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

SGCI FOOTPRINTS

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ABOUT SGCI

The Science Granting Councils Initiative in sub-Saharan Africa (SGCI), aims to strengthen the capacities of science granting councils (SGC) in Sub-Saharan Africa in order to support research and evidence-based policies that will contribute to economic and social development. The objectives of this Initiative are to strengthen the ability of Science Granting Councils to: (i) manage research; (ii) design and monitor research programmes based on the use of robust science, technology and innovation (STI) indicators; (iii) support knowledge exchange with the private sector; and (iv) establish partnerships between Science Granting Councils and other science system actors.

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Cover Photo - International Development Research Centre (IDRC)

SCINNOVENT: Impact and Achievements of SGCI in Phase One

ScienceAfrica

Dr. Maurice Bolo, Executive Director, The SCINNOVENT Centre

Q. Briefly comment on the background of the Science Granting Council Initiative (SGCI)

In 2014, the International Development Research Centre (IDRC) commissioned a study that was conducted by the Centre for Research on Evaluation, Science and Technology and IRD Stellenbosch University in South Africa that covered 17 African countries. It was a landscaping study about the Science Granting Councils (SGCs) in Africa. In that study, the SGCs were defined as bodies that fund Science, Technology and Innovation (STI) on the continent. The configurations of SGCs vary among the Africa countries. In some countries they are currently, or were previously referred to as councils and we have or had national science and technology councils. Kenya, for example, used to have the National Council for Science and Technology (NCST) but has since transformed to National Commission for Science, Technology and Innovation (NACOSTI).

Malawi has a National Commission for Science and Technology (NCST). Rwanda like Uganda, has a National Council for Science and Technology (NCST). In some countries, the councils are organized as semi-autonomous or autonomous government bodies or agencies. For instance, in Ethiopia, Senegal, Botswana and Ghana, the SGCs continue to operate as departments of the ministries responsible for STI.

At the Centre for Research on Evaluation, Science and Technology (CREST) and IRD Stellenbosch University in South Africa, there were recommendations about what needs to be done to strengthen the capacity of these government agencies to deliver on their mandates.

Though their mandates varied from country to country there are many similarities, including the fact that they fund research. So, resource mobilization, funding and all other related activities constitute huge component of the councils.

Coordination is another major function of the councils. It entails coordinating different actors within the national science system, national innovation system and making sure that they work together to generate the kind of technology or products that are required.

The other key function of the councils is capacity building. This includes organizing and supporting capacity strengthening. At the post-graduate level, they often fund masters and PhD students, and organize for scholarships and related activities among key functions.

Quality assurance is another major function. They give permits, ensure research ethics and integrity in the region, they set out rules and regulations to support research and processes.

The councils are also involved in bilateral and multilateral scientific cooperation between countries. For example, the National Research Fund (NRF) of South Africa and NRF Kenya have bilateral scientific cooperation in various areas of funding or capacity strengthening. One example in Kenya, the Newton Utafiti Fund is based on Kenya Innovation Agency and the UK DFID.

Finally, one other thing is policy advice to the government on matters of science, technology and innovation. These constitute the five or six key functions of the SGC. What we call the SGCs Initiative is a multi-donor platform or 'Initiative' and IDRC, UK's DFID and NRF South Africa, were the main funders

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The CREST study identified the key issues and transformed them into four sub-themes tied to the functions of what the councils are supposed to do, including enhancing the capacity around the issues. This is the reason why the SGCI is coined as a capacity strengthening Initiative.

in phase one. They organized how to enhance the capacity of the SGCs to perform their functions better. Those functions were generally divided into four main sub-themes.

One sub-theme had to do with the capacity to manage research. It involved looking at issues of how to allocate: resources, investments in research and development, make research calls, identify who to fund, how to provide technical support, how to monitor development and the whole project cycle. That includes grants management, it is a fairly broad agenda.

Q. What were the main outcomes of the CREST study?

They mainly revolved around the different structures and functions of the councils. That structurally the SGCs are set-up differently. These institutions are set up by Acts of Parliament and National Legislations and become valid structures as autonomous institutions with their own budget lines. The other finding was that the capacity to perform those functions was weak in most of the areas. Therefore, there is need for intervention to strengthen capacity in the main four thematic areas.

Q. How were the SGCI themes determined?

The CREST study identified the key issues and transformed them into four sub-themes tied to the functions of what the councils are supposed to do, including enhancing the capacity around the issues. This is the reason why the SGCI is coined as a capacity strengthening Initiative.

Q. What is the current status of SGCI?

The SGCI as an entity operates at different levels. There are different sub-themes. The Initiative is a multi-donor platform comprising IDRC, the DFID, the NRF South Africa and Sida.

In terms of the governance structure, they form the Executive Committee (EC) which is the policy organ of SGCI. Right below EC is the Initiative Management Team (IMT) made up of representatives of the SGCI investors. This is like the secretariat for the SGCI project coordinating and managing the Initiative.

Below IMT is the SGCs Committee composed of representatives of the heads of the various SGCs referred to as the heads of research councils (HoRCs). This is followed by the Collaborating Technical Agencies (CTAs), the think tanks and implementing agencies of the different themes and sub-themes. The CTAs were competitively selected to join the project around 2015/2016 while others joined in 2017. The Initiative itself was launched in 2015 in Nairobi.

Q. Can you list the CTAs and the themes or sub-themes they are handling?

The CTAs were SCINNOVENT Centre, Africa Center for Technology Studies (ACTS), Africa Technology Policy Studies (ATPS), Africa Association of Universities (AAU), Southern Africa Research Innovation Management Association (SARIMA), the African Union Development Agency (AUDA-NEPAD) and Science Technology Innovation Policy Research Organisation (STIPRO).

Theme One focused on research management and was led by SARIMA in phase one, in partnership with Association of Commonwealth Universities (ACU). SARIMA has regional branches in East Africa (EARIMA), Central Africa (CARIMA), and West Africa (WARIMA). SARIMA drew from its membership and ACU to implement the project.

Theme Two focused on the use of STI indicators and was led by AUDA-NEPAD.

Theme Three focused on private sector engagement and bilateral scientific co-operations. It comprised ACTS (lead CTA) and the SCINNOVENT Centre as co-lead. Other consortium members included STIPRO in Tanzania and the Accra-based AAU.

Theme Four focused on networking and peer-to-peer learning among the councils and was led by ATPS and the SCINNOVENT Centre.

Q. What were the specific roles of SCINNOVENT in the two themes?

Our role in theme three, which is about knowledge exchange and technology transfer in the private sector had two components. One was bilateral scientific cooperation which was supposed to help councils come together and define ways of working together in a scientific cooperation environment.

This involved supporting the councils to sign up a memorandum of understanding or agreements to work together. Simply getting SGCs on to the table to agree to work together was no mean feat. The other aspect was about supporting projects under those agreements as a test-run to ascertain if these kinds of bilateral or multilateral scientific co-operations could actually work. That is the bit in the consortium in theme three that was led by ACTS, working very closely with STIPRO in Tanzania.

The second aspect led by SCINNOVENT Centre was about engagement of the private and public sectors on how they could work together. It involved getting the private and the public sectors to jointly design research projects and execute them. There were two parts in this particular theme. There was what we refer to as co-investment, meaning that if countries were going to participate in that particular sub-theme, then they needed to set aside their own money from that of the donor. We had about ten or twelve out of the fifteen countries commit their money into this project. Some put in a minimum investment of USD10,000 while others like Mozambique put USD 100,000.

This demonstrated that countries can actually invest their own money into research, development and innovation and there are many letters of commitment. Countries were not only judged by how much they could raise or set aside; but also, by their willingness to invest money in the project. This was the foundation between the SGCs and the Initiative; it was donor money plus country money. In others words co-investment that was a big requirement.

The other big requirement was the private sector public sector cooperation. All the projects we funded had a private sector partner. There was the co-investment and co-creation of knowledge. We then moved away from the aspect of universities conducting research then sending the results to the private sector to co-creating this knowledge with the private sector. Thus, to make the project a co-investment the private was also required to make a contribution.

Given that the private sector in Africa is still weak, we did not insist on financial contribution. We accepted in-kind contribution, for example, allowing the use of their facilities for research. In Uganda for example, a milling factory with roasters and Makerere University came together to exploit each other's resources by the factory availing its mill and roaster to the researchers.

The in-kind contribution was sufficient as they did not have to inject cash into the project. This is the direction we are trying to move the discussion towards because on many occasions the narrative has been that the private sector in Africa makes no contribution and this is because in-kind contributions have no monetary equivalence.

Another good example is in Malawi where the municipal council donated a toilet worth over USD4,000 to the project. The donation enabled the biogas production partnership to succeed much faster. We need to capture some of these contributions as good practices and stories because they are unique.

Q. Can you elaborate further on the toilet-biogas issues?

In Malawi, we supported the project on renewable energy. One was led by Lilongwe University of Agriculture and Natural Resources (LUANR) while the other was led by the Malawi University of Science and Technology (MUST) and both had private sector

partners. The one on biogas was located in a large municipal market in the south of Malawi at the border with Mozambique, serving the two countries.

The large amount of vegetable waste generated by the market presented a sanitization, waste disposal and deforestation challenge. The aim of the project was to generate biogas out of the municipal waste. The university partnered with a private sector institute called GIT to design a system that allowed the municipal council to process the waste into biogas. An abandoned project that had built a pit latrine for the municipal market came in handy after the team realized that instead of evacuating the massive human waste, they could re-work it into the biogas system to get a bigger volume of the waste to generate the biogas.

The municipal slaughter house was also connected to the biogas project. We now have a big facility that is being served by the municipal vegetable waste, toilet and the slaughter house.

The volume of gas production is now higher than what it was. As we speak the Government of Malawi through the energy department, is said to be monitoring and following up with a view to replicating it elsewhere in the country. This for us is a huge success story that is now being replicated. There is also the dairy project in Malawi that is also thriving so I must commend the Malawian researchers for their good work.

Uganda is another outstanding success case. We had a bee project that resulted in products. Quality science and one that connects to the community. Bee keeping is big in Uganda and the use of propolis and bee venom is significant. We supported a project that resulted in propolis tea that has since been branded and is on its way to the market. We are dealing with Intellectual Property Rights (IPRs) protection for it. We are trying to find the best way to protect it within the institutional IPR policy of Makerere University and the Uganda National Council of Science and Technology.

The propolis tea and propolis powder in Uganda is a success that we need to shout about because of the scientific process that went into it. The science in Makerere on the propolis was an extremely high-level science.

The propolis tea is actually a medicinal product. This is scientific intervention at a point when the private sector in Uganda and the bee keepers' association were already struggling with how to sell propolis to the masses. It is something that they were trying to get into the market but there was no scientific backing. They used to sell propolis in a crude form so we decided to support them. This research project has led to a product that is now ready for the market.

There is also the propolis powder that can be used in almost every industry including the food industry, pharmaceutical industry, and in the medical field. Connect this to the bee farmers and you will begin to see how this project can change lives from the ground up. We are talking about over 9,000 farmers, products and distribution channels or supply chains that are already in existence. Thus, we have an opportunity to make a huge impact not only on the lives of the farmers but also to Research and Development(R&D) industry.

Q. Are there regulatory frameworks or standards for bee propolis in Uganda to govern this important development?

Policy influencing to safeguard manufacture and trade in bee propolis products is another area that the project team is driving. Since these are new projects in Uganda and the region, we do not have standards for propolis. There are no standards in Uganda and probably across East Africa for propolis and its derivatives. There could be something for honey but not propolis and venom. Therefore, the research team at Makerere and the consortium are now working with the Uganda National Council for Science and Technology and the Uganda Bureau of Standards to establish standards and regulations for propolis and venom.

This outcome is a direct contribution of the project into a policy process and falls under the Ministry of Science and Technology within which the UNCST now operates. Also, under the cocoa project in Uganda, the team is pushing for regulatory framework for crop which is rapidly gaining popularity with Ugandan farmers and traders.

In Mozambique, there is an interesting story about Mussika, people kept asking us what has tourism got to do with science or science and tourism, where is the connection? One of the things we did while selecting projects is to base them on national priorities.

Mozambique approached us with the idea that they wanted to focus on tourism. We agreed and requested them to show us what they had. They came up with

two ideas, Mussika and value addition of indigenous fruits and vegetables and we ended up funding both. The two were actually the largest projects that we funded under SGCI PPPs. In my opinion, the big story is about how Mussika started off as a small project funded under SGCI and has since transformed itself into a private company that is ready to be replicated in other SGCI countries.

That speaks of entrepreneurship, innovation, sustainability and scaling up and out. An idea that started as a public private partnership project that has culminated into a new business entity all together. Soon we will be talking about the larger issues of job creation, employment and revenues generation.

They developed the project; it is about using ICT in ecotourism. Actually, it may appear like a simple idea but it has big prospects in Mozambique. The Government gave it the green light, the backup and momentum required to thrive and it is thriving. This is a big success story because it's about business models and a project transforming itself into a sustainable company that is employing people.

Q. What are the other outstanding success cases?

In Ghana, we have supported the establishment of what we call the Ghana Innovation Research Commercialization Centre, GIRC. Ghana informed us that they wanted to set up a small department within our ministry of science and technology development unit. We had several meetings with the ministry in Ghana which was the equivalent of the SGC based on the ministry of technology, science and innovation.

Then we had discussions with the technical officers to provide guidance on the appropriate kind of structures that the institutions required to enhance technological uptake and commercialization in Ghana. We guided them through a process that helped move the idea from a desk office in a ministry to a full-fledged innovation center. In so doing, they invested their money as we too invested money. In so doing, we supported two case studies in Ghana that are now aligned towards making national framework for this commercialization centre.

We also supported a study on the business case for the centre that was conducted by the Science Technology and Policy Research Institute (STEPRI), which is part of Ghana's Council for Scientific and Industrial Research (CSIR). A second study focused on the ecosystem.

The two studies were supported through the Initiative and we linked them with the Technology Innovation Agency in South Africa (TIA) for expertise because South Africa has experience with this kind of innovation agencies. A joint technical working group was established and in mid 2018 we held a regional meeting in Accra, Ghana. Essentially, we are building that framework for private sector engagement and that particular centre in Ghana.

In Cote d' Ivoire, we supported two projects under PPPs, both of which I consider to be fairly successful. They are good projects that bring in the Francophone perspective that I would also like to highlight. We often forget French speaking Africa in some of these projects but I think those two projects are important. Cote d' Ivoire also hosted the 2018 Annual Forum where many lessons were learnt.

In Kenya, Theme Three we did not attain much as it was around the time when the NACOSTI, NRF Kenya and the Kenya National Innovation Agency (KENIA) configuration was taking place. It was Kenya's former President Mwai Kibaki who signed the STI Act 2013 into law before leaving office and it is this Act that created NACOSTI, KENIA and NRF.

Q. In summary, what were the key achievements of Phase One?

The element of co-investments by the councils is a key issue that we have been able to demonstrate. That our countries can invest money into research and get results out of it is most encouraging.

The other key thing that we have demonstrated through the project is that it is not always about the investment amount because most of the projects I have outlined are in the range of about USD30,000. Essentially, this means that with USD30,000 one can actually make great strides but that needs two things. The first one is to set your priorities right and second is to have targeted funding. The funding is across a huge consortium so instead of starting from the basic science all the way to the applied, we decided to focus on a stage of new product development.

The other achievement was in the strategic involvement of the private sector in the projects. We have to open up our minds because contribution must not necessarily be in monetary form but can be in terms of expertise, time, facilities, and infrastructure towards the overall research.

We have now created new networks and learning opportunities, not only between the private and the public sector but also inter-councils and inter-countries. Technical synergies created between the teams allowed people to learn together. The other important thing is that we have established bilateral and multilateral scientific corporations between countries thereby promoting sharing of skills and synergies to address common or inter-country research projects or problems.

As I mentioned earlier, in the case of the biogas project in Malawi and Mussika in Mozambique, the governments are putting in additional money into the projects to upscale and out-scale them. We are also seeing the products, such as the cocoa project in Uganda attracting funding support from the government and the European Union. We have also witnessed policy changes to govern products like bee propolis.

There are also a number of issues worth mentioning that have arisen. We have countries that are updating their regulations concerning standard operating procedures (SOPs) based on the manuals that we have put together while other countries are updating their strategic communication framework.

We are also proud to note that a number of students have graduated with doctorate and master degrees in various fields as a result of the project. From the foregoing, it is evident that the SGCI is a high-impact project.

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MOZAMBIQUE

Mussika Stirs-Up Mozambique's Tourism Fortunes

Charles Mangwiro (Maputo, Mozambique)

Charles Mangwiro, Science Journalist

Mozambique is in its early stages of development as a tourism destination with much room to develop various products. Travelers today use their mobile phones to control every aspect of their lives and travels. They check flight schedules, route options and keep up-to-date with possible delays.

In Mozambique for example, visitor arrivals totaled approximately 400,000 in 2019. This demonstrates low utilization compared to registered numbers by other countries in the region. There is, however, considerable latitude for growth given that projections of the World Tourism Organization indicate that the region could attract 36 million tourists in 2020. However, this may not be realized because of the ongoing COVID-19 pandemic.

But Mozambique is on track to capitalise on the global tourism and initiatives are in place in preparation to achieve its share.

Mussika Tourism Technology is an online platform that aims to present the potentialities with a special focus in the areas of Tourism, Music and Culture in the Province of Zambézia, located in central Mozambique and whose capital is the city of Quelimane, located about 1,600 kilometers north of Maputo, the country's capital.

Mussika which means 'markets' in Chuambo language, is a project of the Zambezia Development Studies Center that was created in 2019.

The Mussika online mobile application guides users in the rich tourism exploits of the Zambezia region. The Mussika App whose development was made possible by a grant from the National Research Fund (FNI) to the tune of 2.5 million meticais, is one of the key success stories of and the Science Granting Councils Initiative (SGCI) in Mozambque. The App has five subscription packages: basic, bronze, silver, gold and platinum. The packages provide different marketing features, such as publicity, company profile and public campaign. Other features include bulk SMS, vacancies, advertisement, contact management and online sales.

Mussika has made it quite easy for tourists visiting or planning to visit Mozambique, to locate some of the country's richest tourism attractions, including sandy beaches, music and cultures thereby boosting the tourist numbers to grow the economy. The App contains all the wealth of the Zambezia Province, thus allowing everyone who has the application to access all that the province has to offer her visitors.

Mussika Executive Director, Amin Daud explains that although the App is currently based in Zambezia Province, the intention is to expand it nation-wide before going international, starting with African countries like Angola.

"We got our initial investment capital through a funding from Mozambique National Research Fund (FNI), and we started work in the commercial part, so that non-residents of Mozambique can be informed about the services provided by the company. If an individual is outside Mozambique and wants to identify a holiday location or find accommodation in any part of the country, then Mussika provides as a solution," explained Daud.

To work in this area, the company carried out a field study to confirm if this business would be profitable and viable. They participated in a national tender floated by FNI and won.

According to Daud, after winning the competition he felt confident about establishing the company. He has no regrets about this decision because he not only earns a living through this company but also creates employment for other people and their families.

There are however, challenges despite the progress. These include power shortages and the firm is collaborating with the Mozambican Government to overcome this situation.

"This is a bankable project and we want to expand our services nationwide. We have since designed a project which we hope to present to the Ministry of Culture and Tourism, so that artists from the country can advertise their products on their online platforms, something that is planned for July," says Daud.

In turn, Paulo Gomes, Mussika General Director added that Mussika is the first company to venture in this area. Despite being in its early stages of operation, the company is showing good signs of prosperity.

In the interim, Mussika has sought to advertise its services and has partnered with Mozambican singer Sheila Mahoze, to play the role of an ambassador to support the company's activities through music. She will produce songs in local languages.

"Being an ambassador for a project like Mussika Turismo is a great honor and I will do anything to leverage on Mussika Turismo services. I hope that this project will boost Mozambique's tourism development in the area of technology and tourism, so that my country is known worldwide," said Sheila Mahoze.

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MALAWI

Electricity: Rice Husks to Power Communities in Malawi

Suzgo Chitete (Lilongwe, Malawi)

Travelling around Malawi's rice growing areas, one notices heaps and heaps of rice husks. The heaps provide a playing ground for children but the same can also be an eyesore.

"It consumes space at the rice mill. But where else can we dump it? We have little use for the husks," says one of the rice farmers in Salima, Central Malawi.

Fortunately, out of this husks, Malawi University of Science and Technology (MUST) has discovered a powerful source of energy.

"We looked at energy challenges facing Malawians especially those based in rural areas with hopes of being connected to the national grid anytime soon and were forced to think innovatively. This is why we came up with the rice husk gasification system as an alternative source of power for electricity generation," said Dr. John Taulo, a lecturer in Energy Sciences and Head of Department of Energy Resources Management at the southern region-based University of Science and Technology. Taulo is working with other researchers; Hendrex Kazembe, Willy Maruwo and Alfred Maluwa.

The Government of Malawi, under the National Energy Policy of 2003, planned to increase the number of people connected to electricity from four to ten percent of the population by 2010 and to 30 percent by 2020.

In 2020 only about 11 percent of the population, largely urban-based, is connected to the national grid. The revised energy policy of 2018 envisages that the electricity coverage would increase to 30 percent by 2040. This fresh target, without proper investment, may as well be missed.

Electricity is not just expensive for the majority of the population but the supply is quite erratic – forcing many households to use alternative sources of energy such as charcoal which is contributing to the reduction of the country's forest cover currently standing at just less than 30 percent according to the department of forestry.

Suzgo Chitete, Science Journalist

It is these challenges that have forced scientists at MUST to expand their thinking according to Dr. Taulo. The innovation, to produce electricity using rice husks, is part of the study funded by Science Granting Councils Initiative (SGCI) which is promoting science research and innovation in Africa.

The Initiative provides funds to science councils, in the case of Malawi, the National Council for Science and Technology (NCST) to provide grants to researchers.

In 2019, MUST responded to the call for application and received a USD30,000 grant for this study whose objective was to design, develop and characterize rice husk gasification system as an alternative source of power for electricity generation.

Dr. Taulo said that they had conducted a baseline survey targeting all rice producing districts in Malawi and settled for Phalombe to pilot the project.

"We settled for Phalombe due to cost limitation as it is closest. Secondly, we considered Wowo cluster in the area of Traditional Authority Nkhulambe because there is high quantity production of rice in the area," said Dr Taulo. *"They are also close to Mulanje Mountain where they harvest their firewood making the area highly deforested so in a way we are conserving the forests. We are also saving women from covering up to 10 kilometres to the mountain in search for firewood. There are multiple*

MUST estimates that about USD100,000 is needed for the pilot project to be fully operational. After the pilot, the plan is to extend to other rice growing areas. Beyond rice husks the researchers are thinking of also making use of maize cobs to produce electricity. Maize is widely grown in Malawi which may translate to more people having access to this form of energy.

benefits out of the project," explained Taulo. The pilot phase targeted about 25,000 households.

MUST had to collaborate with other institutions to design the husk-gasification machinery that is yet to be installed partly because of funding and the COVID-19 pandemic. The Industrial Research Centre, Department of Agricultural Research Services and the Department of Mechanical Engineering, University of Malawi have all been part of this success story.

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"It is pleasing to note that our scientists have the capacity to come up with life changing innovations. The SGCI grants have really brought out the best in us. We are looking at ways of ensuring that the innovation reaches those that need it most," said Professor Elijah Wanda, Director General for NCST.

The husk-gasification system, according to the scientists, has a byproduct that can be turned into briquettes necessary to replace the widely-used charcoal and firewood as a source of energy for cooking. This certainly scores marks to environmentalists who are promoting clean energy.

"In the pilot village(s) the plant will provide power for productive use; this electricity can supply a rice mill so people would not travel more than five kilometres in search of a mill. There are places of entertainment, barbershops, lighting and charging phones – all these, in a rural setting, are necessary activities that spur economic activities," argued Dr. Taulo.

Scientists have surely done their part, other players including the private sector and government can also play a role to popularize the technology. While the SGCI funding has proved effective, it is not enough to support all willing researchers in every field hence the need for the Government to provide resources to institutions of higher learning or the NCST to support science research and innovations.

Hope for Dairy Farmers in Malawi as Varsity Develops Solar-Powered Milking Machine

Suzgo Chitete (Lilongwe, Malawi)

Located about 70 kilometers south of Lilongwe, the Mbenderas are a lucky family. Theirs is a life that resembles eighty percent of Malawians who live in rural areas and survive on agriculture. Dairy farming is what kept the Mbenderas body and soul together for a life time.

But unlike the rest, the Mbenderas have access to technology which has consequently transformed their farming and livelihood.

Agriculture in Malawi, though the country's lifeline, has remained traditional; mechanization is yet to fully take shape. Most Farmers are still stuck to the ancestral means such as using the hand-hoe with little hope for improvement.

However, the Mbenderas have become a beacon of hope that farming with the use of technology can be done in a better way. The family is the first in Malawi and probably in sub-Saharan Africa to acquire a solar-powered milking machine which, admittedly, has become a game-changer in their life.

"We milking cows with our bare hands for the better part of our lives. It was never a problem because we had nothing to compare with, but once the milking machine was acquired life changed; we milk faster, better and in a clean environment," says Robert Mbendera, a father of four. The benefits are enormous, from getting about 15-18 litres of milk from two cows per day, the family now gets up to double the amount of milk with the machine.

"That's how good the technology is" boasts Mbendera's wife, who was all smiles during the interview probably out of excitement for being a centre of attraction in a community where milking cows is still done the traditional way.

The solar-powered milking machine is an innovation of the Lilongwe University of Agriculture and Natural

Resources (LUANAR) under the Science Granting Councils Initiative (SGCI) support. SGCI is a five – year initiative which supports research and evidence-based policies for social-economic development. The initiative works with science councils in respective countries, in Malawi's case the National Commission for Science and Technology, through which, grants are provided to researchers.

"Our concept was built around improving dairy farming through the use of technology in milking. We responded to the call for proposals and indeed our concept was approved. We received a USD 25,000 grant and embarked on this project," explained Dr. Grivin Chipula, a Researcher at LUANAR who is among the team that has developed the solar-powered milking machine.

The innovation is an integrated-technology that connects the milking machine and water supply system. The solar-powered technology also provides power to the household for lighting.

In the problem statement of the proposal, the researchers argue that while the milking machine can work independently without the water system connected to it, the water part is equally crucial.

Part of the proposal reads that clean water does not only ensure high milk productivity but also makes it possible to maintain adequate levels of sanitation of cows, cow houses and milking equipment. Hand milking is known to exacerbate cross-infection among dairy cows resulting in high financial losses to farmers. Additionally, hand milking is slow and labour intensive.

As the Mbenderas celebrate this life-changing technology, other farmers in their locality simply admire what they think is a miracle that has befallen one of their own.

The Mbenderas belong to a milk bulking group (cooperative) that sells their milk to dairy companies and receive their dues at the end of the month. They were selected as a subject of focus in this research because of their seriousness in dairy farming.

"We were looking for a farmer with more than dairy cattle. It was a rigorous process until we came across this family," explained Dr. Chipula who estimates that the technology can cost up to USD7,000 per farmer, which is a tall order for most farmers in a country where the majority survive on less than USD2 a day.

The LUANAR research team, under the public-private-partnership, worked with a firm known as Orifice Irrigation and Water Supply Limited that has been responsible for installing the equipment. Dumisani Siwinda, one of the engineers at the firm, says the technology can easily be replicated and one way of making it affordable is to have the Government eliminate value-added tax on solar accessories.

Dr. Chipula also thinks that having a mini-power grid and making water easily accessible in rural areas can significantly reduce the cost of the innovation.

Noel Jester, an Agriculture Extension Worker with the Ministry of Agriculture in the area, feels that the technology ought to reach more farmers to boost production. *"From what I have seen at the Mbenderas, the technology can improve livelihoods. It allows farmers to produce more and faster. Milking by hand can take up to an hour but the machine takes less than 10 minutes and it is smart which increases the milk quality,"* said Jester.

Dr. Chipula also agrees that there is need to have the technology scaled up to benefit more farmers and this is part of their recommendations in the policy brief sent to the Government of Malawi through the university.

The National Council for Science and Technology (NCST) is glad that their partnership with SGCI is paying dividends. The council pledges to sell the technology not only to government but development partners as well to allow more farmers benefit.

"That's the whole essence of SGCI – changing lives. Researchers have done their part and what remains is our role to ensure that this reaches out to more needy farmers," said Prof. Elijah Wanda who is currently Director of the Council.

Prof. Wanda says that while the council is mandatted to promote research and innovation, funding is always an issue hence the SGCI is a timely bail-out.

The Malawi Government statistics shows that the dairy industry is dominated by smallholder farmers, estimated at a population of 7,000. They are responsible for the bulk of milk that is available for processing.

These farmers are rural-based with only two-percent having access to electricity hence the solar-powered-technology makes more sense.

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NAMIBIA

Value Addition Boost Sale of Underutilized, Indegenous Fruits and Plants

Absalom Shigwedha (Windhoek, Namibia)

Absalom Shigwedha, Science Journalist

MARIA Ndengu, a Namibian young woman from Oshiziya village in Oshana Region is making income from selling jam made through adding value to native under-utilized fruits and vegetables. This is thanks to the basic training on processing indigenous natural fruits and vegetables that was part of the activities of the collaborative research project carried out in Namibia and Mozambique from 2018-2019.

The project, funded by the Science Granting Council Initiative (SGCI) project is being implemented in 15 sub-Saharan African countries. Ndengu explained that the October 2019 training, held in Rundu Town in Kavango East Region has made her value native fruits, vegetables and plants because when you process and add value to them, one can derive other food products from them. People can then earn an income from selling these products.

"I am now making jams from pumpkins, from Mutete (Hibiscus sabdarrifa Caylces) and from Mauni (wild orange fruits) and I am earning an income from selling these products, mainly at pension-pay out days. I am also making bread-spread peanut butter from Kalahari melon seeds," said Ndegu.

Ndengu continued to explain that some people in Namibia, especially in the northern parts of Namibia where people grow crops, do not know that these natural native fruits and vegetables can bring them good income if they process them to add value. *"Sometimes, people throw away these native fruits and vegetables,"* continues Ndengu.

She cited lack of wood as one of the challenges she faces when processing these natural resources to add value. Other ingredients like colouring and preservatives are only found in Windhoek, which is a far away from where her location. Another challenge is that the food bottles are expensive and can only be sold in packages and not per piece.

Ndengu said that if people in all 14 regions of Namibia can be trained on how to process native fruits and vegetables to add value, this will lead to food security and economic growth because the country will be selling and consuming their own products.

The collaborative project on processing of under-utilized indigenous fruits, vegetable and plants for enhancing nutritional quality in Namibia and Mozambique, was carried out by the University of Namibia and two research institutions in Mozambique - the Institute for Agriculture Research (IIAM) and the Centro de Investigacao e Desenvolvimento em Etnobotanica (CIDE) through funding from the SGCI project.

The funding was made available to UNAM and IIAM/CIDE through the National Commission on Research, Science and Technology (NCRST) and National Research Fund (FNI). The SGCI is being implemented in 15 sub-Saharan African countries, including Namibia and Mozambique.

The aim of the project was to extract the phytochemicals of wild edible Strychnos spp (Eembu), wild orange fruits (Omauni), Hibiscus sabdarrifa

Caylces (Mutete), (Vanguerista infausta (wild medlar), wild spinach (Amaranthus) and sweet potato then incorporate these into different processed dairy and fruit derived products with increased nutritional and medicinal products.

This information is contained in a technical report on the project, whose principal investigator in Namibia was Dr Penny Hiwilepo van Hal while in Mozambique, the principal investigator was Dr Damiao Wetimane Nguluve.

It was also aimed at providing scientific and technical solutions required to establish and grow sustainable value chains for utilization of indigenous fruit and vegetables and provide technical bedrock upon which commercialization can be built, to formulate medicinal compounds from active ingredients derived from wild edible vegetables and plants (violet tree), which both contain medicinal properties to multiple diseases including cancer.

Another project aim was to increase the nutritional value and provide medicinal properties to milk products like yogurt and ghee by adding active ingredients derived from wild orange fruits, mutete, and Ipomea spp, thus increasing their consumption and commercialization potential.

The University of Namibia concentrated on the wild orange, mutete and violet tree while IIAM/CIDE concentrated on the wild spinach, wild medlar and sweet potato.

However, it was later agreed that the objective was no longer to formulate medicinal properties but rather to do a phytochemical characterization for the bark and roots with a view to incorporating its extract in a food product and the ethno-botanical survey for the University of Namibia was narrowed down to a survey on utilization.

Nutritional and phytochemicals characterization of the raw materials; wild spinach, wild medlar, sweet potato, wild orange, mutate and violet trees were carried out to determine the proximate analysis, total phenolic content, total flavonoids content, total condensed tannis and anti-oxidant activity.

Vitamin C analysis was also done for plants in Namibia. As a result, product prototypes were developed such as jam (mutete and wild orange), yoghurt (mutete, wild orange, wild medlar, sweet potato), juice (mutate, mango-juice blend, wild medlar), wild spinach syrup, wild spinach soup, wild orange leather and wild orange muffins.

Test and the sensory evaluation performed on all the above product prototypes, showed moderate to good acceptance. The report indicated that content analysis for labelling purposes was performed on the products locally in Mozambique and by an internationally-accredited laboratory in South Africa. Violet tests performed on extracts showed that leaves could be used in food products.

Increased quantities of the products were produced and used to test the market's acceptance and willingness to pay was done in Maputo (Mozambique), Rundu (Namibia) and Windhoek (Namibia) and the result was favourable.

The developed products were also exhibited at two shows to raise awareness of value and addition opportunities to mutete and wild orange in Namibia and Mazambique National Market Fair and at some seminars.

Project Impact on Community/Industry

As part of the capacity building, 18 community members and workers from four regions in Namibia (Oshana, Ohangwena, Kavango East and Kavango West regions) were trained in the basic processing of adding value to natural indigenous fruits, vegetables and plants while 35 students were trained in Mozambique. Three of the participants in Namibia received further training-the-trainer training.

A results dissemination workshop was held in Manhica (Mozambique), involving farmers, governments officials and researchers. The project also resulted in the development of a training manual that was jointly developed while three training videos were also developed by the project.

A draft memorandum of understanding between the Kavango West Regional Council and the University of Namibia, aimed at promoting value addition to indigenous fruits and vegetables in the region was finalized and a regional investment conference held in the region, included some of the products developed to attract private investors.

In Mozambique, the Manhica Dairy Farmers Association community have adopted the technology and are now

producing and selling the three value added yoghurt products.

Another Namibian who also took part in the training, Aggripina Nyambe from Kavango East region said she had benefited from the training held in October 2019. *"The training was very interesting and it would be good if similar trainings can be done for other people in the future. The skills and knowledge gained can change someone's life in terms of making income from products like jams made from indigenous fruits,"* said Nyambe.

Bilha Iipumbu, an employee at the Ongwediva Rural Development Centre in Oshana region said the training has helped her to understand the importance of indigenous natural products. *"I have learned that natural resource products in our communities are valuable because, you can process them and produce other food products from them such as jams from fruits like wild orange fruits, which people can sell and make an income,"* she said.

Susete Zita, a Mozambican project beneficiary said that the project was good. *"I thank the IIAM and FNI for the opportunity they gave the farmers of Manhica. I have learnt a lot about processing and yoghurt making,"* said Zita.

Dr Van Hal said overall, the project was a good initiative as it has produced the basic information on what to build on and has created opportunities for commercial entities to venture into the processing of indigenous fruits and plants.

She said that as a beneficiary of the project, she has now improved her living standard through income generation by selling her products. *"I gained the knowledge of milk processing and value addition through the use of native fruits,"* she added.

Another Mozambican beneficiary of the project, Gomes Tivane, said the project provided a good opportunity to learn about milk processing and how to make food products by adding value to indigenous fruits.

Dr Van Hal said overall, the project was a good initiative as it has produced the basic information on what to build on and has created opportunities for commercial entities to venture into the processing of indigenous fruits and plants.

Challenges and Lessons Learned

However, there has been some challenges too in the implementation of the project, which was funded to tune of USD 10,000 and ran from the 3rd September 2018 – 30th November 2019.

According to the report, substantial challenges were experienced in sending samples to external laboratories and obtaining results from these accredited laboratories as there is no accredited laboratories that can carry out food analytical services in Namibia and Mozambique.

There were also delays in procuring services such as a vendor, establishing logistical arrangements, and also substantial delays in procuring reagents, additives and packaging.

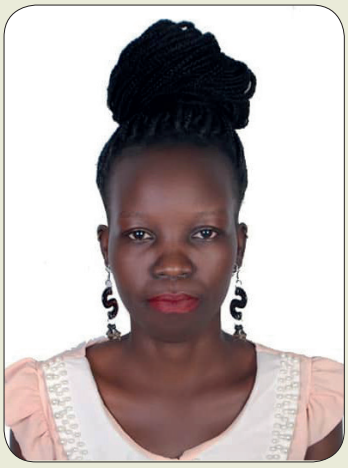
According to the report, one of the lessons learnt from the implementation of the project is that arrangement and delivery of samples to outside laboratories requires substantial time. Another lesson learnt is that incorporating students in the project work can sometimes hamper timeliness of activities as their availability is not guaranteed because of the academic calendar and the use of MSc students or part-time research is recommended.

The project also recommended that engagement in the project be widened to include different actors in the value chain. It also recommended the establishment of accredited food analytical laboratories in Namibia and Mozambique to reduce the cost and eliminate the complications in transporting samples abroad and obtaining validations of products.

UGANDA

Cocoa Waste to Wealth: Using Yeast Strains from Ugandan Box Fermentation

Jacky Achan (Kampala, Uganda)



Jacky Achan, Science Journalist

In Uganda, to harvest cocoa beans, a farmer digs a hole in the garden, lines the floor hole with banana leaves before placing the cocoa beans harvest and covering them with banana leaves. This is left for a few days to allow the cocoa to change from a whitish to brown colour. In the process the cocoa beans develop a chocolate flavour.

Joseph Mulindwa, a Ugandan Food Scientist says that while cocoa farmers in Uganda are fermenting their cocoa beans in the right way the process is quite rudimentary.

"We were intrigued to know what happens during that process," says Mulindwa who works with National Coffee Research Institute (NaCORI) which is under the National Agricultural Research Institute (NARO). NaCORI handles coffee and cocoa research in Uganda.

A study conducted under the project, 'Cocoa waste to wealth: using yeast strains from Ugandan box fermentation', found that the species of microorganisms that aid fermentation of cocoa in the cocoa growing area of Mukono, Kayunga, Buikwe, Jinja, in Eastern Uganda was different from that in Bundibugyo in western Uganda.

"All have particular characters. We were able to isolate some of the microorganisms and use them to facilitate our fermentation process, to get the best quality," reveals Mulindwa the Principal Investigator.

"It fulfils our aim which was to find these microorganisms, get them, and use them to get more consistent fermentation of Ugandan cocoa beans," he adds. Mulindwa explains that fermentation is a crucial process and without it, the cocoa beans cannot neither develop a chocolate flavour nor the chocolateness.

He explains that in the process of fermentation, some other microorganisms can come in, and instead of forming the chocolate flavour the cocoa beans instead get spoilt. *"We succeeded and got a strain of microorganisms that gives us a consistent colour and flavour when we ferment the cocoa beans,"* he says.

This was achieved using funding from the African Centre for Technology Studies (ACTS) that belongs to a donor consortium of the Science Granting Councils Initiative in sub-Saharan Africa (SGCI).

The Transformation to Better Techniques of Fermentation

Joseph Mulindwa says that most cocoa farmers in Uganda are small scale and either ferment their cocoa

beans from home to sell to export companies, or simply sell unfermented cocoa beans.

However unfermented cocoa beans fetch little money about UGX 2,300-2,500 per kilogram, but after fermentation and drying, the farmer gets on average of UGX 7,500 per kilogram.

"There is loss made if the cocoa is not fermented," says Mulindwa. Unfortunately, the stacked fermentation box available to the small-scale Ugandan farmers is unfavourable forcing the farmer to continue using rudimentary methods. It has a capacity of holding 800-1,000 kilograms of cocoa beans, however a small-scale farmer with an acre of cocoa, harvesting either weekly or bi-weekly depending on the season can only get a maximum of 60-100 kilograms of cocoa.

"With a small yield, a farmer cannot use the stacked fermentation box. Some farmers opt to dig a hole in the garden put in banana leaves followed by the cocoa yields to ferment," says Mulindwa.

This rudimentary method can achieve 40% to 50% fermentation which is not good enough. Mulindwa explains that the minimum recommended level of fermentation should be at least 65% to 70% fermentation.

Using the traditional stacked fermentation box, a farmer carries the cocoa beans to the first box, which is up, on the stack of four to three boxes. The beans are covered to reduce the supply of oxygen, in turn there are microorganisms that are turning the cocoa sugars into other substances, hence developing chocolate flavours and colour.

The cocoa beans are turned from the first box into another after two days. During the change from one box to another a farmer is mixing, to ensure fermentation is uniform and also allow some aeration. Mulindwa explains that aeration is important because microorganisms are also changing. *"The ones you start with are not the ones you end with because during aeration they are also changing and all these steps are very important. If one step is missed, fermentation will not be complete and uniform. You will also get off or lose flavours,"* says Mulindwa.

The fermentation takes a minimum of six days and maximum of seven days using the traditional stacked fermentation boxes. But it is not easy using the traditional stacked fermentation boxes. *"It's a long, laborious process. Imagine someone lifting weights of 800 to one tonne in the first box and turning it to the next box, it was too much work. But we have designed the single fermentation box with a capacity of 50 to 100 kilograms. The single stack fermentation box has a hand crank to turn the box, it has racks inside which can mix the cocoa,"* continues Mulindwa.

In the mixing process, the cocoa beans on top go below in the next box, and the one below comes on top to have uniform fermentation.

Mulindwa says that with the single fermentation box almost 90% of the cocoa beans are well fermented and also the fermentation time is reduced. *"We found that the box retains enough heat and facilitates a rapid process of fermentation. It reduced the fermentation duration from seven to four days,"* he says.

The single stack box is also gender friendly. It is easily used by women and children who do most of farm work whereas men go out to sell. The labour needed to change from one box to the other is also reduced and it offers security.

"Imagine how expensive cocoa is; what if it is stolen from the hole you dug in the garden? With the box, you can do fermentation in your house where there is security unlike in the local methods. Also, the stacked fermentation box that are big are not practical for small-scale farmers, so all options point towards adopting this single fermentation box," he says.

Beyond the Box, Other Innovations

Joseph Mulindwa says that cocoa holds about 60% juice after harvest which is too much and the fact that farmers ferment cocoa at home presents other challenges. *"When this juice drips on the ground it also undergoes fermentation giving an off smell that leaves a bad odor around home. Another major thing is that because it is acidic, the juice is corrosive to the environment so that when it drips continuously in one place that soil stops supporting plants or life,"* continues Mulindwa.

The positive thing is that cocoa juice can be consumed, *"Using funding from ACTS we designed a juice extractor, to put the cocoa juice to use. It makes very beautiful wine, when you control fermentation you get wonderful results."* he adds.

Mulindwa explains that cocoa juice only becomes acidic because of the wild microorganisms that ferment it, but when yeast is used to produce the wines, it produces flavours that best describe the alcohol beverage.

Under the ACTS project brandy was also made. "*After fermenting the juice, we subject it to fractional distillation and leave the collected ethanol to mature for a minimum of about a year under controlled conditions. From the process, we get brandy which is a dry like alcohol with some characteristic flavor,"* explains Mulindwa.

He adds that with the onset of the COVID-19 pandemic they also make sanitizer/disinfectant using the ACTS fund without diverting from the major objective project.

Involving Farmers

Over 200 farmers of which about 20% are women and 5% are children mostly involved in farm work but working with two export companies ICAM chocolates in Bundibugyo and Lwanga Enterprises in Mukono, have been trained to use the single fermentation box.

"We have trained them on the innovation of the single fermentation box, extraction of the juice and ethanol and they have appreciated the innovations we have developed. We have shown farmers how they can extract the cocoa juice and add other juices from oranges and passion to punch and improve the flavor for home consumption," says Mulindwa.

He continued to say that most of the farmers may not produce wine but instead of leaving the cocoa juice to go to waste they can now extract and make home juice.

Embracing use of Fermentation Boxes

Henry Lwanga, a cocoa farmer and exporter said that the single fermentation box and the juice extractor performed really well. He lamented that farmers were processing cocoa poorly using the traditional fermentation techniques and this would make cocoa bitter with no aroma *"Cocoa is supposed to be sweet,"* says Lwanga.

Other farmers, he said dried the cocoa under the sun without fermenting it *"You can't even chew it as it leaves a bitter taste. We have tried this new innovation and it will provide quality fermented cocoa that will fetch a good price. Hopefully we can duplicate the single fermentation box to process quality coffee and earn more money,"* concludes Lwanga.

The Challenges

Prof. Archileo Kaaya, a Senior Researcher at Makerere University and co-Principal Investigator of the study said that fermenting cocoa beans using rudimentary methods such as digging a hole on the ground can lead to molds and aflatoxins thus compromising on quality. He added that the single stack box is cleaner, user friendly and an easier method that can be scaled up. Prof. Kaaya is attached to the Department of Food Technology and Nutrition, School of Food Technology Nutrition and Bioengineering, College of Agriculture and Environmental sciences.

"We were also to look further into the microorganisms that aid the cocoa beans fermentation process and isolate them at molecular level to see the genetic makeup and how we can conserve pure strains to make sure that we can control fermentation to the dot but we hit a snag. On three occasions, we were supplied with reagents that couldn't bring the results we wanted," disclosed Mulindwa.

Results of Improving Fermentation Processes

"The project helped us to improve the stacked fermentation box for greater efficiency and ease of use, we also developed different products including wine, ethanol, and cocoa powder," says Mulindwa.

"In addition, we have further isolated these microorganisms at morphological level and also at bio-

chemical level looking at some of their metabolites that they give out during fermentation," he disclosed.

However, at molecular level the project hit a snag but it can be revived.

Prof. Kaaya added that they managed to identify and preserve good microorganisms that aid the fermentation process to be used directly by farmers to produce quality cocoa beans.

"It will ease the problem of quality. Proper post-harvest handling of cocoa attracts more money for farmers," he says.

He adds that cocoa is a promising industry in Uganda and more people are starting to produce it. Prof. Kaaya states that the global price of cocoa never falls and this can boost earnings for Ugandan farmers. Another positive aspect is that cocoa can grow anywhere coffee grows and in 3/4 of Uganda.

The development of value-added products such as ethanol and wine from cocoa pulp juice and sweating is expected to reduce Uganda's ethanol importation costs which stood at USD500,000 in 2015.

The project is expected to boost income generating capacity of participating cocoa farmers in varying agro-ecological zones of Uganda by up to 25% through the sale of value-added products to laboratories and well fermented cocoa beans to cocoa buyers thus fetching better prices.

According to Mulindwa, the future holds much promise as many farmers are now adopting cocoa production because they have found a treasure. *"It doesn't require too much, it's a lazy man's crop, in agriculture it means you don't put in too much yet you earn so much. So, farmers are embracing it,"* he says.

"Uganda may have no place in cocoa exports but the nation is blessed with good climate and fertile soils. About 80% of our cocoa is organic giving us an advantage over other exporting countries," he adds.

Besides that, Mulinda states that Ugandan soils favour the quality of cocoa *"Most exporting countries prefer our cocoa. The market is readily available and they are offering good money which is almost times three the price of coffee, and many farmers are now starting to take up cocoa. We are in the right truck,"* he says.

Mulindwa however says that Uganda needs a regulatory authority that will handle the cocoa sector, to have well organized farmers, and a clear value chain.

How do we make the single fermentation box innovation durable and cheap?

"The magic in Phase Two will be for us to partner with business people who can help with mass producing and marketing the boxes," says Mulindwa.

A business model with the exporting companies that work with farmers can also be designed to help multiply these boxes at that level, so that farmers can access them.

There is word that Uganda Coffee Development Authority (UCDA) which is the coffee regulatory body may also take up cocoa regulation if this happens then funding to upscale is assured.

Fortunately, innovations never die, even if they remain on shelf, at the right time and with funding they can be up scaled for farmers.

We also need to change the attitude of our farmers who wait for free things, having received training they can take up the technology and fabricate the boxes locally as the design is not complicated. Unfortunately, to maintain the status quo, the business sector takes advantage of the farmer's ignorance so that they can pay less for the cocoa beans.

Business people will always prefer the unfermented cocoa and tend to entice farmers with ready cash as soon as the cocoa has been harvested. Pressed for cash, the farmers opt for the money instead of waiting for four to five days' fermentation period.

The challenge is that without a regulatory body for cocoa, it is the exporter who is setting standards and conducting regulation but once the cocoa sector is taken up by that Uganda Coffee Development Authority (UCDA) they will set the standards.

Like coffee farmers, cocoa farmers will know at what stage to sell while selling unripe and unfermented cocoa beans will be illegal. These innovations will proceed once the cocoa sector has been regulated and standards set.

Impact of Cocoa in Uganda

Cocoa ranks fourth in foreign revenue contribution, and supports over 10,000 households in Uganda. In 2018, according to Bank of Uganda statistics Uganda exported cocoa worth USD 64 million (sh236 billion), up from USD 54 million (sh199 billion) earned in 2017.

"If you go back 15 years, Uganda was only earning USD 7million annually, this translates to an increase of over USD10 million every year. The growth is becoming exponential," says Job Chemtai, a Research Officer and Cocoa breeder at NaCORI.

"We are not only working on developing varieties but also aggressively working on adding value to cocoa and building our team in terms of numbers and skill. We have developed prototypes of chocolates, cocoa powder, cocoa butter and domestic products like lip balm and body jelly. We promised a fermentation box and teaching farmers but are now delivering chocolates and other products. We have delivered more than we promised," adds Chemtai.

Chemtai feels that the government is not adept at conducting business. *"The best we can do is to develop prototypes and interest people who can set up private companies and be able to commercialize what we have developed,"* explains Chemtai.

"We develop knowledge and publish in the public domain for whoever wants it. But we are developing department NARO holdings that can now handle the business part," he reveals.

According to Chemtai NaCORI has proved that they can do business although at a small scale. *"We have developed products such as coffee powders for sale and they are always available. We recoup that money and put it back into our systems. Our role is to generate knowledge and products for the good of the society, in this regard, we work for the public and get paid by the government,"* elaborates Chemtai.

"Cocoa ranks fourth in foreign revenue contribution, and supports over 10,000 households in Uganda. In 2018, according to Bank of Uganda statistics Uganda exported cocoa worth USD 64 million (sh236 billion), up from USD 54 million (sh199 billion) earned in 2017.

What more needs to be done to Bolster Quality Cocoa Production?

The single fermentation box requires some improvements because we realized that it normally breaks because the wooden parts are too thick. It needs to be reinforced using some stainless-steel so that it does not break when a farmer is using it.

"We also want the fermentation box to have a compartment or mechanism of collecting the cocoa juice so that a farmer can collect, ferment, and dilute it with water," says Chemtai.

Chemtai explains that cocoa juice can also be used as a pesticide, *"When you spray the fermented cocoa juice on the cocoa plant some insects die and when it rains, the rain water washes away all the fungal growth from the tree and the trunk making it clean, thus producing more fruit,"* he says.

We trained over 200 farmers and if we can develop 15 or 50 single fermentation boxes and leave them with the farmers it will improve the fermentation process and the quality of cocoa.

"The box is easy to assemble and quite reliable. Anyone can assemble it. We made it in such a way that even the farming community can look at it and replicate it for their own use," he adds.

According to Chemtai, someone can take the single fermentation box innovation as a business and mass produce it for sale. *"It will not help funders to develop this box which has shown promise and then we keep it in our stores, it needs to be used by farmers for quality cocoa production, to get more earnings,"* he says.

Future Plans

The next phase will focus on developing more single fermentation boxes and leaving them with cooperatives to encourage them to fabricate the product.

Chemtai explains that in case entrepreneurs want to take up the idea, terms can be agreed upon so that they can get some royalties before scaling up on production.

"Our desire is to have the farming community using the fermenting box to eliminate the challenge of quality because most farmers do not ferment which compromises our cocoa brand as a nation. If we can encourage most of our farmers to use this box while taking other agronomy measures, we will able to compete in the global cocoa market and fetch more money for our crop," says Chemtai.

There is a possibility that in the next 10 years, cocoa may soon rival coffee because of the rate at which it is growing. *"The volume may not, but cocoa has twice the value of coffee. After processing, a kilo of cocoa fetches between UGX 8,000 and 10,000 while coffee fetches between UGX 4,000 and 4,500 meaning that cocoa has higher prospects,"* he says.

About Science Africa

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The Scinnovent Centre

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