that benefit the people as soon as possible, if not immediately. Society speaks back in demand for relevant knowledge for survival and better living conditions. This is a strong incentive to find other ways than a dominant linear way of disseminating R&D results, which often takes too long time and is not always efficient or context-relevant.

4.1 Zanzibar seaweed cluster, Tanzania

Background

The Zanzibar Seaweed Cluster Initiative (ZaSCI) is one of the eight Pilot Cluster Initiatives started at the end of 2005 following the training of Cluster Facilitators. ZaSCI started its activities in 2006 to bring innovation into the seaweed farming industry that started in Tanzania in 1989 considering that there have been challenges linked to the impact of climate change and the world market, challenges that directly affect the farmers. ZaSCI's Triple Helix Model involves farmers, small-scale processors, exporters, and Users of seaweed linking them with government and academia/research institutions. ZaSCI works in two areas of innovation: developing innovative farming methods and value addition. In 2006 ZaSCI started its activities with one group of 21 women in one village at Kidoti, North Region, Unguja (Msuya 2011). After the Kidoti group, more farmers were trained under ZaSCI in Bweleo, Kisakasaka, and Chwaka villages during 2008-2009. Later the other villages joined ZaSCI and in 2021 ZaSCI had more than 3,700 members, most of them seaweed farmers but also including around 500 seaweed processors and more than 15 professionals in scientific, economic and social research/economic development.

Joint knowledge and technology production in Seaweed value addition

The cluster initiative started to use research results as far back as its start in 2006. Following research in value addition in Tanzania conducted mainly by the Institute of Marine Sciences, University of Dar es Salaam (IMS-UDSM), ZaSCI started to apply the research results directly to address its challenges. The first activity done in 2006 was to produce seaweed powder which was used to make seaweed soap and body cream. To make these products the group needed to grind the seaweed and therefore machines for making seaweed soap were acquired under ZaSCI. These machines were seaweed solar driers, grinders, soap mixers, and soap cutters for producing soap pieces among others. The solar drier was important because dry seaweed could not be ground as is unless it was dried further to a crisp state. The financial support for the acquisition of the machines was provided by the SMEs Competitiveness Facility (SCF) and the machines were made by the College of Engineering and Technology, University of Dar es Salaam (CoET-UDSM). Funding for training in operating the machines came from the Tanzania Commission for Science and Technology (COSTECH) and the Institute of Marine Sciences, University of Dar es Salaam (IMS-UDSM). Trials in the production of seaweed value-added products were made in 2006 and after acquiring the machines in 2008 the first seaweed product to be produced by a Zanzibari (and Tanzanian) seaweed farmer - the powder and soap - was marketed (See details in Msuya 2011). Since 2009 ZaSCI has more than 50 seaweed value-added products combining cosmetic and food products.

Joint knowledge and technology production in Innovative farming techniques

Another application of research results by the cluster initiative is farming seaweed in deeper waters because the seaweed Cottonii which fetches a higher price in the world market than Spinosum failed to grow in shallow water areas because of the effects of climate change

including the increase in surface seawater temperatures, ice-ice disease and epiphytes. To address this challenge ZaSCI endeavoured to develop innovative seaweed farming technologies working with its Triple Helix component. Technologies developed including floating lines system ropes and bamboo rafts showed that cottonii can be farmed in deeper waters (Msuya 2006, 2011c). Therefore, under ZaSCI seaweed farmers were trained on deep water farming technologies and experiments were conducted in five villages of Kidoti, Bweleo, Chwaka, Kisakasaka, and Muungoni. However, it was realised that the potential of the technologies could not be fully realised due to the challenges of the rough sea which breaks the seaweed and farmers to lose their crops. To overcome this, ZaSCI developed a new technique for deep water farming - the tubular nets - a technique which was experimented on in Brazil by Reis et al. (2015). The tubular nets technique enables coping with the effects of climate change and producing higher valued seaweed as well as enabling new ways of farming, improving working conditions for the farmers, and unlocking their capacity to improve their livelihoods and status. So far training in making and using tubular nets has been done in one village and 1,280kg of the higher-valued seaweed (wet weight) has been produced. The training is conducted in more villages. Most of the trained users of the technique are women.

Changing mindset

When the cluster initiative was starting its activities and when farmers were told about using seaweed to make products it was something very strange to them because in Zanzibar and the whole of Tanzania, no one used or ate seaweed. So, one major impact of making seaweed value-added products is that whereas the people of Zanzibar never knew that seaweed could be used to produce products let alone be eaten, ZaSCI has brought a "Habit of Eating Seaweed in Zanzibar". Today if one visits any village in Zanzibar (especially Unguja Island) and asks to be given seaweed food most likely the owners of the homes will prepare and give seaweed juice, cake, cookies, salad, crackers or noodles. Additionally, the people are now trading in seaweed value-added products, an activity that has improved their livelihoods to a marked extent.

Achievements

The cluster initiative:

- Is the first initiative to make the first seaweed value-added product made by seaweed farmers in Zanzibar and the whole of Tanzania
- Has managed to unite its members - farmers call each other when in need of e.g. seaweed seed or powder/material.
- Has managed to link farmers to research institutes and the government. A farmer can visit a government office or research institute/university to discuss challenges and other issues.
- Farmers can talk directly to seaweed exporters. This was not the case before the cluster initiative started.

- Before the start of the cluster initiative, no local person in Zanzibar ate seaweed. Today we have seaweed eaters in several villages in Zanzibar and mainland Tanzania.
- The government has recognized the cluster initiative's Seaweed Day (23rd July) and proclaimed this day as the National Seaweed Day on 23rd July each year.
- Recognizing the efforts of the cluster initiative to add value to the seaweed, the government through the ministries of Agriculture and Trade has started to engage in seaweed value addition and earmark that seaweed has a potential impact on the economy of Zanzibar
- Has managed to create 497 small-scale seaweed processors at the end of 2021.
- Farmers now have knowledge of innovative farming methods that can be used to produce the higher-valued seaweed cottonii. If challenges of disseminating these methods (e.g. rough sea, lack of boats) are solved, the cluster initiative members will farm cottonii again.
- In 2006 when the cluster initiative started it had only one product from seaweed farming-the dry seaweed. By 2008 it had four products - dry seaweed, seaweed powder, soap, and body cream produced in one village. In 2018 the cluster initiative had more than 50 products produced in 12 villages.
- Has expanded the internal market for seaweed products to include beauty spas.

4.2 Lake Katwe salt cluster, Uganda

Background

Salt Lake Katwe was one of the first seven pilot clusters in Uganda, initiated in 2005 (Rydhagen, Trojer 2011). The cluster idea was introduced to salt workers around the lake by one of the participants in the first cluster facilitator training course. The cluster formed a local leadership group in the village Katwe, representing salt workers (women salt winners and men salt extractors), salt loaders and salt traders. The local leadership group is in regular contact with the facilitator and with the local government on certain issues. Researchers at Mbarara and Makerere Universities have conducted research on how to refine the salt to table salt quality.

The lake is located in southwestern Uganda in Queen Elizabeth National Park. Its surface is 2.5 square kilometres, with a depth of a maximum of 1.5-2 meters. The salt has been extracted from the brine by residents for at least a hundred years. Today, it is reported that 10,000 persons work with salt extraction from the lake during the high season. The number of permanent residents working throughout the year is estimated to be between 1,000-2,000. The salt is sold for industrial use and animal consumption in Uganda and across the border to Kongo Kinshasa.

Salt Production

Salt is extracted through evaporation in shallow ponds along the shore and the cutting of salt

rock from the bottom of the central parts of the lake. On the shore, salt is weighed and paid for by women traders, who then sell it to buyers from outside the village, who collect the salt on trucks. The salt workers depend on buyers to appear regularly, since there is no storage for salt. The salt is carried from the lake to the trucks by male loaders on their necks.

Salt loaders, salt extractors and salt traders are organized in formal organizations where some of the profit is kept for collective use and as security for those who are sick and cannot work for a period. The collective fund is used to pay hospital fees when a member is in need. Women salt winners are more in number and less organized.

According to several salt workers, the main activity until now had been to find ways to refine the salt. A major concern the salt workers shared was the risk of losing control over the salt to external investors. A constant problem was also working conditions and the negative effects of salt on the skin and bodily organs. Therefore, major suggestions within the cluster were to develop work conditions and legal and organizational matters besides product quality improvement or increased salt extraction.

Over-utilization of the lake has led to conflicts between pan owners and extractors concerning safety distances between extraction and pans. Complaints also concerned the establishment of salt pans in the pathways for rainwater into the lake, which in turn caused flooding in nearby salt pans. Increased rainfall adds to the problem of dilution and flooding of pans and the main lake. In the women's groups, they also talked about the destruction of the green cover around the lake. Cattle grazing was regarded as one explanation, but also cutting of grass and bushes to mend the pond walls. Reduction of the green cover around the lake was a concern, since this had led to increased water runoff and the erosion of soil into the lake. In some groups, it was suggested that researchers should be invited to give environmental education and information to the community members, to emphasize and legitimize regulation for grazing and conservation of the green cover. This has been to some extent executed and persuaded people concerned to take action. In November 2012 positive results in increased green cover were reported.

Although the leadership group and the salt workers were interested in finding ways to increase the value of the salt, they raised concerns that more commercial extraction and refinement of salt might likely lead to foreign control of the resource. The cluster members have encountered situations, where external investors tried to get a mining license for the lake. So far, no license has been approved. There is a mobilization within the cluster and linked actors to keep control of the lake and thus secure income for all the people since long depending on the salt-lake resource.

Disciplinary (mode 1) research integrated into applied research (mode 2) practice

Research in the cluster context is more visible and more beneficial when it is formulated as an interdisciplinary and transdisciplinary activity. The establishment of cluster initiatives with local actors including universities in the vicinity of the small-scale business firms and local

government officials leads to innovation taking place at a speed fitting the local stakeholders and in areas crucial for further development and competitiveness of the business.

Local, small-scale development of natural resources has contributed to the economic and social development of rural communities as in Lake Katwe. Some key success factors seem to be:

- Respect for local knowledge and needs, such as control, deliberative progress and joint
- decision-making.
- The balance between competition and collaboration within local groups.
- Interdisciplinary research addresses different aspects of work conditions and products.
- Mutual trust between the stakeholders including the government.
- Support from University leadership to establish and pursue Mode 2 type research.
- Gender-aware planning to include and embrace women's and men's work conditions and
- position in society.
- Consideration of the environmental situation to address aspects of continued utilization of the natural resources during forthcoming years.

A co-evolving knowledge process in cluster contexts is not only a hand-in-hand process between actors within and outside universities. It is an integrating process between applied (mode 2) researchers, disciplinary (mode 1) researchers and partners in society. One concrete example from the Lake Katwe Salt Cluster is given by the issue of salt crystallization. A research team at KTH (Royal Technical University, Stockholm, Sweden) is working on salt crystallization processes at different international sites. In one of their projects, they used Katwe Salt Lake in Uganda as a case. They took water samples from the lake and brought them home for studies at their laboratories at KTH. Their main priority was the basic, disciplinary (mode 1) research on the crystallization frequencies of the salt. The results of their research show the salt crystallizing in sequences/fractions, where the sulphur-containing fraction crystallizes first followed by the chloride-containing and last the carbonate-containing fraction. There are not very distinct borders between the fractions, but as a first recrystallization, this first refinement step to remove more of the sulphur-containing salt is a great achievement compared to the existing local situation. To have a so-called table salt for human consumption the sulphur needs to be removed, as the added iodine chemically bonds to sulphur and can thus not be absorbed by humans. A low-tech method can be used to detect the sulphur fraction and when the crystallization is about to move over to the wanted chloride fraction. The researchers suggested that the differences could be tasted with the tongue. This example shows how mode 1 research can be linked to a distributed knowledge production of high context relevance i.e. a mode 2 approach.

4.3 The bee-keeping cluster, Babati district, Tanzania

The Beekeeping cluster in Babati district implemented a project aimed at developing bee products and harvesting and processing technologies. The project was funded by COSTECH through Sida support. The first step was to identify a team of professionals, who were directly involved in the development of the required technology. Thus, the team of five experts included staff from the Vocational Education and Training Authority (VETA-Manyara), the cluster facilitator together with one representative from the cluster members. The Cluster facilitator of the beekeeping cluster is a beekeeping expert employee in the Babati District Council, while VETA-Manyara is majoring in training in the fields of carpentry, electricity and welding of steel reinforcement.

The team identified institutions that were more knowledgeable in this field of expertise. The institutes identified were the Beekeeping Research Centre located under the Tanzania Wild Life Research Institute (TAWIRI), the centre for processing and trading bee products (Nashipai) located in Makuyuni, Moduli District in Arusha Region, as well as the Beekeeping Training Institute (BTI) in Tabora.

The method used was to adapt and improve the existing technologies depending on context and available manufacturing facilities. The experts visited the identified institutions to see and discuss the technologies in operation. Technologies developed are bee venom collectors, royal jelly harvesting, bee pollen traps, beeswax extraction using solar energy (solar wax extractors) and technology to remove the tendency of honey to granulate (honey warmer and mixer).

In implementing this project, the beekeeping cluster has proven the importance of the involvement of various stakeholders in the Triple Helix approach and utilizing knowledge and skills from different fields of expertise. In addition, good relations between the facilitator and all the stakeholders involved as well as the readiness of the team member was instrumental in the success of the project.

To facilitate the transfer of the prototypes, the prototype is placed at VETA Manyara, which has the role of an incubation centre with prototype support as well as a training centre. VETA Manyara has agreed to establish a new course on bee-keeping technology.

5. Co-developing Innovation Processes

5.1 Development of an automatic sisal decorticator (Raspador)

Prototyping

The Sisal cluster initiative in Kishapu District, Tanzania is an innovation project that is centred

on the development of an automatic sisal decorticator. The innovation was thought to solve technical challenges experienced when operating existing mobile sisal decorticators which include the inconsistency of quantity and quality of the fibre produced by the decorticator (Raspador) due to dependency on the skill and experience of the operators instead of efficiency of the machine itself. Also, the tediousness of the machine operation compromised the quantity and quality of the fibre and hence, lowered the price.

This innovation project involved a local artisan (innovator) who developed the existing Raspadora, members of the sisal cluster, a researcher from the Centre for Agricultural Mechanization and Rural Technology (CARMATECH), an expert in IP and a project coordinator of the Relief to Development Society (REDESO), which is an NGO working in Kishapu District. The research was included to evaluate the engineering of the prototype developed by the innovator.

The designing process and prototyping involved regular technical meetings with researchers, as well as testing the functions with the members of the cluster firms. These meetings allowed the designer (local artisan) to link science-based and experience-based knowledge while maintaining its functionality for sisal processes (members of the cluster). Requirements included mobility of the machine within the plots of sisal farms plots and minimizing ‘Pete’, which is an uncleaned portion around the fibres. The researcher from CAMARTECH investigated the technical parameters of the prototype such as workability, durability, safety, construction time and cost. From the analysis of this information, a researcher was able to determine the specification of the required materials which when compared to the one used a considerable cost could be saved. Another valuable contribution of the researcher was his experience with the availability of key parts. He recommended manufacturing locally instead of purchasing the imported ones as they are not durable and readily available.

Due to the dispersed nature of the sisal farms and farmers in Kishapu District, the new automated Raspadora is imposing a change in business strategy from employing individual processors' existing mobile Raspadora to a group of processors owning one automated Raspadora.

Thus, REDESO facilitated and monitored field trials of the automated Raspadora with all cluster members owning the existing Raspadora. The aim was to demonstrate the efficiency of the new machine such that processors would be convinced to adopt the new machine with the associated new business model.

The developed prototype of automated Raspadora proved to be, efficient, and consistent in quantity and quality of fibre which ranges from 500 kg - 100 0kg per day compared to the previous one which was only 150 kg - 300 kg per day.

Other variations between the old Raspadora and the new automatic Raspadora include the capacity of the machine to produce washed fibres on access to water or to produce unwashed fibre on no access an inadequate water. The old one produces unwashed fibre only. Thus, an automatic sisal Raspador is designed according to the needs identified in the dialogue between the local artisan, members of the sisal cluster and a researcher.

The other important practice to note is the funding mechanism. In this case, the donor COSTECH funded the project through cluster members. Therefore, the engagement of all key actors including researchers was managed by the cluster facilitator and guided by members. Consequently, overheads and logistics consumed only 26 % of the total project cost.

5.2 Experiences from the Zanzibar seaweed cluster initiative in Tanzania

An example of developing innovative activities/processes is shown in the Zanzibar Seaweed Cluster Initiative in Tanzania working with research and government institutions. At its start, the Cluster Facilitation involved engaging potential members from the earmarked Triple Helix. The concept of "Facilitator, not a boss" through establishing equal relations/ status/ working environment was demonstrated. After face-to-face meetings and group discussions, the cluster using Triple Helix processes engaged in open innovation in:

Seaweed farming

- Production of clean high-quality seaweed
- Production of higher-priced seaweed
- Integrated seaweed farming and fishing

Seaweed value-addition

- Production and marketing of seaweed value-added products
- Use of the low pride seaweed

Before the innovation development, farmers were there but worked independently-farmers were farming but no direct communication between seaweed farmers in different villages; buyers worked independently-activities a secret; buyers had only arena with farmers: when purchasing seaweed from farmers; IMS conducted research but not directly with farmers on e.g. innovation, increased production. After the innovation collaboration was developed, farmers are now communicating directly; they are training each other on a particular aspect e.g. innovative farming: they can make a phone call to the firm/group that was trained under the cluster to arrange and train them; farmers & buyers to sit in one room and discussed issues; the five seaweed export companies sit in the same room and discussed issues; Staff of Departments of

Agriculture, Fisheries and Trade are in the cluster leadership team; on learning about innovative farming the leadership team member at Fisheries department advised his department to disseminate innovative deep-water seaweed farming; and farmers were told by the department of fisheries that anyone who wants to farm seaweed in deep waters will get financial help from the department; and seaweed buyers work with the cluster to experiment on innovative farming methods. All these show that open collaboration and networking in the so-called "open innovation" or "collaborative innovation" used by the Seaweed Cluster Initiative in Tanzania is the key to the success and innovativeness of the cluster initiative. Such collaboration is and has made the cluster initiative one of the most successful cluster initiatives in the country.

5.3 Experiences from the KIWANGO leather cluster, Tanzania

Background

KIWANGO Leather Cluster was founded in 2011 and 2013 got its official registration as a Community Organization (CBO). Since its official registration, KIWANGO Leather Cluster has been upgrading its skills at the Dar es Salaam Institute of Technology (DIT) Mwanza campus by sending its members for various short courses on leather processing and product making. The training helped the cluster members to get the basics of leather processing and product making. Using that basic knowledge and skills, the cluster members manufacture their leather using traditional methods of leather production. The products are sold in the local market and enable members to gain income to sustain their lives.

The biggest challenge facing the cluster is the quality of leather and subsequent leather products caused by the inefficiency of the traditional method of leather processing. In the traditional method, the inputs of the material used are not optimized. This leads to improper dosing that compromises the quality of leather and leather products. Consequently, the products fail to compete in the market. Furthermore, using industrial chemicals brings several health challenges, such as skin allergies and respiratory issues to some processors and poses environmental pollution as the cluster lacks infrastructure for treating chemicals-rich wastewater. Additionally, the tedious nature of the traditional method of processing leather and the use of health-threatening chemicals have discouraged members to involve in leather processing, hence low productivity.

Realizing these challenges, a cluster facilitator approached the Tanzania Industry Research Development Organization (TIRDO) for support. TIRDO nominated a competent and interested researcher to research their problems and come up with a solution. The engagement with TIRDO started in 2017. After problem identification, the researcher used those problems to build a PhD case study. The study aimed at optimizing the utilization of tanning agents from local trees used in traditional methods to process leather. The method for preparing tanning agents from trees was developed. The method ensures that about 95% of the tanning content in the tree barks are exploited and used in leather processing as opposed to less than 50%

exploitation of tanning agent in the traditional method. This study was completed in 2020 and it was ready to be transferred to the cluster for application. Seeing the importance of such a relationship bringing research, academia and industry together to solve the problem, COSTECH funded a project to upgrade the traditional leather processing practice used by KIWANGO Leather Cluster using the technology. This project was implemented in collaboration with TIRDO and Small Industry Development Organization (SIDO). The project made use of research findings to upgrade the traditional leather processing technology making it more efficient and effective.

The researcher from TIRDO collaborated with staff from SIDO to design and fabricate the needed associated technologies including tree bark milling machine, tannins extraction machine and drum. The use of these introduced machines and the new recipe reduced work tediousness to a greater extent. A total of 14 cluster members were trained on how to use the machines and best practices in tanning leather using the new recipe of organic tannins. The project has made leather processing less tedious, cost-effective, quick, safe and eco-friendly, with substantial product quality improvement. With the new system, 2 to 3 people are enough to operate the machine as compared to more than 6 people in the traditional method. Furthermore, the unhairing, liming and deliming time has been reduced from 9 days to 3 days. Tanning time has been reduced from 3-5 days to 1 day.

A trial of leather processing by using new production facilities, optimized inputs and recipes was done in March 2022. The resultant leather was used to make leather products and the products were marketed via the TIRDO website and social media, the cluster page on the COSTECH website and during the National Innovation Week exhibitions (MAKISATU 2022) in Dodoma.

Achievements

The cluster initiative:

- has managed to link small-scale leather processors to research institutes and the government. A small-scale leather processor can visit a government office or research institute/university to discuss challenges and other issues. This was not the case before the cluster initiative started.
- increased trust of industries in the research results to solve their problems, something that didn’t exist before especially in the leather industry
- time for producing finished leather has been reduced from 12-15 days to 7 days
- increased the number of customers who are interested in buying leather and leather products
- the waste generated can be recycled easily as containing no toxic chemicals.

6. IPR / Knowledge Commons - New Models for Ownership

6.1 Introduction

The open innovation activities in the cluster context involve several partners. The main knowledge producers in these activities are researchers and the cluster firms involved. To foster an inclusive process, the co-production of a wanted and identified innovation needs to be based on a common understanding and even an agreement of ownership. Valuable assets are to be found in the specific cluster firms and not only at the university/knowledge institutions involved.

Intellectual Property (IP) issues are high up on the agenda for open, inclusive innovation not the least in EU countries. European IPR Helpdesk offers a Fact Sheet - *Intellectual property management in open innovation*[2], aiming "to highlight the importance of an open innovation model as an opportunity for Small and Medium-sized Enterprises (SMEs) as well as for research and technology organizations (RTOs), and to highlight the issues to be taken into account for a proper management of IP when innovating through open approaches".

The understanding of open innovation in this fact sheet includes the following. Differently from the closed model where the entire innovative process is carried out internally by companies or at universities – the "develop it by yourself" paradigm – open innovation offers a different model. Here the development of innovative solutions is based on internal and external sources of knowledge and therefore in collaboration with several R&D actors, with the advantages of for example shortening the time to innovate, reducing costs, and getting access to markets.

Due to the co-development activities that might be carried out in collaborative projects, the allocation of ownership of results is crucial for their optimal use and implementation. Since open innovation is all about sharing knowledge and know-how, the innovation activities in the cluster context should start considering IP at the beginning of the innovative process. The more concrete results of the IP discussions might include a MoU followed by, a 'consortium' agreement, joint ownership, and assignment of IP.

It is crucial in any open, inclusive innovation process that the different IP models or approaches are developed or adapted according to the specific context of the cluster.

Simon Kremer (2017) writes about *Open Innovation and Intellectual Property – a Troubled Relationship or a Perfect Match?* He states that "it is sometimes suggested that open innovation processes should not be bound by IP considerations in the same way as these more conventional arrangements. For example, there may be concerns that a focus on IP issues will somehow

[2] *https://intellectual-property-helpdesk.ec.europa.eu/regional-helpdesks/european-ip-helpdesk/europe-fact-sheets_en*

inhibit collaboration and the free exchange of ideas within the open innovation model. In some ways, this might even erode trust between the parties. Alternatively, it may simply be assumed that the outcome of the open innovation will be at an early ("pre-competitive") stage and that IP can, therefore, be considered later when the research is further developed and applied.....The confidence that comes from knowing that IP considerations have been properly aired right from the start should enhance the trust in the collaboration and facilitate the exchange of ideas. With so many real and practical problems that need to be answered in agriculture, open innovation initiatives need to focus on ensuring that the best innovative solutions will eventually end up being applied in the real world. Considering IP ahead of the game is one way to ensure innovators do not meet deployment hurdles later down the line."

There is a spectrum of IP rights (IPR) for open innovations with patents on one side and commons (open source (compare gnu.org)) on the other side.

The experiences from Sida-supported cluster development tell us that the IP issues start with a focus on branding issues. If the cluster has a well-developed, joint brand, the benefits for a cluster firm have shown to be substantial. For agriculture-related clusters, the branding is closely linked with official certification. Access to analysis lab facilities at universities for certification is one of several ways for cluster firms to cooperate with universities.

6.2 Situation in Tanzania

The situation in Tanzania at the beginning of 2018 was characterized by the following.

1. Despite the Nation's subscription to many international conventions and agreements (WTO, WIPO, PCT etc.), knowledge of the provisions of the conventions and IP at the grassroots level is minimal.
2. This lack of knowledge extends also to patents and other IPs which are now in the public domain. One aspect is awareness of the existence of such knowledge and the other is access to this information.
3. The promotion of access to technology in clusters provides an initial platform for shared knowledge on disseminated technologies. Further improvements and innovations on the basic technology remain with the individual enterprises and exchange is more informal with every enterprise guarding their added innovation as a competitive edge without any legal protection for any IP.
4. The framework for shared knowledge is not well established, especially with the prevalence of enterprise protectionism.
5. There is no system for the registration of Industrial designs which would have been the next best thing to patent registration.

6.3 IPR as an issue for common ownership

The problem of ownership is one challenge to multi-actor invention processes. Nevertheless, this challenge is not often perceived as the most important, when favourable conditions for the co-development of the technology are first established. The experiences from the innovative cluster initiatives development tell us that the ownership of common property is not often based on IP but with a focus on physical property. As a result, if there are no clear management and maintenance strategies which in most cases are lacking, sustainability becomes a challenge.

Integrated knowledge utilization is characterized by distributed knowledge processes, including knowledge producers, not only within the academy, and thereby raises the issue of how to approach ownership in another way than those traditionally understood. For example, in the case presented in 4.1 (the automatic sisal decorticator), both the material goods (the prototype) and the intangible goods (the knowledge assets) including the utility model and competencies produced in collaboration, are commonly produced within the cluster. This means the project created a test of cluster owning IPR as a common property and not the physical asset as it used to be.

6.4 Issue for common ownership - experiences from the Morogoro food cluster

The Food cluster in Morogoro, Tanzania, has been involved in an innovation project focusing on creating *a nutritious aflatoxin-safe complementary food formulation based on aflatoxin-safe ingredients*.

This innovation project involved four parties - food processing cluster firms, the facilitator of the Food cluster who is also an expert on food science (retired professor from SUA), staff from the Food science and agro-processing department at SUA and selected consumers of the food products in Morogoro. SUA was included for the provision of analysis and quality control facilities of the innovation product.

The design process and prototyping included consultation of results from previous supervised PhD students' research, literature review as well as seeking consumer opinions. Thus, the improved food formulation could be designed according to the needs identified in the dialogue between the researcher, Food cluster members and users.

Utilization of Research Results

This innovation is a result of the integration of knowledge and technological information from different sources mainly the public domain which could otherwise not commercially be useful and no longer qualify for IP protection. The source of the idea originates from the research results of five PhD works from SUA. One study confirmed that the source of aflatoxin in

nutritious composite flour (*chakula lishe*) is the ingredients used. Two studies determined the level of aflatoxin contamination in complementary foods produced locally and ingredients used for preparation. Another study established the positive effect of handling and preparation procedures such as control of the storage environment and the use of proper packaging that minimizes levels of contamination. Still another study established a lack of awareness among those who prepare complementary foods as well as consumers about aflatoxin contamination Another source of information concerning the extent of the aflatoxin contamination problem in Tanzania was a study supported by the *Platform for aflatoxin control in Africa (PACA).* The project was implemented by SUA and the Nelson Mandela Institution of Science and Technology (NMAIST) where the facilitator of the Morogoro Food cluster was among the consultants of the project. The project established levels of aflatoxin contamination in selected cereals and grains namely maize, groundnuts and rice.

The cluster facilitator, using the collected knowledge and information, managed to develop a new food formulation using an ingredient that is less susceptible to aflatoxin contamination. This cluster project avoided traditionally used ingredients such as maize and groundnuts, that are contaminated and instead identified food ingredients (grains) that are nutritious but less susceptible to aflatoxin contamination. Millet, cassava, and orange-fleshed sweet potatoes were selected as the source of carbohydrates while soya beans and breadfruit known as shelisheli in Kiswahili as protein and energy. Baobab and moringa, OFSPs and shelisheli were included for minerals and vitamins. In addition, literature further informed that shelisheli being gluten-free is preferred for wheat. To some consumers, gluten can cause allergic reactions. Cluster members with their accumulated experiences established appropriate cooking parameters such as cooking time, proportioning water as well as particle size suitable for different types of food products. For example, to get the appropriate size for smooth nutritious flour porridge, the sieves of the milling machine need to be changed from 1.2mm to 1mm. Finally, the new formulation was subjected to a user test where users provided feedback on the product qualities such as colour, taste, texture and aroma. The formulation was adjusted to accommodate the views of the consumers. For example, at some point, a panel of consumers detected some bitterness was caused by the over-roasting of soya beans. The problem was solved by producing porridge with a pleasant taste.

Thus, the new food formulation is a result of knowledge creation and knowledge exchange through interaction, communication, collaboration and co-production. The result of this kind of knowledge utilization which is more based on human capital as compared to a structural asset, needs a different type of ownership. Also, a more inclusive business model is needed because the tendency is for the new product to compete with the products of individual firms within the cluster as is for the Morogoro food cluster.

6.5 Development of a common - a reflection

In the literature, the concept of *commons* has emerged as shared goods (material or immaterial), as a resource or resource system and as a property-rights regime (for instance de Moor (2015), Hess & Ostrom (2007) and Ostrom (2015)). Acevedo (2018) emphasizes that the common is not exclusively a thing or a set of tangible or intangible goods that are shared and used by many. The common is produced. It is made by many through generating a multiplicity of associations, whose collaborative relations continuously enable the production and enjoyment of a large quantity of material or immaterial common goods.

Following this approach, an open innovation project in a multi-actor setting can result in design, production methods, prototypes, and different kinds of tangible and non-tangible knowledge products without restrictions on intellectual property.

The development of a common can be implicitly defined from the outset, given the objectives of joint definitions and collective knowledge. But there are always risks involved and a common is in danger, if the multi-actor collaboration is not deeply anchored in the local context. If a resource like a common, vital for the cluster firms, is found to be profitable, chances are that more powerful external actors see opportunities to exploit, buy land or property or go into business in ways that do not benefit the local economy and the cluster members. Situations are also such that, when the cluster firms become more profitable, the risk increases for external interests to manipulate the cluster members and take over.

7. Co-opetition - Experiences and Results

Co-opetition is defined in cluster terms as a relationship within or across clusters where members compete while collaborating. Such scenarios include making similar but specialised products within a cluster. For example, one cluster firm can make a product similar to another firm but prepare a very attractive package. In selling the products, however, these cluster firms sell the products in the same market and usually sell together e.g. few members taking other members' products. In such a situation, each firm would compete to make either a more specialised product or packaging while enhancing skills and product development.

Another example is the Morogoro Engineering Cluster Initiative in Tanzania where cluster members were competing for the same market for some time. It later became clear to some members that they needed to innovate to conquer the market while working as a cluster. The solution was that some cluster members decided to specialise in certain products which are either used by fellow cluster members to produce the same products as before or are sold within the same market. One such specialisation was to make ceramic bowls (moulds) which were used by charcoal stove makers in the cluster. Both the moulds and the stoves were sold in the same market and the cluster members were selling together.

In the Zanzibar Seaweed Cluster Initiative in Tanzania the cluster Facilitator used the idea of developing "jealousy" among members to increase competition while at the same time cooperating. When one firm in the cluster was not innovating, another firm was trained on the same innovation and when the second firm started to produce the products, the first group decided to compete. The cluster firms then worked together to make similar products and compete in making their products more attractive (e.g. using better aromas), but at the same time cooperating in sharing raw materials and markets.

The Zanzibar Seaweed Cluster Initiative in Tanzania also used a method of "dissolving" groups where members of the groups were not active instead they waited for the leaders of the groups to work while expecting the benefit to be for the whole firm. The leaders and a few members of the cluster firms decided to "break free" by starting their businesses within the firms and announcing that each member should have a business of her/his own. In such cases, firm members would make different or similar individual but modified products. The products are marketed together, and the cluster firm still works as a group but the co-opetition is well-defined.

8. Ability/inability of Clusters to Absorb/utilize Research Results

For a long time, there has been a gap between universities/research institutions and the community of processors/innovators. The universities were seen as the so-called ivory towers where a community member couldn't reach the university. This made it almost impossible for research results produced by such institutions (mode 1 knowledge production) to be used by the people to improve their activities and livelihoods. The clusters program has enabled the closure of that gap by linking cluster members (communities) to research institutions/ universities.

A good number of clusters in East Africa and elsewhere have managed to reach universities and research institutions and utilise the research results. Such examples include the Lira Bee Cluster in Uganda. Beekeepers had beehives, but they had a challenge that bees were not entering the hives. Through working with Makerere University, the university researchers conducted research which revealed that the wood used by cluster members was poisonous and thus kept away the bees. Another wood was recommended and used, and the cluster members revived their business.

Another example is the Bagamoyo Cultural Heritage Cluster Initiative in Tanzania, which worked with the Bagamoyo Institute of Arts and Culture in Bagamoyo. The CI members received training in performing art from the college and through this knowledge they became number one performers and received a recognition medal. The CI also worked with communities around their area to perform together on cultural issues and this was a great way to reach the community.

The Zanzibar Seaweed Cluster Initiative in Tanzania had a problem of failure to grow the higher valued seaweed because of the effect of climate change. The cluster worked with the Institute of Marine Sciences, University of Dar es Salaam to develop innovative farming methods. Continued research between 2006 and 2014 resulted in the development of a new method of using tubular nets which the cluster is piloting in two villages in Zanzibar, Tanzania. Equally, the cluster had the challenge of not knowing how to make products out of their low-valued seaweed for increased value. Research conducted by the Institute of Marine Sciences between 2006 and 2008 resulted in the production of the first seaweed products. Cluster members are now using their low-valued seaweed to produce several seaweed products which are sold in the country as well as neighbouring countries.

While these are good examples of clusters that use research results to advance their innovative skills and products, there are cases where the clusters could not utilise research results. One example is the Biofuel Cluster Initiative in Tanzania where research was conducted on producing value-added products out of bio-fuel, but the cluster could not utilise the research results because the large biofuel companies which were supposed to be one of the main members of the cluster did not show interest. As a result, the cluster did not take off and thus research results could not be used (Msuya 2011).

Another example is the Sisal Cluster Initiative in Tanzania where research was done, and results showed that several products can be made out of sisal. However, the cluster was not able to use the research results because the research was more geared towards a degree program and thus after graduation (results confirmation period) the facilitator did not continue to work with the cluster (Msuya 2011).

Example three comes from Uganda where some student-oriented projects failed to be fully adopted by the respective clusters and theses are;

1. The leather embossing machine, which the leather products cluster failed to take up for upscaling due to a lack of common resource pull.
2. The straw flattening machine for the basketry cluster was never fully taken upon completion of the research due to inadequate finances by cluster members, and preferences for local hand methods for flattening the straws as they couldn't easily get the required funds for its development for commercial as it had been designed and developed as a student's project.

These examples show the importance of clusters working closely with universities/research institutions to utilise the research results. The cluster facilitator is key to this kind of relationship and if the facilitator is not fully equipped with knowledge and passion for the cluster then research results may not be utilised for the advancement of innovative skills/products of the cluster.

9. Funding Experiences in Low-income Settings

The role of the facilitator is important when it comes to funding, as mentioned above. The facilitator needs to identify (or lead the identification) and acknowledge possibilities for funding opportunities for projects encountering both the needs of the cluster firms and the interest of researchers. This role can be supported by the coordinating committee / Board of the cluster initiative.

Examples of funding possibilities are provided in the following.

Donor funding such as Sida has supported several cluster-related projects via local funds at cooperating universities in the bilateral research agreements. Sida has also supported directly specific projects, where researchers at the university cooperate with cluster firms. One example is the research and innovation project at Universidad Mayor de San Simón, Bolivia, with the general objective of having the tannery firms of the Leather Cluster, Cochabamba, apply clean production for more environmentally friendly practices.

A recent funding possibility from Sida in Tanzania is the Innovation fund managed by COSTECH.

Government

There are experiences of funding by the government on local, regional as well as national levels, where explicit links exist between CIs and researchers at universities. The key arguments for this kind of support come from concrete results of cluster activities presented to the supporting governmental authority.

An example of funding at the local/regional level through collaboration between a CI, a university and local government is from Tanzania, where a Zanzibar Seaweed Cluster firm received financial help. The Zanzibar Seaweed CI firm Tusife Moyo Group in Kidoti, northern Zanzibar had a premise that already had wiring installed through the CI funding. But electricity had not been installed. The Institute of Marine Sciences of the University of Dar es Salaam helped to pay for the installation of electricity to the premises. This was done in collaboration with the local government at the Regional level - North Region of Zanzibar.

Another example of funding from the national level comes from Uganda, where Makerere University managed to receive funds for the cluster program initiated by Sida. A delegation from the Faculty of Technology led by the then VC and deputy VC of Makerere University met the President of Uganda in December 2009. The President agreed to support Innovation projects including CIs for 5 years (25 billion UGX, about 13 million USD) from July 2010. The president was impressed by the cluster concept and agreed to support it.

Local Government Authorities (LGA)

LGAs can fund prioritized cluster activities. If challenges experienced by the cluster initiative and its cluster firms need close collaboration with researchers, the research & innovation (R&I) project will be developed jointly by the involved cluster initiative and the researcher(s). If approved by the LGA in question, the R&I project can be sponsored by the LGA.

A more concrete platform for the cooperation between the cluster initiative, researchers and LGA is important for meetings, planning, follow-up, reporting etc. The responsibility for this platform is the local part of SIDO, where the project is conducted.

International

Even international funding has been available e.g. in the example of FAO in Tanzania where a Zanzibar Seaweed CI firm received funds from FAO. The Director General (DG) of FAO had an official visit to Zanzibar to lay the foundation stone of a hatchery, that is being built by FAO and KOICA for the government of Zanzibar. The DG visited the Zanzibar Seaweed CI firm Furahia Wanawake on the East Coast, which was constructing a premise but had no funds to complete it. The DG promised to help finish up the premises and purchase soap-making machines by providing USD 10,000. The premise is now at the finishing stages and the soap-making machines are being made.

Internal

A kind of cluster-sustaining funding can be achieved using a certain percentage of the payment from winning a tender because of being a cluster firm. This percentage resource will be used to maintain joint cluster activities.

Crowdfunding

Another way of creating resources is crowdfunding, which is shortly identified as the practice of funding a project or venture by raising small amounts of money from a large number of people.

One example of crowdfunding concerns the creation of a revolving fund for the Zanzibar Seaweed Cluster Initiative.

In Zanzibar, there were 26,000 seaweed farmers in both Unguja and Pemba Islands as of 2016. Out of this number, 3,000 are currently members of the Zanzibar Seaweed Cluster Initiative (ZaSCI). While starting up the Revolving Fund (RF), ZaSCI found it necessary to start with a few groups as “pilots” and then continue with other groups when the RF was running. In this case, working with 200 pilot farmers from four (4) pilot groups was performed. These pilot groups were Bweleo (West District), Kidoti (North B District), Paje (South District), and Chwaka (Central District) all in Unguja Island.

The idea was initiated by Erik von Bahr, who started crowdfunding by asking his friends in Sweden for contributions. A sum of 10 000 USD was transferred to the ZaSCI to set up a revolving fund. The loan agreement and application format were developed and decided upon by the ZaSCI Leadership and Members through several meetings, discussions and activities. The process involved the following steps:

1. *Application for recognition and registration by the Department of Cooperatives*
2. *Registration with the Tanzania Revenue Authority*
3. *Registration with the Zanzibar Revenue Authority*
4. *Opening a Foreign account for ZaSCI*
5. *Formulation of Loan Agreement Form between ZaSCI and its (individual) members*
6. *Identification and visits to the pilot groups*

Visits to the 4 pilot groups were conducted to establish what was on the ground to make sure that the groups were eligible, i.e. they could use the loan to move forward and not remain where they were. Group members were asked to discuss among themselves the modality of running the RF and document their discussion for sharing during the meeting of pilot groups.

7. *Meeting of the pilot groups*

This meeting was aimed at bringing together the leaders of the pilot groups to share the results of the discussion on RF that was held with their group members. The leaders of the pilot groups including chairpersons, secretaries and treasurers were called to the meeting. The number of participants in the meeting was 12 from the four (4) pilot groups.

From the meeting, the modality of running the RF was agreed to be as follows:

i. There will be loan application forms which will be paid for USD 4.5 (10,000 TZS) each.

ii. No interest on the loan. The payment for the application forms will cover the "interest money" that would have been paid.

iii. Re-payment time will be three (3) months after the date of borrowing.

iv. The loan will be 500,000 TZS.

Each member will fill out a "membership application form" and pay a fee of USD 0.45 (1,000 TZS).

v. The loan should be specific for activities on seaweed farming specifically farming in deep waters and value addition.

vi. All transactions will be based on USD

8. Employment of a ZaSCI Desk Officer

It was discussed and agreed to employ one person who will be handling the RF activities, monitoring and processing from the ZaSCI members.

The first objective of the fund is to teach and assist Zanzibar Seaweed cluster members to farm the Cottonii plant. They need information on deep water devices that can be successfully used in rough seas. It means selecting equipment to design tubular nets suited to their needs. They need training on how to build the nets and where and how to put them in the sea. The second objective (which was suggested following the existing on-ground situation) is to promote the production of seaweed value-added products. This includes upscaling existing products, making new products, and reaching markets.

In the beginning, the value of the fund was supposed to decrease as loans were paid. As soon as possible it is a must to introduce a requirement for a minimum monthly contribution from cluster members to the fund. The intention is that the fund later shall be used to partly finance other parts of the development of the Zanzibar Seaweed Cluster as proposed, like scaling up on the production of value-added products (not for benchmark visit) and construction of a green-house-type solar drying facility.

It was stated in the start that if the CI succeeded in creating a revolving fund functioning by the plan and securing repayment, it would later be relatively easy to attract new donors in Sweden to add contributions to the ZaSCI fund and also to finance similar revolving funds to other cluster initiatives in Tanzania.

ZaSCI has given loans to 27 members in three phases (data from September 2018). The first one was pilot (7 people, USD 1,560-January 2018-repayment started in May)), the second (10 people, USD 2,200-May 2018-repayment started in September) and 3rd (10 people, USD 2,200), October 2018-repayment will start in January 2019). Repayment done is:

a) 1st phase 43% have finished the repayment (3 out of 7).
b) 2nd phase 60% have started to pay (6 out of 10)

10. Multi-dimensional Sustainability Issues in Cluster Development

Every research-related cooperation activity is obliged to consider in practice the SDGs with a special focus on

1. gender dimension fostering quality and inclusion of women
2. decent work agendas

3. the environmental responsibility.

Gender

SDG goal 5 aims to achieve gender equality and empower all women and girls. It states "Gender inequality persists worldwide, depriving women and girls of their basic rights and opportunities. Achieving gender equality and the empowerment of women and girls will require more vigorous efforts, including legal frameworks, to counter deeply rooted gender-based discrimination that often results from patriarchal attitudes and related social norms".

The first perspective in exploring gender dimensions focuses on the quantitative arguments. For a long time, work on gender-inclusive issues has been focused on women; especially in the 'absent' women in certain sectors and making visible 'the forgotten women' in some other sectors. Based on studies, investigations and surveys various projects and activities have been developed and implemented to increase the number of women in male-dominated sectors. The goal has been quantitative presuming that by adding women and increasing their numbers we get a more even gender representation, in other words, a more gender-equal society.

However, besides focusing on and emphasizing the quantitative objectives, more qualitatively oriented factors have been used to motivate the importance of balanced gender participation. According to the qualitative perspective, increasing the number of women in male-dominated sectors is supposed to increase the quality of activities and results of the same. It is argued that the quality of activities and practices when women participate in these sectors will be of better quality. The improvement of the quality is realized as women will bring in a larger spectrum of specific skills, knowledge and experiences. This argument has been and is used as the manifested principle for the need and importance of including more women. This discussion sometimes has taken and takes the direction of an essentialist view of women. Women and men are different by definition and to strike a balance in the world of work both their efforts and participation are needed.

As this CRIM is concentrated on research and cluster activities reinforce development, the gender dimension can include the following.

Concerning cluster firms

In the case of a CI to be female-dominated, the ability of researchers involved to absorb the long-term experiences and knowledge of the women in the cluster firms must be secured and utilized.

In the case of a CI being male-dominated, more profound work needs to be done to transform the culture and working environment of the cluster firms to be women-inclusive. Explicit arguments for the qualitative aspects of this gender-inclusive transformation can be developed. This transformation work needs to be very context-sensitive and done with knowledge, trust

and experience. External support might be necessary e.g. gender researchers or gender experts at relevant NGOs in the country.

Concerning university/knowledge institution

Expertise in gender research (or gender-sensitive research), development and innovation must be secured and utilized. This knowledge expertise needs to be based not only on theory but also on empirical experiences. If the researchers involved as partners in cooperation with cluster firms do not hold this kind of expertise, the researchers must link up with existing gender expertise at universities/knowledge institutions. The latter exists at e.g. UDSM and Makerere University. At this point, the word "gender" needs to include youths, who may be fewer in some of the CIs.

Decent work agendas

SDG goal 8 aims to "promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all."

The goals number 5 and 8 are interlinked. This is explicit in the target indicator 8.5. stating "by 2030, achieve full and productive employment and decent work for all women and men, including for young people and persons with disabilities, and equal pay for work of equal value."

The target indicator 8.8., which is closer to this specific crosscutting dimension of the CRIM, states "protect labour rights and promote safe and secure working environments for all workers, including migrant workers, in particular women migrants, and those in precarious employment."

Examples of work conditions improved by collaboration between research and CI come from Tanzania where the Zanzibar Seaweed Cluster Initiative worked with IMS and international researchers under FAO. The CI (led by its Facilitator who is based at IMS) worked with an international researcher under an FAO project to look at seaweed diseases caused by climate change (high seawater surface water temperatures) and farming seaweed in shallow waters. Some of the recommendations given as a coping strategy was farming seaweed in deeper waters where conditions are more stable and water temperatures are lower. Two Seaweed CI firms are now piloting farming seaweed in deeper waters. Farming in shallow waters involves carrying farming materials and the harvested seaweed on the head, sitting in water in the sea for more than 6 hours, and the possibility of getting cuts and stings from sharp shells and marine creatures. Working in deeper waters on the other hand improves working conditions by the fact that farming materials and the seaweed harvest are carried by boat. Women and men work together in groups reducing the time spent at sea and no cuts and stings as most of the work is done on boats.

Environment

The environmental aspects are crosscutting in the SDGs and appear in almost every one of the 17 SDGs. In this document, three SDGs are highlighted.

SDG number 8 includes, as mentioned above, significant environmental aspects in working conditions.

SDG number 13 concerns climate change stating "Take urgent action to combat climate change and its impacts". Climate change is especially challenging in e.g. the Zanzibar Seaweed CI with the impact of global warming on seaweed farming. Linking research to cluster innovation processes is vital for farming and finding new seaweed species adapted to higher water temperatures.

SDG number 6 concerns water stating "Ensure availability and sustainable management of water and sanitation for all". How water pollution is affecting the environment close to concerned CIs and thus access to useable water for the surrounding society is critical for CIs like cluster firms in the leather sector, specifically tanneries and in the agriculture sector like coffee production. Cooperation between the concerned cluster firms/farms and research gives examples of how production processes can be developed to overcome water pollution.

SDG number 2 includes environmental aspects in the goal stating "End hunger, achieve food security and improved nutrition and promote sustainable agriculture". In the cooperation between researchers and members of the Katwe Salt Lake CI in Uganda, the food security aspects for the latter were handled. The salt production was severely affected by the grazing of cattle at the hillsides of the Salt Lake causing soil erosion as well as by overharvesting of the vegetation for handicraft making. Mawater Women Group with women buying and selling the rock salt acknowledge in this research cooperation "how important it is to protect the environment because the sustainability and conservation of this lake determine our stay in business. So the cluster is trying hard to educate the stakeholders on how to protect the salt lake both as an environmental and economic asset" (Kabarangira 2014).

11. References

Acevedo, C. (2018). *Developing Inclusive Innovation Processes and Co-Evolutionary University - Society Approaches in Bolivia*, Dissertation Series No 2018:07, Blekinge Institute of Technology, Sweden.

de Moor, T. (2015). *The Dilemma of the Commoners: Understanding the Use of Common-Pool Resources in Long-Term Perspectiv*e. New York: Cambridge University Press.

European IPR Helpdesk, *https://www.iprhelpdesk.eu/Fact-Sheet-IP-Management-in-Open-Innovation)*

Hess, C., & Ostrom, E. (Eds.) (2007). *Understanding Knowledge as a Commons. From Theory to Practice*. Massachusetts. Cambridge and Massachusetts: The MIT Press.

Kabarangira, J. (2014) "Voices from Katwe Salt Lake Cluster Initiative" in Rydhagen, B., Trojer, L. (eds.), *The role of Universities in inclusive innovation. Cluster development in East Africa*, publisher Nelson Mandela African Institute of Science and Technology, Arusha.

Kremer, S. (2017), Open Innovation and Intellectual Property - a Troubled Relationship or a Perfect Match?, AgFunder news, February 15. Retrieved from https://agfundernews.com/aboutagfundernews/

Msuya F.E. (2011). *Status Report of Cluster Initiatives in Tanzania*, Report submitted to the Pan African Competitiveness Forum, Tanzania Chapter, March 2011.

Ostrom, E. (2015). *Governing the commons*. Cambridge: Cambridge University Press.

Rydhagen, B., & Trojer, L. (2011). *Research report from Cluster Initiatives Lake Katwe*

Salt, Uganda and Zanzibar Seaweed, Tanzania. Final report for SWE-SP2010-005.

Stockholm: Sida.

SDG, http://www.un.org/sustainabledevelopment/sustainable-development-goals/