

## Makerere University

### ***‘Mak@100, Propelling Research, and Innovations for Development’***

In 2021, to join the rest of Uganda and the world to celebrate the 59 years of our Independence, Makerere University is grateful for the opportunity to showcase 18 projects (12 Funded by the Government of Uganda through Makerere University Research and Innovations Fund (Mak-RIF) and 6 funded by International Agencies) designed to drive Uganda’s development Agenda. These are a handful of over 1,000 multidisciplinary projects currently ongoing at Makerere University and being implemented in different communities in Uganda. Makerere University is participating in Uganda’s Independence Day Celebrations guided by the Theme: ***Mak@100, Propelling Research, and Innovations for Development.***

### **A Highlight About Projects being showcased**

#### **1. Advancing Tissue and Organ Biobanking in Uganda**

Makerere University, at the College of Health Sciences (CHS) has pioneered biobanking in Uganda by establishing the first well-annotated, quality assured biorepository for nucleic acids, blood, and its derivatives with over 100,000 samples in storage over the last 10 years. Basing on this success, through this project, the multidisciplinary team led by **Professor Moses Joloba**, has expanded the scope to tissue and organ biobanking, starting with sperm, ovum, and umbilical cord blood. This team has established a tissue and organ biobank at Makerere University to serve as a catalyst for research in organ collection, biobanking, and transplantation in Uganda. This project has improved health worker’s capacity in tissue and organ banking, developed Standard Operating Procedures for the collection, processing and storage of human sperm and umbilical cord blood, developed Functional tissue and Organ Catalogue and Constituted Bio-banking advisory board to promote the non-commercialization of tissue and organ donation, fight against organ trafficking and the development of ethical, quality and safety standards in the field of organ, tissue and cell transplantation.

By establishing the first public human tissue and organ biobank in Uganda, the team has contributed the following:

- Pioneering tissue and organ transplantation for clinical care is long overdue in Uganda since the country suffers a high disease burden, part of which can be addressed through human tissue and organ transplantation.
- Baseline information for ethical, legal, and social implications surrounding human tissue and organ biobanking in Uganda. Knowledge generated from this study will guide debate on the Human Organ and Transplant bill in parliament.

- Establishment of the first public human and tissue and organ biobank to facilitate clinical care and research. This infrastructure at Makerere University is a resource that can be utilized by students and researchers to conduct research and training to improve this field. Furthermore, this resource will be used as the basis to create curricula at the College of Health Sciences to train students in this field.
- Well annotated semen and stem cells are freely available to the public (potential recipients) in need of these tissues for treatment.

Overall, established capacity will stimulate tissue and organ transplantation in Uganda, which will reduce the need for overseas treatment, and thus improve healthcare.

## **2. Up scaling the Usefulness of Ugandan Moringa oleifera and Aloe barbadensis through Formulation and Clinical Development of Novel cosmetics and pharmaceutical products**

Aloe barbadensis and Moringa oleifera Lam. are economically important tree and vegetable, which have been reported to possess many pharmacological activities which include analgesic, anti-inflammatory, antiasthmatic, antiulcer, antispasmodic, antibacterial, antihyperglycemia, antioxidant, anticancer, and larvicidal activities. Although the medicinal profiles of these plants make them more suitable for production of cosmetics and Pharmaceuticals, little has been done in Uganda to upscale this economic potential. **Dr Lutoti Stephen** and his team have formulated and standardized cosmetic and pharmaceutical products including; the **Makrif Immune Booster** for improving the immunity, **MAKrex Skin Ointment** for wound healing and skin moisturizer and **MAlerex Herbal Solution** for symptomatic management of malaria. Product formulation, preclinical evaluation of safety and efficacy of the products and quality assessment of the products to profile in terms of phytochemistry and microbial contaminants are completed. Assessment of the products by National Drug Authority and Uganda National bureau of Standards and Clinical evaluation of the products is still ongoing.

The last 5 years have seen tremendous growth in the popularity of herbal products amongst consumers who view them as safer and more effective than conventional products. Globally, the Herbal products industry commanded sales of US\$ 71.19 billion in 2019. Where once a customer would have to go to a specialty shop to purchase herbal products, now those same products are available in Supermarket chains and pharmacies. Scaling up industrialization of Mak-RIF Immune Booster, MAKrex Skin Ointment and MAlerex Herbal Solution will promote a healthy population, create employment for the youth and increase revenue in the country.

### **3. Development of an open design Low-Cost Ventilator in Response to the COVID-19 Need**

The current Bulamu Medical Ventilator prototype is the 4th generation and is being produced for animal trials. Currently one unit is fully integrated and ready for Animal Trials. Three other units targeting animal trials are also being worked on.

The domestic development of a low-cost emergency ventilator presents an affordable and more accessible alternative to the normally expensive options available on the market. The low-cost ventilator shall not only increase Uganda's capacity to offer clinical care to severe COVID-19 cases facing respiratory challenges during this emergency period, but also give many patients a fighting chance against the disease and reduce fatality where possible. The capacity developed in the area for local content participation in the manufacture of Low-Cost Ventilators will be valuable to Uganda even post the COVID-19 Pandemic.

**4. Dr. Cosmas Mwikirize has led a team of researchers to manufacture a low-cost Device for Decontamination of Personal Protective Equipment Towards Safe Reuse.** Medical Personal Protective Equipment (PPE) such as N95 masks, face shields and goggles should be treated as infectious waste and disposed off after single use. However, epidemics such as the ongoing COVID-19 create unprecedented demand for such PPE amidst disrupted global supply chains. This usually leads to acute scarcity and elevated prices for the PPE. Developing countries are often hit the most: In Uganda, it is now common for medical workers to reuse N95 masks by maintaining one mask on throughout the day, and thereafter, doffing and reusing it without decontamination. Others spray the masks with alcohol-based sanitizers, which is an ineffective decontamination strategy and potentially leaves residual chemicals on the masks.

To address this need, this team of researchers has developed a portable device for decontaminating medical PPE towards safe reuse. The device comprises an enclosed insulated mechanical structure; an embedded control system; a UVC light assembly and a heat source. In a typical embodiment, the device utilizes a combination of humid heat (C at 50%-85% relative humidity) and ultraviolet light (UVC: 200-280nm wavelength) for biological decontamination of N95 masks from SARS-CoV-2. In a suitable decontamination protocol, non-soiled N95 masks used by one health worker are placed in the decontamination device which is then enclosed. An external user interface is utilized to set the required parameters (temperature, exposure time) for the masks. At the end of the set period, any SARS-CoV-2 on the masks are deactivated, and the mask can be safely reused by the same health worker. We have undertaken structural integrity on N95 masks after a 15-minute exposure in the device and results show that the proposed method maintains fit and structural integrity of the masks up to at least 5

decontamination cycles. Studies to test the antimicrobial efficacy of the treatment protocol against SARS-CoV-2 and other microbes deposited on the PPE are ongoing.

We have developed the device with a target price of US\$ 500 (~1.8 million UGX). Taking the cost price of N95 masks (~ UGX 25,000) as a case in point, decontaminating 72 masks (7 decontamination cycles in small form factor device) would achieve payback. Our device will ensure that the effective lifetime of PPE is extended, hence efficient protection of health workers involved in caring for COVID-19 patients in Uganda and other developing countries. Beyond the COVID-19 pandemic, the proposed device and method can potentially be a staple in all hospitals and health centers in Uganda and Africa since N95 masks and related PPE are routinely required in high-risk areas such as the respiratory ward, emergency department, intensive care unit, and TB room isolation, as well as for high-risk procedures such as endotracheal intubation. In Uganda, it is common to find health workers in such high-risk areas without any protection, due to the prohibitive cost of N95 masks. Our device would be a solution to this challenge, since a single mask can be used, decontaminated, and reused by the same health worker. We have filed for a patent for the device and seek support towards industrial production.

## **5. Kiira EV and Kiira EVS**

The Vehicle Design Project is an innovative research project aimed at applying contemporary technologies to develop sustainable transportation solutions for Uganda and Africa. The Project was inspired by the Vehicle Design Summit (VDS), an International Student-Led Consortium aimed at Leapfrogging Sustainable Transportation Technologies. In 2008, Vehicle Design Summit (VDS) Teams from 35 Pre-eminent Research Universities built a 5-seater Plug in Hybrid Electric Vehicle, The Vision 200 Led by Massachusetts Institute of Technology (MIT). Makerere University, the only African team, developed the Power Train and in-Vehicle Communication Network for the Vision 200.

The vision of the project is to be at the forefront of research and development of green transport technologies in Africa, while its mission is to carry out research aimed at development of cost effective and environmentally friendly transportation technologies for Africa. The Tactical Objective, on the other hand, is to build from scratch a 2-seater Electric Vehicle code-named Kiira as proof of concept, while the strategic objectives are; development of Hybrid Public Transport Vehicle-(Omni-bus), and establishment of Centre of Excellence in Transportation Research. The project is currently headed by **Prof. Tickodri Togboa Sande** assisted by **Mr. Paul Isaac Musasizi** and **Mr. Dominic Semukuttu**.

In the follow up to the Kiira EV, the Vehicle Design Project team intends to design and fabricate a 28-seater commuter electric vehicle KAYOOLA a Green Public Transport Solution tailored for Kampala City. The project is also working toward establishing a Transportation Technology Knowledge Bureau, code named the Centre for Research in Transportation Technologies (CRTT).

The design and Development of other systems including the power train, Body electronics, Communication Network and Transmission system is complete and procurement of the relevant fabrication tools for these systems is ongoing. The final body and interior designs will be implemented using fiber glass material which is locally available. The vehicle design project strategically aims to establish a center of research in transport technologies to develop solutions to local transport needs including road, water, air and rail for public transport, agricultural and industrial needs.

## 6. Engines made in Uganda

Makerere University College of Design Art and Technology, through incubation programs like MAPRONANO ACE in collaboration with Kevoton Motion Engineering Limited (KMEL) launched the first of its kind Engine Proof of Concept prototype developed from locally available materials. This was launched by the Hon. Dr. Monica Musenero, Uganda’s Minister of Science, Technology, and Innovations.

Commercialization shall be hinged on the domestic value addition through the establishment of supply chain localization linkages and strategic technology transfer partnerships. Supply chain localization activities will translate into lowering production costs, stimulate job creation, foster economic growth, and facilitate human capital development through capital, knowledge, and technology transfer.

KMEL Commercialization Strategy has three (3) core phases i.e. Establishment of a fully functional Engine Manufacturing Plant, Local Value Addition through localized Supply Chain linkages, capital, knowledge and technology transfer partnerships and the Establishment and sustainability of Engine market share in East and Central Africa. The engine will boost the low levels of production, productivity, and value addition in the Agriculture and Transportation sectors through agricultural mechanization and affordable transport solutions. The engine will boost the low levels of production, productivity, and value addition in the Agriculture and Transportation sectors through agricultural mechanization and affordable transport solutions.

Table 1: Key Benefits of Engine Production

SN	Category	Explanation
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1	Catalyze investment	The direct investment of \$ 32,895,961 in the five years of operation is projected to create economic gain of 39,475,152.
2	Youth Employment and Skills Development:	A total of 269 jobs will be created with 69 direct jobs and 200 indirect jobs
3	Mineral Utilization	Establishment of an Engine manufacturing facility is projected to increase demand for the utilization of natural resources such as steel from iron ore deposits (260 million Metric Tons).
4	Tax Revenues:	The Engine manufacturing facility shall contribute to significant tax revenues from vehicle sales, usage-related levies, personal income taxes, and business taxes. Production and sales of engines, parts, and services deliver excise, sales, value-added, and local taxes and import duties to boost the country's current-account performance and trade balance with other economies.
5	Regional Development	Across the world, the Engine manufacturing industry is a spark for regional development. Industrial clusters form as original equipment manufacturer (OEM) plants are surrounded by component manufacturing facilities. These clusters lead to new municipalities with solid road infrastructures, railway and freight connectivity, and new housing developments.

### **7. A Pedal-Operated Seed Cleaner (PoS-Cleaner) To Boost Post Harvest Grain & Legume Quality, Increase School-Study time & Create Financial Freedom in Rural-Uganda with the leadership of Dr.Peter Tumutegyereize**

Five pedal operated seed cleaners were developed and distributed to five farmer groups which are active in grain crop production in Butansi and Namasagali sub counties in Kamuli District. The cleaner consists of a bicycle-like pedaling system, hopper, a centrifugal fan and three cleaning sieves which include two inside interlocking sieves and one fixed; whose meshes can be adjusted to be larger than the size of the unclean

seeds by simply translating the second sieve to achieve the appropriate seed size. This allows trapping of foreign impurities larger than the seeds. Host farmers for the machines among the five groups were selected based on their potential to provide space and security for the machine as well as potential to train other farmers on the use and operation of the machine. For monitoring and evaluation of the use of the cleaners, a data collection sheet was also provided so that whoever uses the machine, registers his or her subcounty, parish, village, type of seed brought for cleaning, quantity cleaned, time taken, approximate distance from their homes to the host farmer and remarks for feedback. This provided important information of for example, the effect of distance on machine use, the clean rate and user acceptance.

Large scale production of the pedal operated seed cleaner will lead to a tremendous reduction of Post-Harvest Losses (PHLs) of grains & legume in Uganda. Currently Maize grains lost alone, could feed over 1.14 million persons for a full year. These losses along the food chain are greatly attributed to poor seed sorting or cleaning. Unclean seeds and foreign materials promote mold development resulting to dry matter loss, nutritional changes, seed quality loss, aflatoxin contamination and PHLs during storage and processing. The available imported seed cleaners in Uganda are energy and cost demanding in terms of ownership, operation, and maintenance. Therefore, farmers resort to traditional screening or winnowing which is inefficient, time consuming, labor intensive, coupled with 4% of total production losses, low revenues and ill health exposure resulting from inhalation of dust.

## **8. Development of a Green Low-Cost Touchless Hand Wash Technology (TW-20 Kit) For Public Shared Spaces**

Preventive measures such as effective hand washing for at least 20 seconds with soap and limiting contact with contaminated surfaces are among the approaches championed by WHO to contain the spread of COVID-19.

With Funding from Government of Uganda through Mak-RIF, a Green Low-Cost Touchless Hand Washing Technology (TW-20 Kit) for Publicly Shared Spaces (the population accessing hospitals, market areas, busy streets etc are already using the TW-20 Kit) has been developed by Dr. Joshua Wanyama and his research/innovation team.

To facilitate point-of-use user data mining, the TW-20 Kit is connected to the TW-20 View, a custom-made data repository and analytics platform that receives handwashing user data remotely and reports it to the public.

Through the TW-20 View we are able:

- (i) Monitoring of handwashes per kit per day across all beneficiary sites.

- (ii) Tracking of the progression of hand hygiene adherence based on the sampled points; and
- (iii) Accurately and precisely determining the water and detergent used by each site overtime.

This acts as an early warning system to enable preventive measures to be taken in individual organizations and support transfer of practice from the best performing organizations to the poor ones.

**Moving Forward:** This Project aims at harnessing data science techniques in advancing point-of-use handwashing user data collection using TW-20 View from the installed TW-20 Kits.

### ***9.. Strengthening Science, Technology, Engineering, and Mathematics (STEM) Using Gamification in Primary Schools (GamePlus); a project led by Dr. Benjamin Kanagwa***

This is a solution for primary school children to enjoy & improve learning of science and mathematics by themselves using interactive computer and mobile phone video gaming technology. We achieve an educational objective by taking learning to things that children enjoy most, which is playing and winning.

We use challenges and missions a child must accomplish and be rewarded under specific circumstances such as picking and delivering oxygenated blood through the correct blood vessels in each time. The challenges are designed to meet learning objectives based on the national curriculum. This is interactive learning by doing that gives the closest realistic feel of what is being learnt.

Our motivation is to double the number of the next generation of scientists by making learning of science and mathematics fun and easy to understand thereby stimulating more innovations and economic prosperity. We have developed three technologies called *Kamati* for learning mathematics starting from primary five; Gastro Trek for digestive system, and Blood Cruz where children play, learn and master blood circulation. Findings reveal that children can master advanced concepts when embedded in games.

With this mode of learning, (i) Children can enjoy learning from wherever they are; (ii) Learning materials are very easy to distribute and (iii) We have opportunity to include other learning areas such as culture, patriotism, and local traditions.

The three technologies are currently in use by many children as per downloads and reviews. Our target is to reach every child, add more fun to the current learning



materials, and cover all topics for primary school science and mathematics. This is the future of learning because it has been used to train pilots and train strategy in military among others.

#### **10. Makerere University Electronic Human Resource Management System (eHRMS) being worked on under the leadership of Prof. Josephine Nabukenya.**

Under the Mak-RIF 2 grants award, the development of an electronic Human resource management System (e-HRMS) for Makerere University was undertaken. The e-Human Resources Management System (e-HRMS) sought to automate Makerere University's Directorate of Human Resources (DHR) business process(s) and/or workflows while linking to related systems to improve the functionality of managing its human resources and staff needs. The e-HRMS system supports the key HR functions such as Recruitment and Selection, Administration of Personnel Records, Management of Payroll, Staff Welfare and Benefits, Leave Management, Staff Performance and Appraisal, Staff Training and Development, as well as triggering the Pensions and Terminal Benefits Administration process. Other processes that are supported include Human Resources planning (monitoring the establishment), Staff Attendance monitoring through timesheets, as well as Discipline and Grievances handling. The integrated human resource management system will improve the human resources productivity by reducing delays incurred in the respective processes and increasing data sharing among four (4) main HR divisions (employment; performance and payroll; staff training, welfare, and development; and the records and information), and other units in the university. With respect to employment, the e-HRMS seeks establishment monitoring, recruitment (including advertisements), confirmation, promotion, resignation, retirement, and termination. Under performance and payroll division, the e-HRMS supports leave management, appraisals, and payroll management to ensure an up-to-date payroll ready for payment through IFMIS.

More to that, and core to the operations of DHR, the e-HRMS supports staff records and information management fully encompassing the creation (upon recruitment), maintenance (during active service), closing and archiving (upon retirement, resignation, termination, or death) of staff records for all employment terms. Additionally, training planning i.e., identification of staff skills gaps and study leave management are supported. Important to note is that stakeholders were involved right from requirements, design, validation and in the current implementation stage. This system is potentially very transformative if adopted and utilized in the whole country.

#### **11. Covid-19 and Learning from Home: Parental involvement in the learning of Primary School going Children, a project being led by Prof. Betty A Ezati.**

The abrupt closure of schools in March 2020 left about 10 million primary school children in Uganda out of school. Many schools were unprepared to avail their learners with materials to continue learning. The Ministry of Education and Sports requires parents to “give learners ample time for their children to engage in educationally beneficial activities such as revision of their previous work, listening to educational messages on radios and TV, working on take home packages given to them, and offering balanced and objective feedback”. The study team analyzed how parents were supporting home learning. Specifically, how parents in the different locations were assessing and supporting their children to use the learning materials sent by the MoES, parents’ experiences of supporting learning during the lockdown including how they structure the learning processes and challenges experienced.

Findings showed the use of a combination of materials and modes of learning. These included print study materials, TV and radio. However, the print study materials were the most available in the study locations compared to TV and radios. This was because of the cost of batteries as well as lack of electricity.

Parental support included reminding children to read and complete working on the print materials, buying print materials and newspaper pull out for the learners, ensuring that learners have food. However, parents in peri-urban areas were less available for their children. Many participated in small scale business that required them to go to the trading centre/town. In both peri-urban and rural areas, parents had limited capacity of parents to support home learning due to literacy level, lack of knowledge of the syllabus and materials to help them provide support. It was also found that parents are torn between supporting learning of their children and securing resources for sustaining livelihoods and supporting children’s learning.

This team of researchers recommends that Government should change the mode of distribution of print materials. Instead of using the political structure, government should use education offices. This means dispatching materials from the MoES to the district education offices. Head teachers would then pick and then the children irrespective of the schools they are enrolled in should pick print materials from the schools nearest to their homes.

Government should ensure that the materials are adequate, teachers within communities to be facilitated to move around to support and provide feedback to children. children can be clustered in groups of 5 for this and orient parents on the study materials to effectively support their children’s learning

## **12. Pathogen Economy: Microbial Probiotics for Improved Pig Health and Productivity led by Professor Samuel Majalija.**

This project provides solutions for improving the health and productivity of pigs while taking advantage of useful bacteria from the environment here referred to as U-ProLacto. We are harnessing the rich unexploited microbial resources in Uganda.

In Uganda, pig production is one of the fastest growing livestock with over 3.2 million pigs. But all is not rosy, because of numerous diseases, farmers maintain small herds of 1-5 pigs. Most people associate pigs with dirty and smelly environment. This is a nuisance to the would-be farmers, especially the youth who have engaged in profitable pig farming. Similarly, this negatively affects the urban and peri-urban dwellers who cannot use their small plots to raise pigs to supplement their incomes. Thus, our project taps the rich, diverse, unutilized microbial resource in Uganda to promote commercial pig production.

- When U-ProLacto are fed to the pigs, they can fight off disease-causing germs from the body, instead of using drugs and chemicals
- U-ProLacto can also stabilize the gut environment which allows efficient absorption of the nutrients from the digested food. This leads to rapid buildup of the muscles, translating into faster growth rate of the animals. The farmer will spend less on feeding the pigs which saves on the feeding costs while increasing on profits.
- U-ProLacto has shown promising preliminary results of smell reduction in pigs reared under the deep litter system. Low-cost housing is used without the need for concrete floors, regular cleaning and removal of pig dung.
- U-ProLacto can degrade the pig dung, ammonia and other smelly gasses leaving an odorless piggery unit. The breakdown of the pig dung is accompanied by release of heat, which provides a suitable ambience for raising piglets without the need for providing extra heat. The U-ProLacto also can out-compete and inhibit growth of pathogenic bacteria in the deep litter which will improve pig health. The deep litter material can be maintained for 9-12 months before removal, after that they are used as manure or sold to other farmers.

Our target is to promote commercial pig farming supported by U-PigLacto, a commercial product that will improve the health, growth and provide a clean environment for rearing pigs. With U-PigLacto, we provide clean pig production technology with low cost-housing, making pig farming more affordable, attractive, and viable for farmers to grow to commercial farming. This is also appealing to the youth that shun dirty agriculture.

We have planned further studies to optimize and refine the use of U-PigLacto on a larger scale and under different field conditions. We will carry out controlled feeding experiments to determine the efficacy and safety of U-PigLacto at different stages of pig

growth, prior to the final commercial products in various preparations, formulations, and packaging.

### **13. Design of an Improved Cooking Stove for Clean Energy, Electricity Generation, Food Security and Climate Change Mitigation** led by Hussein Kisiki Nsamba

This project custom designed a cooking stove that can provide clean cooking, with little or minimum pollution, produce biochar, which can act as a soil amendment tool, to improve on the low fertility soils and subsequently raise agricultural productivity while mitigating climate change, as well as use the waste heat during cooking as a starting material for conversion to electrical energy. The electrical power generated during cooking can be used for the LED lighting, charge mobile phones or stored in lithium – iron phosphate battery to complement the basic energy demands in electrically deprived areas such as refugee camps. The ability of the stove to produce less or insignificant emissions offsets the challenges that come along with conventional stoves. This research has the ability for scale up and subsequently commercialization to increase its competitiveness and benefit to communal users or custom made to service individual homes. This stove works under controlled conditions and thus reduces on the amount of firewood used during cooking thus saving the environment as well as provide immediate energy solutions for regions such as refugee camps that go without food due to the lack of cooking facilities.

Designing and developing an improved cooking stove will enable the production of biochar which ensures soil enhancement and subsequently food security, sustainable energy through cooking as well as converting the waste heat to electricity using a see back effect technology

This will assist subsistence farmers produce their own char that will add value to the low fertility soils and grant guarantee food security. Converting biomass waste to biochar shall ensure efficient waste management, reduces greenhouse gases accumulation, and sequester carbon in the soil. The multiple synergistic uses of biochar hold enormous promise for earth and humankind's future. There is need for the sustainable as well as environmentally friendly technologies to produce this char alongside energy recovery.

#### **Stages of Development**

This was planned to go through three stages (i) Conducting a country survey on the cooking cultures in Uganda, (ii) Designing of the prototype stove (iii) Evaluating the performance of the stove in terms of emission factors, biochar and thermo- electricity generated from various biomass wastes under natural draft and forced draft (using

either a manually driven fan and an electrical driven fan during cooking). So far, the first two stages have been already achieved and only the last is still on going. The stove shall be utilizing any agricultural waste (as a tool for waste management) and Eucalyptus grandis due to its availability discouraging deforestation of natural forest for firewood and for charcoal.

Details on Objective One can be downloaded or viewed on doi:10.4236/jsbs.2021.111003

#### 14 **Practicals to the Home for the Rural Student led by Taddeo Ssenyonga**

In Uganda, it has become a norm for students to fail science subjects, the Ministry of Education and Sports (MoES) together with the Uganda National Examination Board (UNEB) and other stakeholders attribute the higher failure rate to the lack of labs, lab equipment, and reagents in both public and private schools and they further attach the lacking to high cost. To reduce the science subjects' failure rate the MoES employed a model of building a lab and equipping it for every public school, this model has failed to address the problem because of its high costs of implementation, and this has left many disadvantaged students whose parents cannot afford fees for best schools which have equipped laboratories. We have come up with a new novel approach different from what MoES has been using. In our novel approach instead of setting up a lab for a single school, we set up a lab in a central area that can be accessed and used by students from all the neighboring schools. We piloted the new approach in the Kalungu sub-county, Buyende district on 8 schools with more than 2,000 students in total, and all the 8 schools were able to successfully use this one lab. Our novel approach reduces the cost of running practicals in schools drastically by more than 80.0%, in our pilot study, 8 labs, equipment for 8 schools, and reagents for 8 schools were replaced by one lab, equipment for one lab (school), and reagents (consumables) costs reduced by almost 60% because the remains of what is prepared were used by another group from another school before they expired. The costs for running practicals can be further reduced if a box body truck is included to move equipment from one centre to another. Furthermore, our novel approach caters to both public and private schools and is in line with the new revised secondary school curriculum where students must research by themselves.

#### 15. **Wekebere-Medical Device** developed under the leadership of Mr. Stephen Tahobya

Wekebere is pioneering the future of prenatal care in Uganda with a potential of positively impacting lives even outside Uganda.

Our mission is to empower women by delivering unprecedented insight into their health. We use smartphone-connected sensors and the app to put clinically validated information into the hands of expecting parents starting with a better way to visualize and track pregnancy. Our long-term mission to improve the health of mothers and babies and this is fulfilled through a community of mothers. By crowdsourcing the largest and most comprehensive dataset on maternal and fetal health parameters the company hopes to accelerate long overdue advancements in women's healthcare with a better understanding of pregnancy complications such as preterm birth. The wekebere pregnancy tracker is offered for both iOS and Android and available as a Monthly rental in the us at [www.wekebere.org](http://www.wekebere.org)

## **16. Eco Mobile water purifier**

This purifier turns wastewater or contaminated water such as rainwater, ground water, wastewater from industries into drinking water or for wastewater into harmless water which can easily be discharged off to the environment for safe use.

**Stage of Development:** Scaling stage.

**Impact:** The project has been implemented in more than 40 health centres, more than 30 schools, individuals, two refugee camps, churches among others. The above implementations have not been commercial however, the water being produced can be used in packaging industries, food industries, pharmaceutical companies, homes among others.

The company has a complementary product of activated carbon from cattle bones which can as well be used in the industries and other environments as listed above.

## **17. EpiTent Limited A "portable habitation solutions" provider**

EpiTent is both the name of our flagship product and our company. EpiTent Limited's flagship product is a prize-winning and groundbreaking tent that achieves a passive cooling of over 7°C (higher temperatures only cause higher cooling), a 95% improvement in airflow over existing structures (by causing a negative internal pressure) and a 90% reduction in social exclusion (from large windows and modern conveniences).

The EpiTent has evolved from just a prototype with three features into a modular system allowing for; use of modern conveniences such as green power (solar energy, sockets and light fixtures), customization the internal environment to suit all kinds of emergency medical scenarios such as consultation rooms, changing rooms and even

surgical suites and, our product is compliant with the Infection Prevention and Control Protocols up to and including level four environments (certification pending).

We are now deployed in the following locations

1. Bombo Military Hospital
2. Adjumani Hospital
3. Ayiri HC III
4. Gulu Regional Referral Hospital
5. Masaka Regional Referral Hospital
6. Mbale Regional Referral Hospital
7. Mbarara Regional Referral Hospital
8. Entebbe Grade B Hospital
9. Tororo Malaba port of Health
10. Zombo Military base
11. Mubende Regional Referral Hospital
12. Naguru Hospital (To be installed next week)
13. We have 13 tents that will be installed in November in other sites to be identified by Ministry of Health, Uganda.

#### **18. KUNGULA (Winnowing Thresher): Aggregated Post-Harvest Solutions**

The Kungula aggregated post-harvest solutions being developed under the leadership of Mr. Ssekanyo Stephen is a set of agricultural post-harvest machinery for Ugandan small holder farmers which include.

1. A maize Threshing and winnowing machine which removes maize from cobs while cleaning it too remove chaff and dust to give a clean ad superior product with the highest efficiency. The machine threshes 1000kg of maize grain in one hour on one liter of fuel.

2. A rice threshing and winnowing machine which detaches rice grains from stalks while cleaning it at the same time at a rate of 1400 kg every hour on two liters of fuel.

3. A silage and hay chopping machine with the ability to process 800 kg of animal feed forage on one liter of fuel in an hour.

4. A grain dryer unit for the artificial drying of grains on farms.

### **About Makerere University Research and Innovations Fund (Mak-RIF)**

Mak-RIF is a funding stream from the Government of the Republic of Uganda to support generation and translation of high impact Research and Innovations to drive Uganda's development Agenda. This unique initiative is being implemented under the Research and Innovations Fund (RIF) at Makerere University in Kampala Uganda. It arose after engagements between the top University Management and the Government of the Republic of Uganda.

The three objectives of the fund include;

1. Develop and fund a robust research agenda based on National development priorities identified from academia, government, implementing partners and industries.
2. Support the dissemination of high-quality research and innovations in a way that impacts on development policies and programs
3. Support the growth of research leadership capacity in the university

Details about Mak-RIF are shared and accessible on <https://rif.mak.ac.ug/>

For more information and to contact these Researchers and Innovators for further engagement and opportunity to collaborate, please reach out to; The Office of the Vice Chancellor, Makerere University on email address [vc@mak.ac.ug](mailto:vc@mak.ac.ug) and telephone number +256 414542803.