



PanAfrican
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The agricultural biotech promise

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- | Q&A with Kenya's National Biosafety Authority CEO Roy Mugiira.

Fixing the potato value chain

Inside East Africa's juice maker Kevian's commercial seed multiplication plan.

Agricultural Finance Corporation boss on de-risking lending to smallholders

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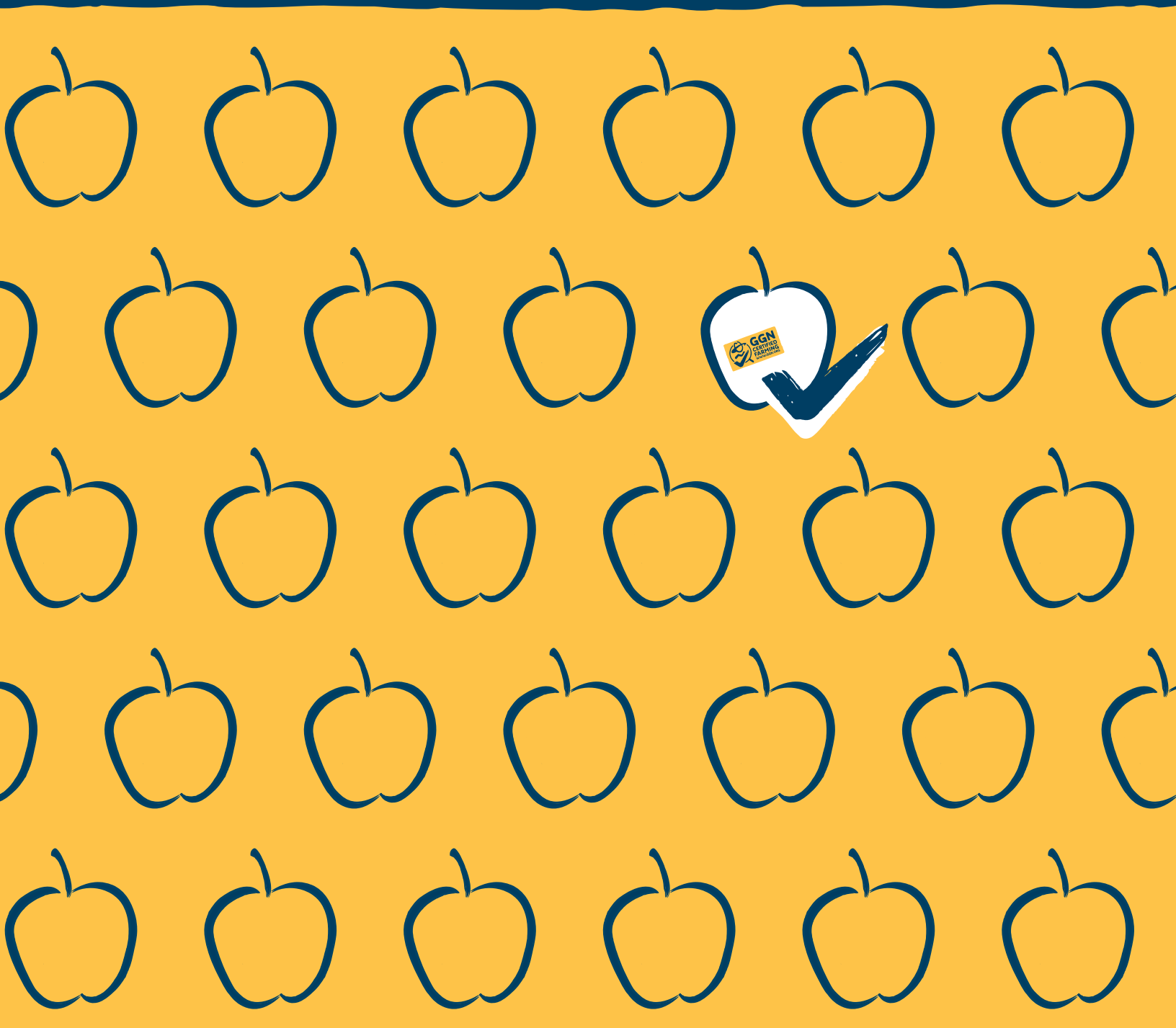


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Editor's Note

Pull down the regulation barriers against agricultural biotechnology

Modern agricultural biotechnology has been likened to past remarkable innovations such as agricultural mechanisation in Europe and the Asian Green Revolution in terms of its potential to significantly improve food production and cut poverty levels.

Africa missed out on the benefits of the earlier innovations, underlining the continent's persistent food security problems.

Unfortunately, the agricultural biotechnology revolution might yet again pass Africa unless governments pull down the regulatory barriers that have so far seen only seven of the 54 African countries allow commercial growing of genetically modified (GM) crops.

In this issue of *PanAfrican Agriculture*, three experts with a front-row view of the agricultural biotechnology conversation, research, communication and regulation in Africa, give a deeper understanding of the matter in well-argued articles and a one-on-one interview.

As part of the special report, our team of writers in different countries also shadowed biotechnology researchers inside the laboratories and out on the farms where cutting-edge biotech experiments and field trials are ongoing and filed stories of breakthroughs and near-breakthroughs.

The cautious approach to agricultural biotechnology on the continent isn't replicated in other innovations though.

Read about how urban gardening is thriving in Cameroon's cities, aided by quick adoption of aquaponics and why goat keepers – who have in the past seen their stock wiped out by the goat plague – in the West African country have everything to thank DNA-based diagnostic tools for.

We continue to monitor developments in trade, markets and processing, which remain a weak link in Africa's agricultural value chain, and bring you some good news from Ghana, Mali and Kenya.

A certification programme is opening export opportunities for Malian mangoes while Kenya will later this year start exporting fresh avocados to China after passing Beijing's tough quality tests.

A Ghanaian agribusiness start-up is challenging multinationals in the domestic and export market with its quality branded rice.

In Kenya's Taita Taveta County, a Danish-based company is contracting farmers to grow a fast-maturing banana variety ahead of the opening of a banana processing factory in the area next year.

Enjoy your reading.

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Africa missed out on the benefits of the earlier innovations, underlining the continent's persistent food security problems.

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18. De-risking agricultural financing

Investors, the commercial sector and the banking sector have remained apprehensive in putting resources in the agricultural sector. The Agricultural Finance Corporation was established as a land bank to offer affordable credit as an incentive to drive the development of the agriculture sector. Mr George Kubai, the new AFC Managing Director engages *PanAfrican Agriculture* on how the institution is assisting in the development of agriculture and agricultural industries by making loans to farmers, cooperative societies, incorporated group representatives, private companies, public bodies and local authorities.

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25. The GM crops dilemma in Africa

The potential revolution in farming made possible by GM crops has been met with monumental controversies, resulting in a great deal of ambivalence regarding policies for regulating this new technology. Whereas farmers, mostly smallholder farmers, in some developing countries, have adopted GM crops and are now growing them commercially, most other countries in the world have taken a much more precautionary approach, ranging from policy restrictions of various kinds to outright bans.

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Bean research is advanced through PABRA and has resulted in the release of over 550 new bean varieties across 31 countries in Africa. Photo Credit: CIAT

What's in a name? Mapping Africa's bean trade routes

By Owen Kimani, Boaz Waswa, Eileen Nchanji, and Patricia Onyango

EVER heard of Kablanketi, Nyota, Angaza, Onyora, KATBi, Small Red, Saitoti, Nyayo and Mbunduguru? They are names of different varieties of beans in Africa.

But what's the story behind these names? What is their significance? William Shakespeare asked, "What's in a name?" and for the colossal African continent, the answer would be "Everything".

Naming in the African culture is a way to convey certain messages, either to an individual, family members, or a community.

Names give a sense of identity; the tribe, geographical location, and nature of the environment. Naming conspicuously distinguishes one from the other.

Naming is not just unique to people but to crops such as beans as well. Over decades, beans have been named because of their colour, taste, resemblance or association to someone. Some beans don't always take the African naming trend – they only have scientific names.

The Alliance of Bioversity International and the International Centre for Tropical Agriculture (CIAT)

is home to over 37,000 accessions of beans at the Future Seeds genebank in Colombia. These materials are useful in supporting research for bean improvement around the world.

In Africa, bean research is advanced through Pan Africa Bean Research Alliance (PABRA) and has resulted in the release of over 550 new bean varieties across 31 countries over the past 25 years.

There is pride in naming beans, as it gives it a sense of acceptance to a community. When a bean is named in the local dialect, it is readily adopted by the community.



A farmer on a bean plantation. Photo Credit: CIAT

A bean variety has a name that is scientific and universally recognised, whereas the local name differs from tribe to tribe and country to country. Some naming might be obvious, like small red, referring to its appearance (size and color), while others have a deeper story behind it. For example,

Angaza, a high-iron bean, is named after its white outlook. Angaza is a Kiswahili word that loosely translates to being bright in appearance. The Kablanketi name in Tanzania comes from its similar look to the purplish Maasai blanket. The Mwendu bean in eastern Kenya is named after a girl in the Kamba dialect meaning 'Loved'. This is a fast-cooking bean that does not require too much fuel to prepare. The name mwende also signifies beauty.

A good example of a bean with different local names in different tribes is Kakamega15(KK15), which is fondly called Raila in the eastern part of Kenya, named after a political figure due to its dark appearance. The same black bean variety is named Ndombolo in western Kenya because of how the tendrils appear to "dance" when blown by the wind! Ndombolo is a popular music genre and dance style from the Democratic Republic of the Congo, highly embraced in most African countries.

Nyayo and Saitoti in Kenya were named after popular political leaders who actively promoted their adoption among farmers through various government food security programmes in the early 1980s.

Katamani Bean 1(KATB I) is a yellow-green bean commonly grown in Kenya and was released in Burundi, Tanzania, and Uganda under the PABRA regional breeding initiatives.

In these countries, the variety has adopted different local names, for the local markets. In Kenya, the bean is known as Kathika, in Burundi it is named Mbunduguru, while in Tanzania, it is called Goroli Njano (yellow pebble).

Farmers during the participatory variety selection (PVS) and release process have given the beans local names to fast-track their adoption in communities, make them acceptable in community markets. Having beans with local names close to the community market is a big step to promoting adoption.

One major setback is that having different names for a particular variety complicates universal identification of the said variety, especially when it comes to cross-regional trade. Interested parties looking for a particular bean variety with a different name from what the local market identifies it with might not identify with the local bean name. Thus they end up looking for a near similar or almost similar variety in terms of appearance to what they initially wanted.


So, what is PABRA doing to curb this? PABRA is working on a catalogue that has the synonym of local varieties versus the scientific or trade names or classes. With this catalogue, identifying the local name of a variety in a certain market will be made easier. This will enhance regional identification and trade advanced under the Bean Corridor Approach.

PABRA is using advanced breeding technology to carry out genetic mapping of the bean varieties named differently in different communities to match them to the universally accepted trade or scientific names.

This is an exciting exercise where local knowledge is aligned with scientific knowledge. To do this, we need to grow our partnerships with various bean value chain actors. We also need additional funding support for essential fingerprinting technology, training, and big data analytics.

Together we can celebrate the meaning of names for beans as we benefit from this all-around nutritious grain legume benefiting over 400 million people in the tropics.

The long-term support for bean work through PABRA has been made possible through the support of the Global Affairs Canada, SDC, BMGF, USAID, Kirkhouse, ACIAR, AfDB-TAAT, AGRA, and country bean programs.



*Save Our Agriculture rope assisted greenhouse tomatoes.
Photo Credit: Elias Ngalame*

In Cameroon cities, urban gardening thrives on aquaponics technology

By Elias Ngalame

URBAN farmers in Cameroon are breaking new ground in gardening thanks to the aquaponics technology that permits them to rear fish and grow vegetables together in a confined space without having to use soil and chemical fertilisers.

In the country's big cities of Yaounde and Douala it is common to see aquaponics gardens set up in apartments by landlords and tenants keen to produce their own food and earn additional income.

"Even tenants now grow vegetables on their balconies using aquaponics," says Martha Yuh, a 46-year-old dressmaker in Yaounde.

The technology is also becoming popular with big hotels.

Farmers are attracted to the new method of cultivation because it saves them the trouble of having to acquire farmland outside the cities, requires less water and limited costs are involved.

"The aquaponics farming method is much better than the use of farmland. It gives quality production and it is cost-effective. I have been able to earn additional income from urban gardening," says Ebot Emmanuel, a teacher and vegetable farmer in Yaounde.

The idea is believed to have been first applied by ancient Chinese farmers to raise ducks, fish and rice before gaining worldwide popularity in recent years and spreading across Africa.

In Cameroon, Save Our Agriculture, an agri-tech start-up founded by 28-year-old agricultural engineer Flavien Kouatcha in 2016, has been promoting the use of aquaponics kits for gardening among city dwellers.

Kouatcha says the aquaponics system can produce four times more food than traditional farming methods and is one of the best for urban gardening.

It combines conventional aquaculture (fish rearing) with hydroponics (cultivating plants in water) in a symbiotic environment.

The fish grow in the containers until they reach the size desired by their breeder and are ready for consumption.

The plants thrive on excrement produced by fish, while the recycled and purified water goes back to the fish tanks.

The fish waste provides an organic food source for the plants and the plants naturally filter the water for the fish.

“The system also solves the problem of pollution and waste disposal from fish farming, which is particularly bad in coastal towns like Douala, Kribi and Limbe,” says Kouatcha.

Save Our Agriculture makes aquaponics kits, which can be used as nurseries for vegetables, juvenile fish, water and fish feed.

A basic 150m² aquaponics kit sells for 80,000 CFA francs (approximately USD 412) and is recommended for individual or domestic customers, who use the kits to grow vegetables such as pepper and tomatoes as well as aromatic herbs and rear fish.

The bigger 250 m² model, which sells for 250,000 CFA francs, is mainly suitable for use by hotel and restaurant owners.

Kouatcha says the technology is attracting many more youth groups and customers interested in learning how to use the kits.

“We are also glad that with the training of more youth on the use of aquaponics kits we are able to create jobs and help the government fight unemployment,” he says.

In addition to its ecological benefits, aquaponics is also offering a solution to the problem of high food costs in Cameroonian cities.

Dellor Kandem, the president of the Consumers Association in Yaounde, says that the steady supplies of vegetables and fish in the urban markets have kept prices stable.

Environment experts say the method is climate-friendly as well.

“Across Africa, a growing number of urban farmers are tapping into aquaponics technology that does not depend on rain and uses no chemical additives. The water is simply purified and recycled,”

says Zachee Nzohngandembou CEO of the Centre for Environment and Rural Transformation (CERUT), an NGO that promotes quality food crop production.

“

We are glad that with the training of more youth on the use of aquaponics kits we are able to create jobs and help the government fight unemployment.

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Save Our Agriculture founder Flavien Kouatcha at his aquaponics garden in Doula, Cameroon. Photo Credit: Elias Ngalame



Dr. Esther Gikonyo, a soil scientist, on the field in Ainamoi, Kericho where KALRO is studying soil testing innovations. Photo Credit: Marion Wagaki

‘Lab in hand’ makes soil testing fun

By Marion Wagaki

RESearchers at the Kenya Agricultural Livestock Research Organization (KALRO) are studying two soil testing innovations that could enable farmers receive information about soil fertility and recommend fertiliser use in real time.

The innovations, including a handheld scanner that can give results within 10 minutes of soil testing are thought to be considerably more efficient and affordable than the conventional methods.

“We use the hand-held scanner by placing it on top of the soil. The beams reflect on the soil, and then through electronic magnetic waves, it is able to pick up the nutrients from the soil, and speak to a cloud database.

Based on a calibrated soil data that we have for Kenya, it’s able to tell you, what you need, what nutrients you need to apply in that particular field, based on a crop, so that you can attain increased production,” says Mukami Gitau, who works for AgroCares, the non-governmental organisation behind the soil testing technologies.

Dr Esther Gikonyo, a soil fertility and plant nutrition scientist based at KALRO’s Kabete station in Nairobi, said the new technologies have the potential to improve soil testing efficiency and cost-effectiveness by at least 25 percent.

The data collected from recent field trials, she said, will be subjected to further statistical analysis to determine the most economical method.

“After validation in the field we will come up with recommendations on the way forward and I am very optimistic that the results will be suitable for farmers and clients,” she said during a farmer’s field day in Ainamoi, Kericho County.

“It is time for us to improve crop production in this country by looking at the management of soils in the next 10 years if we have to increase production and achieve food security.”

Dr Gikonyo is among scientists who have been studying the efficiency of analytical services and fertiliser use recommendations in Kenya under the Kenya Climate Smart Agricultural Project (KSCAP).

The project has been undertaken since 2020 in five counties – Kericho, Bomet, Machakos, Nyandarua and Nyeri.



Mukami Gitau of AgroCares demonstrates how the hand-held soil-testing scanner works. Photo Credit: Marion Wagaki



KSCAP aims to facilitate 24 counties in the country to upscale climate-resilient technologies, innovations, and management practices to achieve increased productivity, enhanced resilience, and reduced greenhouse gas emissions.

Soil testing is key to improving land productivity, food production and economic returns to the farmer while conserving the environment.

But the conventional methods widely used currently such as Wet Chemistry are laborious and inefficient.

In 2017, AgroCares launched a Near InfraRed (NIR) soil scanner in Kenya, which gives farmers real-time information on the nutrient status of their soil. An app translates the soil data on the spot into fertiliser recommendations for the selected crops.

“In November 2018, AgroCares and Agriterra evaluated the use of the soil scanner at cooperative and farmer level to identify success factors, possible bottlenecks and the added value of innovative soil testing services for farmers. The results are promising, with farmers having reported higher fertiliser efficiency, increased yields and, in general, willingness to pay for scans,” says Gitau of AgroCares.

Gitau says the tool is better off being used by a field extension officer or an agronomist to test the soil and interpret the results to the farmer.

In Kericho where the field day was held, banana cultivation is practiced by 41-60 percent of the population for subsistence and commercial purposes. The area under banana cultivation is about 423 ha, valued at about Ksh 350 million and is mainly grown in the lower altitude sub-

counties, of Ainamoi, Sosit and parts of Cheplanget and Kiptere.

Rose Chepkwony, a farmer from Lariat Village, Kericho County and whose land was used for experimental treatments, said she had been farming for over 20 years but never for once performed a soil test before planting.

“When KALRO came in 2020 and taught us about soil testing so that we can know what is lacking and what is needed, I allowed them to test my soil and they also gave me the bananas to plant by using five treatments so that we can compare.

The soil was found to be very acidic, but since the right fertilisers and manure were applied we have seen a lot of improvement in our bananas,” she said.



Besides reduced animal deaths, farmers in Cameroon who have had their livestock vaccinated are reporting healthier weights and higher market prices. Photo Credit: CGIAR

DNA-based diagnostic tools revive hope in sheep and goat farming

By Elias Ngalame

IN Cameroon's Northern region of Garoua, livestock farmers face a double threat of prolonged droughts and disease outbreaks killing their animals.

Abdoulaye Ouma, a farmer from the Djola village, says he has been reluctant to keep goats and sheep after an outbreak of peste des petits ruminants (PPR) – ovine rinderpest – wiped out his last flock.

The disease struck amid a drought that destroyed his vegetable crop, burning a huge hole in his family income.

“Poor harvests from my vegetable farm left us desperate. Even the few cattle I had did not survive,” Abdoulaye says.

PPR, also known as ovine rinderpest or goat plague, is a highly contagious viral disease caused by a morbillivirus. In addition to goats and sheep, it affects some wild relatives of domesticated small ruminants, as well as camels.

According to World Organisation for Animal Health, (OIE) PPR was first reported in Ivory Coast in 1942, but it has since spread far beyond its origin

in West Africa. It is now present in over 70 countries across Asia, Africa, Middle East, and Europe.

It is characterised by severe morbidity and mortality rates, and has a high economic impact in areas of Africa, the Middle East, and Asia, where small ruminants contribute to guaranteeing livelihoods.

Affected animals present high fever and depression, along with eye and nose discharges. Animals cannot eat, as the mouth becomes covered in painful erosive lesions and the animals suffer from severe pneumonia and diarrhoea.



Use of DNA-based diagnostic tools is now enabling veterinarians to accurately detect the PPR disease and contain outbreaks quickly, Cameroon. Photo Credit: QC Supply

Death is frequently the outcome.

Veterinarians have in the past confused it with the rinderpest virus, making it difficult to diagnose and respond to outbreaks.

But the use of DNA-based diagnostic tools is now enabling veterinarians to accurately detect the PPR disease and contain outbreaks quickly.

Dr Mahamat Mamate of the veterinary network CAPHAVET says the DNA-based diagnostic tools permit for the right vaccines to be administered on the cattle.

“Since its introduction in Cameroon’s drought-stricken Northern region in 2019 an increasing number of farmers now take up cattle rearing without any fear of losing out on their investment,” Dr Mamate says.

CAPHAVET seeks to make quality veterinary products available, accessible and affordable to farmers, promote prevention and emergency care, popularise new breeding techniques and improve livestock farm productivity through professional advice and training.

According to official figures, animal illnesses threaten over 22 million heads of cattle, 36 million sheep and goats and six million hogs in countries of the Central African sub-region.

The rearing of these animals contributes up to 40 percent of the agricultural GDP of some countries in this part of Africa.

According to Abdoukadiiri Souley from the National Veterinary Laboratory (LANAVET) in Cameroon, accurate diagnosis under a rapid response project means that the authorities are able stamp out outbreaks and stop the spread of the fatal disease to other flocks.

He says prior to the rollout of the project in the area, thousands of sheep and goats succumbed during these outbreaks, leading to millions of CFA francs in losses.

Besides reduced animal deaths, farmers who have had their livestock vaccinated are reporting healthier weights and higher market prices.

Partner veterinarians from Garoua say more emphasis should be placed on sensitising farmers about vaccine benefits and broadening vaccine distribution.

Habiba Hayatou, a farmer in Bibemi village, says some of her neighbours who weren’t aware of the project initially resisted vaccinating their herds, and suffered heavy losses when the disease broke out.

“I vaccinated all my sheep and goats a month before the outbreak was announced, which is why they all survived,” says Hayatou.

Agriculture and livestock experts say sub-Saharan Africa has great potential for higher agricultural output to meet increasing food and nutrition demand, but will need access to safe and appropriate science and technology to address production challenges.

In livestock production, the technology needed ranges from low-tech artificial insemination and fermentation techniques to high-tech approaches involving advanced DNA-based methodologies, embryo transfer in cattle and sex reversal in fish.

Dr Mamate, however, emphasises that agricultural biotechnology is no silver bullet and that successful results will not be achieved unless there is an ‘enabling environment’ around it to make it work.

The government, he says, needs to introduce friendly policies, support extension services, and facilitate access to agricultural inputs, credit and markets.



*A trader pays for avocados directly sourced from a farmer.
Photo Credit: Henry Owino*



China grants Kenya access to its fresh avocado market

By PanAfrican Agriculture Correspondent

AFTER four years of lobbying, Kenya has been granted market access by the government of China to export fresh avocados.

The deal to export avocado to China was agreed on in April 2019 between President Uhuru Kenyatta and his Chinese counterpart Xi Jinping but Beijing required Kenya to export only frozen avocado, which a majority of exporters could not manage owing to the high cost involved.

The directive saw only one firm out of over 100 meet the requirements laid down by the Chinese six months later after Nairobi and Beijing signed the deal.

The reversal of the initial agreement of exporting only frozen avocados, came after a successful completion of the rigorous pest risk analysis carried out by Kenya Plant Health Inspectorate Service (KEPHIS) and the National Plant Protection Organization of China, which identified quarantine pests of concern to China.

KEPHIS is the government agency responsible for assuring the quality of agricultural inputs and produce to prevent adverse impacts on the economy, the environment, and human health.

KEPHIS managing director Theophilus Mutui said all the fresh avocado fruits required to comply with all applicable Chinese phytosanitary (plant health) laws and regulations, health and safety standards and be free from any quarantine pests of concern to China.

“All producers and exporters intending to export fresh avocado to China must have all their production farms, pack houses and fumigation treatment facilities registered by KEPHIS,” said Prof. Mutui.

Producers and exporters must apply good agricultural practices (GAP), keep good sanitary conditions as well as implement integrated pest management programmes, including pest monitoring, chemical and biological control and any other pest control operations.

The exporters will also be required to monitor and manage quarantine pests of concern to China under the guidance of KEPHIS.

They will further ensure that all consignments are inspected prior to export and KEPHIS will monitor the processing, packaging, storage and transportation of the fruits.

“KEPHIS shall carry out periodic field inspection, keep monitoring records of quarantine pests as well as pest management measures implemented as well as carry out phytosanitary treatment of the fresh avocado fruits by fumigation before export,” Prof Mutui said in the statement.

China initially wanted Kenyan farmers and traders to freeze the fruits to negative 30 degree Celsius after peeling off the skin and chill further to negative 18 degrees while in transit to the destination, meaning that farmers needed to invest heavily in cold rooms to meet the requirement.

According to the Horticultural Crops Directorate (HCD) performance report for last year, the volume of avocado export increased from 70.3 million kilos in 2020 to 84.5 million kilos in 2021.

However, the value of avocado exports decreased from Ksh14.5 billion in 2020 to Ksh14.4 billion between January to November 2021



All producers and exporters intending to export fresh avocado to China must have all their production farms, pack houses and fumigation treatment facilities registered by KEPHIS



*Fresh avocado fruits required to comply with all applicable Chinese phytosanitary (plant health) laws and regulations, health and safety standards and be free from any quarantine pests of concern to China.
Photo Credit: Murimi Gitari*

Global certification opens export market to Malian mango farmers



Mango farmers in Mali underwent training for the GLOBALG.A.P. certification.. Photo Credit: NAADS

By GLOBALG.A.P.

THE mango fruit is one of the most abundant crops in Mali due to the optimal climate in the country.

But mango exports to other African and European markets are still hindered by aging orchards with low yields, challenges of fruit fly control, a focus on volume over quality and a lack of knowledge of international supply chains.

In 2017, the Bayer development programme BayG.A.P. and Greenyard entered into an integrated development partnership (iEPW) with GIZ, to support local farmers with training and tackle these challenges.

This enabled further development of the local industry and expanded the existing certified grower base. More than 1,200 smallholder farmers in Mali have been trained on

G.A.P. out of which more than 700 have achieved GLOBALG.A.P. IFA certification needed to gain access to international export markets.

BayG.A.P. provided the farmers with both theoretical and practical coaching in technical, environmental, and ethical aspects of mango farming. Adapted according to local infrastructure challenges, training was held in the local Bambara language in the very mango orchards themselves. Assessments of each local producer's current production processes also took place, with personalised follow-ups by local consultants included.

Global Food Chain Partnership Lead Gerhard Adam says that BayG.A.P. was founded to support and train smallholders worldwide on practices that can bring them closer to certifying their produce.

The results have been impressive, with productivity increasing 30 percent on average and improved quality leading to 50 percent higher gross profit. Additional jobs have also been created within the mango processing industry.

More importantly, says GIZ consultant for BayG.A.P. field coordination Drissa Sanogo, producers have a better understanding of what good agricultural practices mean for themselves and the impact on their business.

Berthe Keletigui, a mango producer in the Sikasso region, says that the BayG.A.P. training and the orchard register, which collects all relevant information about operations on the farms, gives him a more precise idea of the gains made in his field operation.

For Ignace Sacko in Bougouni, his understanding of farm management practices and the safe use of plant protection products have improved. He says pruning techniques learnt from the training programme have significantly helped to improve yields of the orchards.

Dr Ursula Wermund, Lead Sustainability and Quality Project Manager at Greenyard Fresh Services, said that GLOBALG.A.P. is a base requirement to open the doors for the European market. Since the beginning of their partnership project in 2018, they have been able to facilitate certification for a substantial amount of mango farmers in Mali.

The training and assessment opportunities from BayG.A.P., Greenyard and GIZ led to 717 smallholders being able to achieve GLOBALG.A.P. IFA certification.



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REGIONAL OFFICES

De-risking agricultural financing



*Mr. George Kubai, the Agricultural Finance Corporation Managing Director.
Photo Credit: PanAfrican Agriculture*

By Murimi Gitari

GEOERGE Kubai took over the corner office at Kenya's State-backed Agricultural Finance Corporation (AFC) last April amid mounting funding challenges for the country's agriculture sector aggravated by the Covid-19 pandemic.

Commercial banks have successfully lobbied for a return to risk-based pricing of loans, raising fears that sectors traditionally shunned and perceived as risky such as agriculture might suffer even more.

The financing problems of Kenya's agricultural sector mirror those of other African countries.

According to a report by the African Development Bank, less than three percent of total bank lending in Africa goes to a sector that accounts for about 70 percent of all employment and more than 40 percent of GDP.

But Mr. Kubai, the AFC Managing Director, prefers to take a positive view of the unfolding situation.

"Agriculture is the backbone of the economy and is very promising. It is wrong to shun it as risky, what we need to do is de-risk it. As the financier that best understands agriculture in the country we don't see our interest rates going up above the current 10 percent. The government is also implementing the credit guarantee scheme with

selected commercial banks to unlock loans to MSMEs [micro, small and medium enterprises]," he says.

Under the credit guarantee scheme, the government provided Sh3 billion as seed capital and undertook to compensate the commercial banks for part of any defaults on loans advanced to MSMEs.

Mr. Kubai says AFC could have some role in the scheme in the future once a policy framework is developed.

But he is keen to allay any concerns that the State corporation's involvement in the market would amount to competition with the commercial banks.

"AFC does not see commercial banks as competition, we complement commercial banks. In many instances, we play the role of de-risking the market and catalysing investments into the sector, then we graduate clients to mainstream financial institutions, thus enabling access to private capital. Stimulating across-board investments into the sector is key to our success."

"However, in terms of our credit offerings, our rates are very competitive, at 10 percent per annum. You are unlikely to find an equivalent in the market. AFC has a variety of products, which include livestock loans, cash crop loans, agribusiness loans, seasonal crop loans, water development loans, horticulture loans among others," he says.

AFC has its roots in colonial-era agriculture, having started off in 1933 as a land bank financing settler farmers.

Upon independence in 1963, it was established as a subsidiary of the Land and Agricultural Bank to cater to the capital needs of African farmers.

It was, in 1969, reconstituted under the Agriculture Finance Corporation Act (Cap 323) with a new mandate to assist in the development of agriculture and agricultural industries by offering loans to farmers, cooperative societies, incorporated group representatives, private companies, public bodies, local authorities and other persons engaging in agriculture.

“We finance the length and the breadth of agricultural value chains. That is, any person engaged in any node of the agricultural value chain, such as primary production, input providers, aggregators, marketers and processors are eligible to apply for AFC products and services,” added Mr. Kubai.

The biggest challenge for AFC is inadequate financial resources for lending. The Corporation receives an overwhelming number of applications which it is unable to satisfy.

In a typical month, AFC receives loan requests for Sh1 billion on average, but it is only able to disburse between Sh300 million and Sh350 million.

“Our challenge as a loan institution is being undercapitalized as on average we disperse loans worth between Kes 300 million to 350 million against the demand of 1 billion per month,” the Managing Director says.

Mr. Kubai says the financial institution has in recent years deployed a significant value of its investments through the wholesale lending model where an anchor client such as a producer cooperative society or a SACCO [savings and credit cooperative society] on-lends agricultural credit to its members. This model has not only helped the Corporation enhance its outreach but has significantly reduced the rate of



The Managing Director, George Kubai during the interview with PanAfrican Agriculture team at his office. Photo Credit: PanAfrican Agriculture

default among small holder farmers. Currently, AFC has a total of 48 branches in 33 of the country's 47 counties. “Our aim is to be present in every county so as to bring services closer to the people. Additionally, the Corporation has put focus on underserved segments, in particular women and youth,” says Mr. Kubai.

A 2019 survey conducted by AFC in partnership with the Kenya National Bureau of Statistics (KNBS), UN Women, the Kenya Institute for Public Policy Research and Analysis (KIPPRA), Food Agriculture Organization (FAO) and the European Union found that women and youth were largely excluded from accessing finances.

The survey further established that less than 11 percent of the Kenyan population that engaged in agriculture and agribusinesses accessed information from formal institutions in the country.

Arising from the results of that study, AFC is addressing its internal structural barriers as it seeks to lend through use of alternative collateral

such as market contracts, fixed deposits and shares instead of land title deeds, and other hard collateral especially for women and youth.

“AFC, in conjunction with UN Women Kenya, has undertaken capacity building in more than 14 counties, targeting majority women and youth-led agri-enterprises. Further, the Corporation has developed an initiative dubbed the Farmers Business School. This initiative will see AFC work in collaboration with likeminded institutions to provide sustainable and actionable knowledge in agricultural finance and agribusiness management for targeted agriculture value-chain players,” says Mr. Kubai.

The Corporation is also implementing the Novel Agribusiness-Led Employment (ENABLE) Youth Program, co-funded by the African Development Bank (AfDB) and the Government of Kenya. This youth employment creation initiative is a comprehensive program that builds entrepreneurship in agribusiness through skill acquisition and creation of an enabling environment in which the youth become owners of profitable agribusinesses.



George Kubai (right) with President Uhuru Kenyatta (left) during the launch of the 4K Clubs. Photo Credit: AFC

This program will see us lend a total of Kshs. 2.2B towards youth owned enterprises, leading to creation of gainful employment and sustainable income for the youth.

“We are emphasising that Kenyans should embrace Kilimo Biashara (farming as a business) for food security and job creation, and leverage on AFC’s financial infrastructure to succeed,” says Mr. Kubai, who joined AFC from the National Oil Corporation, where he served as the chief executive.

Before crossing over to the public sector in 2019, the holder of an MBA in strategic management had a successful career as an executive in a number of top private companies, including Coca-Cola, Equity Group, KenCell Communications and Sanlam Insurance.

He says his experience of the two worlds has given him a deeper understanding of what it takes to succeed in both.

“In the private sector it is more about the bottom-line, with performance

measured in terms of profits. But in the public sector success is also measured in terms of impact, including the number of people reached [with services].

He believes his professional journey, and approach to work today – getting things done no matter how enormous the task is – greatly mirrors the values gained during his upbringing.

Born into a farming community in Meru 45 years ago, he was exposed to agriculture at an early age.

In his teenage years, he would spend his free time from school on his mother’s horticultural farm and she would pass on concepts like mulching which she learnt from the Agricultural Training Centre in Meru, to him.

He also learnt a thing or two about agricultural resilience by watching his grandfather,

who kept a large herd of cattle, cutting his losses by preserving hides from the carcasses of hundreds of livestock that succumbed to prolonged droughts. “That man was very aggressive.

Today I look at some of the decisions he made like preserving the hides during drought as a lesson in risk mitigation,” says Mr. Kubai.

He will no doubt need to summon that spirit of resilience as he seeks to transform and put AFC at the center of all food security discussions in Kenya.

“I envisage an AFC that is well resourced, attracting sufficient financing from government agencies and other development partners, to adequately meet its mandate as the government’s key agricultural financing institution,” he says.

The Corporation is reviewing its products to make them more responsive and relevant to the needs of agricultural value actors in the sector. It is also working on a digitization strategy to improve efficiency in the delivery of services.



ISAAA AfriCenter

Who We Are

ISAAA AfriCenter is an organization that offers science communication support services and policy advocacy on emerging bio-innovations.

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Dr. Margaret Karembu, MBS, Director, ISAAA AfriCenter at mkarembu@isaaa.org



A farmer tends her Bt cotton crop in Kitui, eastern Kenya. This was during the first season of commercial cultivation of GM cotton in Kenya. Photo Credit: ISAAA AfriCenter

Biotech crops promise to make agriculture competitive in Africa



By Dr Margaret Karembu, MBS

WHEN the story of African agriculture is told, the success in crop biotechnology development features prominently, illuminating the continent's agricultural growth that has somewhat had mixed fortunes over the last couple of decades.

And as the continent's agriculture sector strives to meet the growing food demand in the face of a swelling population, the intractable challenge of climate change has become a major concern. Africa has borne the heaviest brunt of persistent drought, new pests and crop diseases, threatening its agricultural production and food security.

According to Relief Web, a humanitarian information source, one in five people in Africa face hunger with climatic variability being one of the major contributors to this situation.

Besides worsening the food security state, harsh climatic conditions pose a danger to national economies owing to agriculture's competitiveness in generating jobs for millions of youth and women.

Biotechnology offers one of the viable tools required to address these challenges. Climate-smart biotech crops present an option in combating food insecurity and creating job opportunities on the continent.

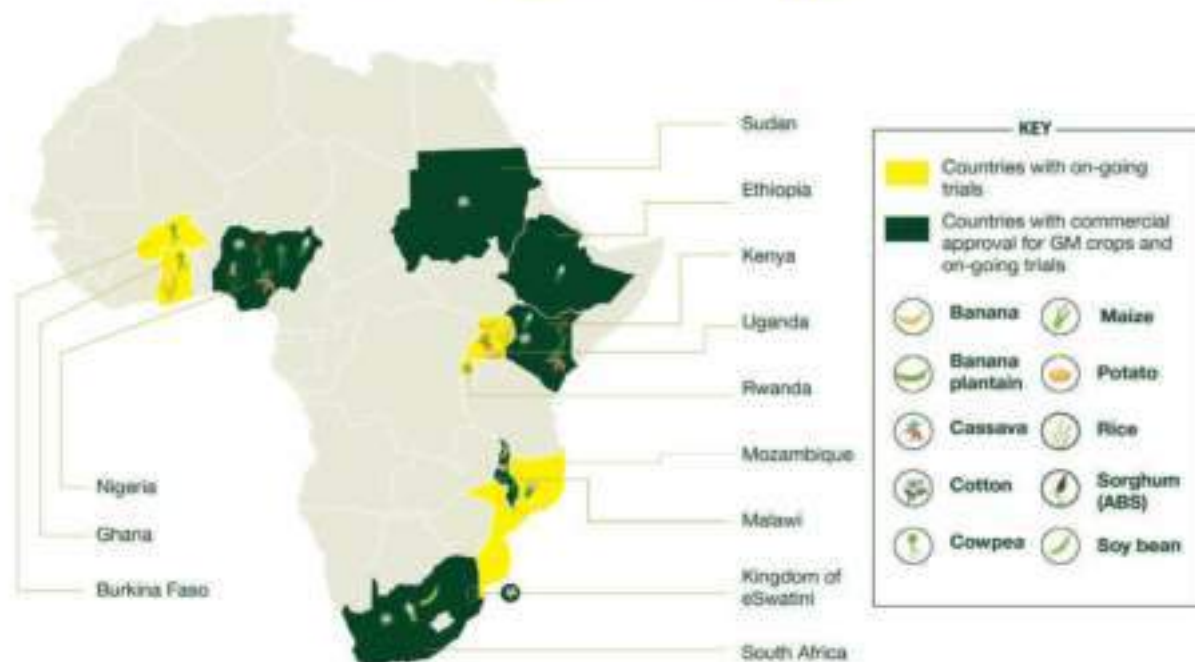
Important milestones

The recognition of this technology's huge potential has seen global adoption of biotech crops increased 112-fold since 1996 when the first biotech crop was commercialised.

"By 2020, the accumulated biotech area was 2.7 billion hectares (6.7 billion acres), making biotechnology the fastest adopted crop technology in the world," says a report by the International Service for the Acquisition of Agri-biotech Applications (ISAAA).

Africa Biotech/GM Research and Commercialization Status by 2021

10 CROPS 12 COUNTRIES 16 TRAITS



Source: ISAAA AfriCenter

Africa has made remarkable progress as well, with the number of countries planting biotech crops more than doubling from three in 2018 to seven in 2021. These countries are Kenya, Ethiopia, Malawi, Nigeria, South Africa, Sudan and Eswatini.

The seven countries grew three biotech crops – maize, soybean and cotton – on approximately three million hectares in 2021. Bt cowpea is the latest entrant on the list of commercialised biotech crops in Africa.

Over the last one year alone, Africa has recorded two milestones in agricultural biotechnology – environmental release approval of two food crops – disease-resistant cassava in Kenya, and TELA maize in Nigeria. This significant advancement has positioned the continent for increased adoption.

Economic gains

African farmers continue to reap significant agronomic, environmental and socio-economic gains from biotech crops.

“Estimated economic gains from biotech crops for South Africa for the period 1998 to 2018 was approximately US\$2 billion and US\$237 million for 2018 alone,” says the ISAAA report.

Sudan has experienced positive change in the entire cotton sub-sector value chain thanks to the country’s full adoption of insect-resistant Bt cotton, which has seen a three-fold increase in yields.

“Other significant benefits will arise from the introduction of gineries and cottonseed oil extraction factories.



Sudanese farmers harvesting their Bt cotton produce.
Photo Credit: ISAAA AfriCenter



A root from a biotech cassava plant resistant to brown streak disease.

This photo was taken in a confined field trial demo farm in Mtwapa, coastal Kenya. Photo Credit: ISAAA AfriCenter

There are also prospects for exporting seeds, spinning, and textile production in neighbouring countries,” ISAAA Report

In Eswatini, farmers reported a reduction of chemical sprays from eight to just three per cropping season – a significant benefit to the environment.

Predictive economic studies conducted by African economists in collaboration with researchers from the International Food Policy Research Institute in Ethiopia, Uganda, Tanzania and Ghana found that the total potential benefits of adopting biotech crops amount to more than USD 4 billion. These studies were based on crops under biotech research in these countries.

GMO import ban

However, the adoption of biotech crops on the continent has not been without challenges. Policy and political uncertainties abound. Biotech policy implementation is still fragmented, resulting in a slow pace in adoption of biotech crops.

For instance, Kenya in 2012 imposed a ban on importation of GMO foods. With this ban still in place,

commercialisation of GM crops has been considered on a case-by-case basis, slowing delivery of improved crops to farmers.

The Open Forum on Agricultural Biotechnology (OFAB) in Africa has been instrumental in providing a platform to address these bottlenecks. OFAB brings together stakeholders to share their aspirations and address concerns, thereby creating an enabling environment for development and adoption of biotech crops on the continent.

Africa’s take-off in genome editing

Even as crop biotechnology records great strides, new breeding tools such as genome editing have proven to be some of the most game-changing innovations in food and agriculture.

Genome editing is a technology that allows precise and targeted modification of genes responsible for desirable traits in crops. Africa has not been left behind as local scientists conduct promising research using this emerging technology.

Already, Nigeria and Kenya have published guidelines to regulate genome editing. Draft guidelines developed by Malawi and Eswatini

are awaiting publication. This development demonstrates Africa’s recognition of the potential of genome editing in transforming Africa’s agriculture and livelihoods. Africa’s chance to benefit from these technologies lies heavily on its ability to efficiently regulate and communicate their potential.

Effective communication provides the basis for building trust around any new technology. Therefore, an all-inclusive communication approach on genome editing in the region is fundamental. Accordingly, the African Coalition for Communicating about Genome Editing has been launched and operationalised. The coalition provides a platform to foster open and transparent dialogue on genome editing in the continent.

Application of modern biotechnology in agriculture will no doubt play a key role in improving food security and livelihoods in Africa, thus contributing to the attainment of the United Nations’ Sustainable Development Goals by 2030.

Dr Karembu is the Director of International Service for the Acquisition of Agri-biotech Applications (ISAAA) AfriCenter and chair of the Open Forum on Agricultural Biotechnology (OFAB) - Kenya Chapter. mkarembu@isaaa.org



*Delegates participate in a 'seeing is believing tour' on a PBR Cow Peas plantation in Nigeria.
Photo Credit: AATF*

To grow or not to grow: The GM crops dilemma in Africa

By Dr Francis Nang'ayo

THE potential revolution in farming made possible by GM crops has been met with monumental controversies, resulting in a great deal of ambivalence regarding policies for regulating this new technology.

Whereas farmers, mostly smallholder farmers, in some developing countries, have adopted GM crops and are now growing them commercially, most other countries in the world have taken a much more precautionary approach, ranging from policy restrictions of various kinds to outright bans.

In most other African countries, a complex and controversial global debate on GM technology seems to have steered the continent to a more cautious attitude towards GM crops. Way back in 2002, Zambia was reported to have declined GM

maize donated as food aid even as the country reeled from a serious drought that threatened millions of people with food insecurity.

The narrative was the same in Zimbabwe, which only accepted the food aid donation with a caveat that it is supplied in milled form and not as grain. Some other African countries such as Angola and Benin went to extreme lengths of imposing bans and moratoria against GM products.

The handful of countries in Africa that embraced GM technology did so by establishing regulatory systems to oversee research and development (R&D) in modern biotechnology, a move that has witnessed progress with confined field trials (CFTs) on some half dozen crops in Uganda, Kenya, Ghana, Cameroun, Malawi and Nigeria.

However, going by the way these CFTs are installed and managed, including high-security fencing and round-the-clock security at testing sites, the general attitude across the continent remains one of extreme precaution on matters biotech. Matters almost got worse in 2012 following the controversial publication regarding safety of GM foods by a team French scientists.

There were claims in this publication that purported to link development of tumours to consumption of feed derived from genetically modified maize.

This publication attracted wide-ranging global attention from consumers, scientists, industry, academia and policy makers as all and sundry sought to establish the validity of claims in the said publication.

Nearly a dozen professional toxicological societies, food safety agencies and academies of sciences are on record to have issued expert opinion and position statements on this matter, clearly identifying the flaws in the study and the erroneous inferences.

At the end of it all, it was concluded that the paper did not have the scientific merit necessary for decision making, and that in fact, the paper was too flawed to be published.

This misleading paper was later retracted from the journal that had published it, putting that controversy on GM food safety to rest. At last a rational, scientific assessment of GM technology triumphed over prejudice, fear, and speculation!

This cloud of uncertainty probably serves to explain why Africa, the second-largest continent with 55 nation states, inhabited by an

estimated 1.2 billion people grows the least proportion of (2.3%) of the world's GM crops. This is ironical considering so many countries in the sub-Saharan Africa have been struggling for decades with unsolved farm productivity problems some of which could be addressed through GM technology.

Policy Choices

Respected scholar Robert Paarlberg, in his book titled *The Politics of Precaution*, argues that regulating GM crops, a new and controversial technology, typically revolves around two diametrically opposite considerations.

On one hand, some countries are more driven by the inclination to promote adoption of GM crops (for whatever reasons) while at the other extreme are countries more driven by the inclination to prevent adoption of transgenic crops.

The former category is termed 'promotional' policy choice and the latter as 'preventive'. There are, of course, gradients between promotion and prevention leading to a scale of four possible policy postures.

Kenya, for example, started off with a precautionary policy posture when it became the first country in the world to sign the Cartagena Protocol on Biosafety, way back in 2000. Then in 2012, it was a big surprise to see a country that had made progressive steps to establish one of the most robust regulatory frameworks for modern biotechnology in Africa, ranking only second to that of South Africa, take turn that represented a giant leap backwards with a cabinet slapping a ban on GM food imports.



Participants of a biotechnology event organized by NABDA in a 'eating is believing' session of ankara made of PBR Cow Peas. Photo Credit: AATF

In Uganda, just like in Kenya, the country started off with a precautionary policy posture when it signed and ratified the Cartagena Protocol, and later published the Guidelines and Regulations and adopted a National Biotechnology Policy in 2008. These early efforts enabled field testing of several GM crops in confinement for nearly a decade.

However, advances in the biotechnology agenda are potentially at risk of stagnation if precautionary considerations in Uganda fuelled by the on-going sensational GM debate continue to delay the passage of the Biosafety Law that has been in and out of Parliament several times. Even the overwhelming pledge for support of the Biosafety Bill by the NRM administration appears not to have marshalled the necessary traction for this critical legislative process.

Many other African countries have taken the extreme policy of either consciously or inadvertently positioning themselves to prohibit the adoption of GM crops. The case of the strict liability and redress regulatory regimes that are currently decreed in Tanzania and Togo serve to illustrate this point.

In legal parlance, strict liability pre-assigns fault to a specific party and imposes absolute legal responsibility for an injury or damage on the suspected wrongdoer regardless of whether that party is at fault or has taken the necessary care.

Despite existence of biosafety legislation and institutional frameworks in these countries, no CFTs for GM crops have ever been conducted in these countries.

Although the application of GM technology is hailed as a major success in many parts of the world, there are persistent concerns about the safety and ethical and trade-related aspects of GM products to consumers and the

environment, necessitating the need for their regulation.

In formulating a national regulatory policy for GM technology and GM food, countries often take into consideration both the opportunities presented by the GM crops and the potential risks associated with them. In Africa there are 55 nation states with diverse political persuasions, trade considerations and environmental interests.

As such, Africa is characterised by a mosaic of national policy positions on GM technology, ranging from those which can be considered to be permissive to those which are more precautionary and ultimately to those which are preventive to the adoption of GM crops.

Admittedly, public opinion on GM technology in many parts of the world, particularly in Africa, is still steeped in controversy. As a result, public policy on GM technology in many African states is laced with

precautionary overtones.

In these circumstances, regulatory regimes have emerged that implicitly assume that all GMOs present high risks unless proven otherwise, an approach which often requires inordinate amounts of information and data to be included in the safety dossier for regulatory clearance. Some analysts have rightly observed that setting regulatory safety standards on such an impossibly high oversight pedestal is a sure way of keeping GM crops from these countries, thereby depriving their farmers of the benefits of such technologies.

Africa needs a rigorous, responsible and predictable regulatory environment to take GM crops to market.

Dr Francis Nang'ayo is the Head of Regulatory Affairs, African Agricultural Technology Foundation (AATF)



Participants are served ankara made of PBR Cow Peas. Photo Credit: AATF

Ugandan scientists wait for green light to release GM Irish potato

By Lominda Afedraru

IRISH potato is a staple and main source of income for many families living in the Western and Eastern highlands of Uganda.

Increased demand for the potato and related products especially in the urban areas has seen production intensified in the traditional zones and spread into central Uganda and other areas.

Currently, 300,000 metric tons of potato are produced each year in Uganda, with market prices ranging between 33-50 cents per kilo or USD 1,500-2,000 per hectare depending on the season.

These numbers, however, do not reveal the true potential of potato farming in Uganda. Farmers currently average seven metric tons per hectare but scientists say they could produce up to 40 metric tons per hectare with improved varieties and best farming practices.

A major problem for them is late blight, a fungal disease that infects potato leaves, stems and tubers and is estimated to cost Uganda about USD 500 million annually in crop losses.

Scientists have been fighting the disease since the 1970s by breeding potato varieties believed to offer resistance to its attacks.

Two such varieties, *Rutuku* and *Victoria*, were widely adopted by farmers.



*Farmers harvesting GM Irish potatoes in Uganda.
Photo Credit: Lominda Afedraru*

In 1997 scientists at the National Research Organisation thought they had finally won the battle against late blight when an improved *Victoria* variety bred and released to farmers showed resistance to the disease.

But in early 2004 farmers began experiencing massive destruction of the potato crop by the disease in their fields.

Highbrid varieties released in 2016, namely *Naropot 1-4* and *Kachpot 1* and *2* showed similar promise before they succumbed too.

Now, scientists believe transgenic breeding will succeed in developing a late light-resistant potato variety where conventional breeding failed.

Transgenic breeding or genetic engineering involves the insertion of a foreign gene into the genetic material of an organism to achieve some desired characteristics.

Agricultural scientists at Kachwekano Zonal Agricultural Research and Development Institute (KaZARDI) have been working on the transgenic Irish potato breeding project in Western Uganda



Agriculture students join farmers in harvesting GM Irish potato at a field trial site in Western Uganda. Photo Credit: Lominda Afedraru

in collaboration with the International Potato Centre (CIP) since 2012. Over that period, laboratory experiments and confined field trials have been conducted to determine whether the gene provides complete resistance.

“The process that we used to develop the bioengineered potatoes is genetic engineering in which three genes from wild relative varieties *Solanum venturi* and *Solanum balbocastanum*, which are known to offer resistance, were identified, cloned and transferred into the local variety Victoria using agrobacterium-mediated transformation protocols in the laboratory. This was followed by rigorous tests in the laboratory, green houses and in the field to confirm that the gene transferred were able to provide protection,” says Dr Abel Arinaitwe, the principal investigator on the research project.

Dr Arinaitwe says the trial, conducted in three locations, namely Kazardi, Rwebitaba Zonal Agricultural Research and Development Institute Kyembogo Station in Fort Portal and Buginyanya Zonal Agricultural Research and Development Institute (Buginyanya ZARDI) in Sironko, is now concluded.

The results indicate that one plant can produce between 3-4 kg of Irish potato tubers.

Those with 3R genes showed 100% resistance to late blight and those without have been wiped out.

Upon attaining full growth in 18 weeks, the harvested tubers were completely healthy.

Unlike the conventional variety with the highest yield potential of 20 tons per hectare, the genetically modified (GM) variety yields up to 35-40 tons per hectare depending on how the farmer tends the farm.

Dr Arinaitwe says the new variety could be ready for release by next year, and the farmers who participated in the recent harvesting of the field trial crop were quite excited about the healthy plants they saw.



GM Irish Potato farming in Western Uganda. Photo Credit: Lominda Afedraru

“We have about six acres under Irish potatoes, climbing beans and maize among others, but we get more money from potato sales. However, late blight is keeping the yields low. Our prayer is that the transgenic potato will give us better yields,” said Immaculate Heart in Rukungiri, a high school student who participated in harvesting the potato at Kazardi alongside her mother Boneconsily Tumwesigye.

Charles Byarugaba, a commercial potato farmer and the leader of a local potato seed multiplication project, said they would like the GM potato seed distributed to them as soon as possible.

Byarugaba and other Irish potato farmers may have to wait much longer, with the Ugandan authorities yet to approve the Genetic Engineering Regulation Authority (GERA) Act that approves the release of GM products.

Dr Arinaitwe fears that delays in removing the regulatory barrier may see Uganda miss out on the benefits of the transgenic potato, with other countries taking advantage of their biotech-friendly laws to adopt the technology earlier.



Dr Ihuoma Okwuonu (left) and Irene Njagi (right) examining cassava plants in a greenhouse. Photo Credit: Donald Danforth Plant Science Center.

Nigerian researchers look to cut off gene feeding cassava disease

By Henry Owino

DR Ihuoma Okwuonu joined the Danforth Center in the US in 2007 as a student trainee on the VIRCA Plus project, which is developing disease-resistant and nutritionally improved cassava varieties. A few years later, she returned to complete her PhD. Her time at the centre for plant science helped her gain experience in cutting-edge research as well as leadership skills.

“It was an eye-opener. It was the opportunity of a lifetime. I was able to gain hands-on experience in microbiology and plant transformation. In addition to the lab experience, I built relationships with scientists throughout the world, some of who are still my collaborators today.

I wanted to make an impact on the world. I believed I could make an impact by developing products that will improve the lives of people in Nigeria,” says the plant biotechnologist.

Today, Dr Okwuonu is doing just that. In her role as a chief research scientist at the National Root Crops Research Institute (NRCRI) in Umudike, Nigeria, she is working with researchers on the VIRCA Plus project to develop cassava varieties with elevated levels of iron and zinc to combat micronutrient deficiency.

The VIRCA Plus project is an international collaboration between the Donald Danforth Plant Science Center in St. Louis, MO, the Kenya Agricultural and Livestock Research Organisation (KALRO), the National

Agricultural Research Organisation (NARO) in Uganda, National Root Crops Research Institute (NRCRI) in Nigeria, the Rwandan Agriculture Board (RAB), and Mennonite Economic Development Associates (MEDA), with ISAAA AfriCenter and SCIFODE providing communication and policy outreach support.

In Nigeria, 75 percent of preschool children and 67 percent of pregnant women are anaemic, and 20 percent of children below five years suffer from zinc deficiency. Iron deficiency affects the immune system, stunts growth and impairs cognitive development in children, while deficiency in zinc causes increased risk of death from diarrhoea, stunting and reduced cognitive development.

Dr Okwuonu introduced her colleagues at the Danforth Center to studying gari and fufu, two common West African foods, prepared by chopping, soaking, fermenting, pressing and roasting cassava.

They found that biofortified cassava could provide as much as 40-50 percent of nutritional requirements for iron and 60-70 percent of nutritional requirements for zinc for children and women.

“We are using genome editing for increased understanding of the role of sweet gene in cassava Bacterial Blight Disease (BBD). One of the reasons why we are improving cassava is because of the impact of the disease,” she says.

Once the bacterium attaches itself to a plant cell, it releases its own ammunition in form of proteins that goes inside the cassava cell, forcing the cassava to produce sugar. This sugar helps the bacteria to grow fast, colonise the plant and cause disease.



Dr Ihouma Okwuonu, a plant scientist. Photo Credit: Donald Danforth Plant Science Center.

The gene making cassava prone to the disease is called susceptibility gene.

If researchers identify this gene, they can use genome editing tools to cut, remove or manipulate it.

“Our goal is to cut off the portion of that gene that enables the bacteria to multiply and grow.” says Dr Okwuonu.

“Our second goal is to use genome editing to develop a disease monitoring tool. We could use the tool to develop a disease model that can help us understand the progression of this disease in cassava. This is a way forward for cassava improvement as things that were initially not possible with conventional breeding are now possible.”



Dr Ihouma Okwuonu, has identified gene editing as a viable innovative tool that holds great prospect for improving the micronutrient deficiency of cassava. Photo Credit: cassavamatters.org



Dr Hussein Abkallo, a biotechnologist at the International Livestock Research Institute (ILRI) in Nairobi. Photo Credit: ILRI

ILRI's gene-editing scientists closing in on vaccine against pig pandemic

By Murimi Gitari

AFRICAN swine fever (ASF) outbreaks are to pigs what the Covid-19 pandemic is to humans.

The viral disease has a case fatality rate of 100 percent in pigs within six to 13 days of infection.

A recent ASF outbreak took a quarter of the world's pigs off the market, caused pork prices to spike, and pushed food inflation to an eight-year high, thereby hurting livelihoods.

In sub-Saharan Africa where the disease is present in over 26 countries, the negative consequences are particularly significant on smallholder farms, substantially impacting food security, incomes, and development.

Healthy pigs are infected when they come into contact with infected ones,

and consume contaminated feed such as kitchen waste, food residues, and meat products.

Infection can also result from contact with contaminated material such as farm equipment, vehicles, clothes and shoes, manure and urine, and bites by infectious ticks.

Warthogs and other wild pigs in Africa and wild boars in Europe and Asia are all susceptible to ASF infection. Currently there is no treatment or vaccines to combat this devastating disease.

"The lack of safe and effective vaccines is the missing link in preventing and controlling the African swine fever," says Dr Hussein Abkallo, a biotechnologist at the International Livestock Research Institute (ILRI) in Nairobi.

"At present, the control measure for minimising the impact of African swine fever is adopting strict biosecurity measures such as setting up quarantine pens for new animals, washing boots before entering pig farms, ensuring that domestic and wild pigs do not mix, and culling of infected or exposed pigs."

But deploying biosecurity measures against ASF in sub-Saharan African countries is not feasible, especially on smallholder pig farms, since the farmers lack the resources to invest.

The popular production system, whereby pigs are widely allowed to scavenge freely, also makes biosecurity impractical for these farmers.

Dr Abkallo and his colleagues at ILRI are burning the midnight oil to develop ASF vaccines using the CRISPR/Cas9 gene editing.

The CRISPR/Cas9 technology borrows from an adaptive immune system naturally used by bacteria to defend themselves against re-infection by viruses. Bacteria defend themselves from viral re-invasion by using this system as a guided “molecular scissor” to recognise invading viruses and destroy them by precisely chopping up the viral DNA.

Biotechnologists borrowed this natural bacterial virus-fighting mechanism to design a tool that can precisely edit - add, delete, replace - sections of organisms’ DNA, similar to how one would type/cut/paste words on a computer, in both basic and applied research.

The CRISPR/Cas9 system is able to precisely alter an organism’s DNA as it is flexible and efficiency makes it an easily programmable system that can read any DNA sequence of interest in a cell. This programmed CRISPR/Cas9 system can find a specific location in the genome and snip the DNA, creating a break.

The organism’s cell, sensing the break, naturally repairs by gluing the loose ends back together either by adding or deleting nucleotides, the basic building blocks of DNA. This, in effect, induces the desired changes, such as disabling harmful bacteria’s genes responsible for severe diseases in humans or livestock, reducing their disease-causing effect.

Conventional genetic technologies for generating live-attenuated vaccines and attenuation by cell passage (where viruses are continuously grown in culture until they undergo genetic changes and subsequently weaken) are cumbersome and time-consuming. It takes up to one year to develop a few vaccine candidates for African swine fever.

The CRISPR/Cas9 technology bypasses these challenges by allowing biotechnologists to modify or delete genes with precision and speed, thereby fast-tracking the development of multiple live-attenuated vaccine candidates.

Using this system, the scientists at ILRI say they have significantly reduced the time to generate African swine fever vaccine candidates to less than two months instead of the conventional genetic techniques, which take six months on average.

“Our gene-editing platform has enabled us to generate over 10 live-attenuated vaccine candidates within a shorter time. Preliminary safety and efficacy results from some of the tested candidates are promising,” Dr Abkallo notes.

The scientists have developed strategies to minimise the off-target effects in CRISPR-Cas9-mediated genome editing and put in place elaborate quality control measures to ensure that target genes are edited as desired.

They estimate that an ASF vaccine could benefit 6-17 million smallholder farmers keeping some 34 million pigs in sub-Saharan Africa.

That is if the current policy challenges policy and communication challenges to adoption of gene editing are addressed.

“The challenges with CRISPR/Cas9 gene editing are more policy and communication oriented than technical. One of the main challenges has been the slow development of frameworks for regulating gene editing. In Kenya for instance, the National Biosafety Authority (NBA) has recently published local guidelines for regulating and adopting gene-editing applications and products in the region to unlock the limitless potential of the technology. The new policy guidelines outline case-by-case scenarios spelling out the scope of regulations- what needs to be regulated under the biosafety law, and will not be regulated under the biosafety law. In a nutshell, gene editing approaches for making genetic changes that are often indistinguishable from natural mutations are not considered a genetically modified organism (GMO).” says Dr. Abkallo.

In developing such policies, it is worth noting that there is a need for clear and case-by-case guidelines and policies governing gene editing,” says Dr Abkallo.

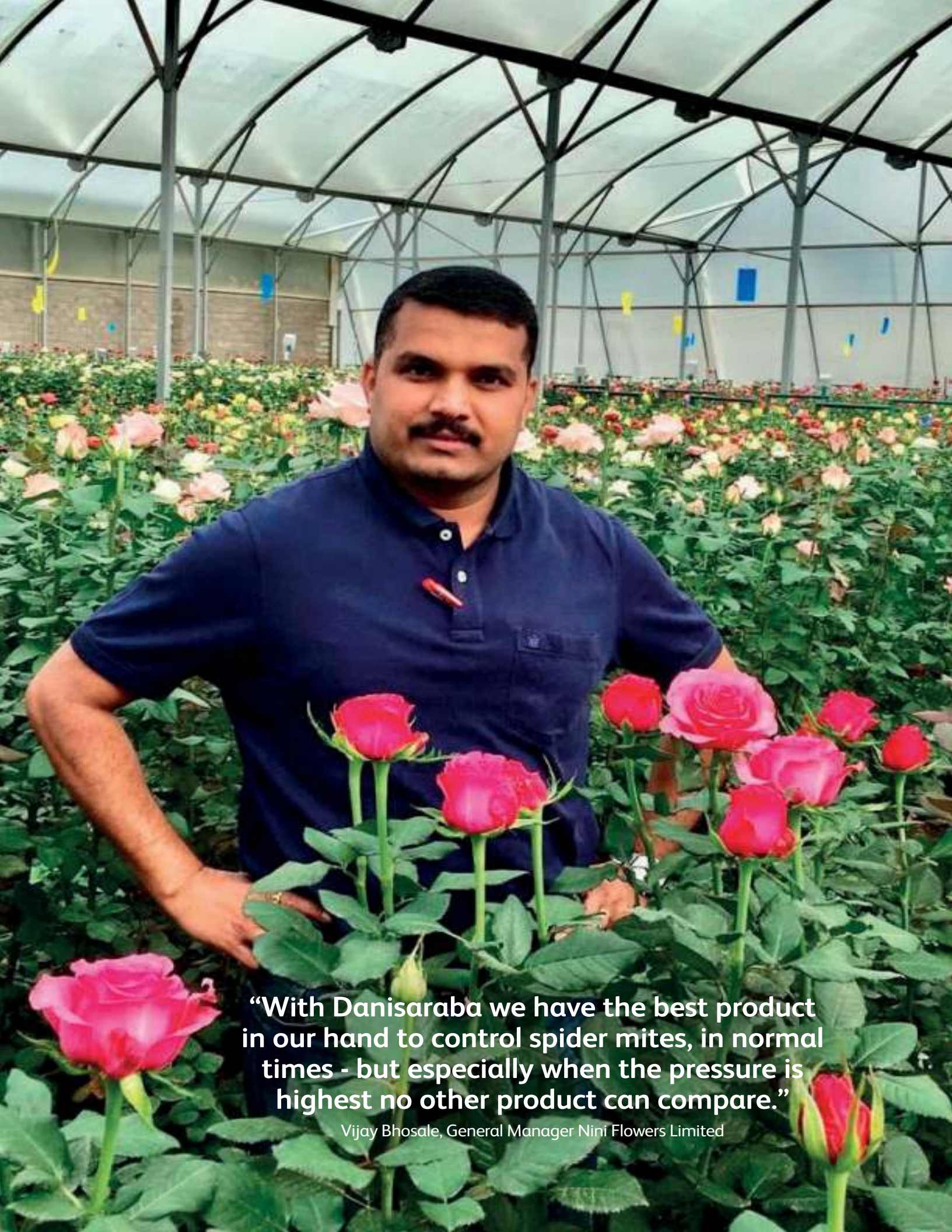
The scientists are also concerned about the scepticism and misinformation around gene editing partly due to a lack of comprehensive understanding of the technology.

“We need vibrant advocacy and coherent communication about the immense potential that gene editing holds in national and global growth and development. To realise the benefits of gene-editing, there should be a dialogue between stakeholders- researchers, policymakers, the public, and the regulators - to come up with a consensus for creating an enabling environment for the adoption of technology and the acceptance of gene-edited products. Gene editing is already in use in multiple facets in agriculture, veterinary and human medicine, and sooner we embrace it, the better,” he says.

The CRISPR/Cas9 technique is already being used to improve agriculturally important crop traits, such as nutritional value, disease resistance, and herbicide tolerance. A tomato with higher nutritional content was the first CRISPR-edited food to go on sale in the world. In medicine, CRISPR is revolutionising experimental therapies for genetic disorders ranging from sickle cell disease to blindness, potentially helping transform the lives of patients with previously limited treatment options.

Several CGIAR centres are embracing the CRISPR/Cas9 technology in their genetic improvement mandate for a food and income secure future.

It is anticipated that gene editing will in future help develop superior crops that can endure the vagaries of climate change, increase yield and enhance nutritional benefits hence supporting global food security for the ever-expanding human and livestock population, and lower environmental impact posed by agricultural practices.



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Vijay Bhosale, General Manager Nini Flowers Limited

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Life cycle

The life cycle of Spider mites is influenced by climate with hot and dry conditions being favourable for reproduction and development. The rate of Mites production accelerates at optimum temperatures and as a result allows them to become quickly resistant to pesticides.

Temperature	No. of days to complete life cycle
20°C	17 days
25°C	14 days
30°C	7 days

Table 1: Effects of temperature on life cycle of Spider Mites.

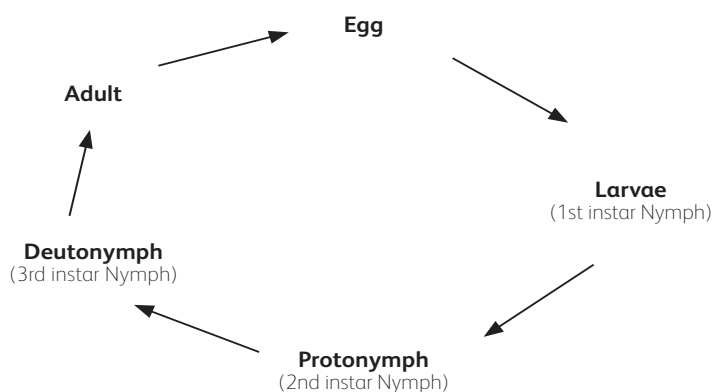


Figure 1: Life cycle of a mite.

Several methods of managing the pest are available to the grower. Cultural, Biological and Chemical control are the methods used to manage the pest. Use of predatory mites such as *Phytoseiulus persimilis* and *Neoseiulus californicus* has become common with many growers. As such, when choosing a Miticide to spray, it is always important to consider compatibility. Cyflumetofen, the active ingredient in DANISARABA® 20 SC is a novel acaricide developed by OAT agrico Co Ltd. The mode of action of Cyflumetofen is by inhibiting mitochondria complex II electron transport.

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AATF Executive Director Dr. Canisius Kanangire (4th left) with other dignitaries during the OFAB Chapter launch in Mozambique. Photo Credit: AATF

Mozambique moves to address biotechnology information gap

By PanAfrican Agriculture Correspondent

MOZAMBIQUE is the latest country to open a chapter of the Open Forum on Agricultural Biotechnology (OFAB), hoping to demystify the myths and misconceptions surrounding the science.

OFAB, supported by African Agricultural Technology Foundation (AATF), seeks to enhance awareness and knowledge of the benefits and safety of agricultural biotechnology among key stakeholders, including policy makers and decision makers.

Mozambique becomes the first country in the Southern Africa region, and the ninth in Africa after Rwanda, Burkina Faso, Ethiopia, Ghana, Kenya, Nigeria, Uganda and Tanzania to launch an OFAB.

The newest OFAB Chapter will be hosted by the Institute of Agricultural Research of Mozambique (IIAM).

As noted by AATF Executive Director Dr. Canisius Kanangire it will offer stakeholders a platform for conversations on the role of science technology and innovation key to the transformation of agriculture in the country.

“This milestone is a clear indication of what great partnerships can achieve and the launch gives us one more reason to celebrate the hard work, commitment and dedication of IIAM and AATF, driven by the unity of purpose between our institutions,” Dr Kanangire said during the launch in March.

“We have witnessed biotechnology ensuring access to more nutritious foods such as with the commercialisation of the first genetically modified cowpea in the world, the pod borer-resistant transgenic cowpea now available to farmers in Nigeria.”

AATF was founded to tackle poverty and food insecurity through technological interventions. In its nearly 20 years of operation, the organisation has facilitated access to technologies worth over USD 400 million for use by farmers in Africa ranging from better seeds, digital tools and agricultural mechanization solutions.

Through interventions in key value chains such as maize, cassava and rice, the foundation has supported farmers to access better tools and seeds, improve their agricultural practices as well as access better markets, leading to improved yields and livelihoods.

Mozambique is one of the countries where the Bill Gates Foundation research of the genetically modified maize under the Water Efficient Maize for Africa (WEMA) project was conducted.

The drought-tolerant Bt Maize, now known as TELA maize, has also shown resistance to the stem borer, which is linked to massive maize production losses on the continent.

TELA maize (whose development and deployment is managed by AATF) is expected to help farmers avert total crop failure in the event of reduced rainfall which has been very common because of climate change. It has been commercialised in South Africa, with yield improvements of up to 60 percent.

IIAM Director General Olga Fafetine noted that IIAM has made substantial strides through the TELA maize project that will soon culminate in the commercialisation of Bt Maize in Mozambique, presenting smallholder farmers with a technology to help them mitigate the impact of drought and pests, thereby improving maize yields.

“As we make these decisive steps towards the commercialization

of Bt Maize, biotechnology communication and awareness creation is needed more than ever. Consequently, the launch of the OFAB chapter in Mozambique is very timely,” Dr Fafetine said.

Mozambique’s vice-minister for Agriculture and Rural Development Olegario Banze said that OFAB’s launch in the country marked an important step in the country’s quest to boost agricultural productivity.

“Through agricultural innovations, we have managed to facilitate access to productivity enhancing technologies, enabling millions of our farmers to improve their farming practices in line with the government’s National Development Strategy ‘ENDE’ 2015-2035. We have particularly contributed directly to the second pillar of our five-year development programme (2020-2024) focusing on economic growth and job creation,” Mr Banze said.

The launch of the Mozambique OFAB chapter comes at a time when Africa’s agriculture-dependent economy is facing myriad production challenges, including climate change, new pests and diseases and finite farm land. These challenges require special attention to enable optimal production yields that are also friendly to the environment.

Biotechnology, which includes innovative tools like double haploid technology, marker assisted breeding, genomics, genetic engineering and genome editing, has significantly shortened the time required to develop new cultivars, varieties and hybrids. These tools can accelerate the development of market-responsive varieties needed for sustainable agriculture in Africa.

In the third phase of the project, OFAB intends to expand its outreach through the establishment of a new chapter in Malawi.

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Kenya takes the progressive path on genome editing rules

By PanAfrican Agriculture Correspondent

KENYA has exempted selected genome editing techniques from its genetically modified organisms (GMO) regulations, boosting research and commercial release of products of the technology.

New guidelines published by the National Biosafety Authority (NBA) in March show that genome editing techniques and derived products that do not involve integration of foreign genetic material or do not contain foreign genetic material respectively are deemed non-GMO and will therefore not be regulated under the country's Biosafety Act.

This means that techniques like site-directed nucleases (SDN-1), used by scientists to improve market-oriented traits in crops, will now be regulated as conventional breeding.

But researchers wishing to undertake a project involving gene editing are still required to consult NBA, including submitting data on the experimental processes and end product to the regulator to establish whether it should be regulated.

"The decision on early consultation by the NBA will be communicated to the applicant within 30 working days. However, genome editing projects that do not have the required data will be regulated under the Biosafety (Contained Use) Regulations 2011," says the NBA.

Decisions regarding GMOs are typically communicated to the applicants between 90 and 150 days.



A scientist inside a gene editing laboratory. Photo Credit: NBA

Under the new guidelines, genome editing techniques that may alter the complete genetic information of organisms resulting in either a GMO or organisms that are not distinguishable from those developed from conventional breeding or natural selection will be subjected to scrutiny under the Biosafety Act.

The law enacted in 2009 mandates the NBA to supervise and control the development, transfer, handling and use of GMOs to ensure the safety of human and animal health and protect the environment.

But there have been uncertainties over the regulation of genome editing – which enables researchers to change specific genes in an organism's own DNA or to insert a new DNA in a target manner –

despite a recognition of its enormous potential to improve crop and animal production and health

"Possible applications of genome editing in crops include biofortification, resistance to diseases and abiotic stress (e.g., drought), herbicide tolerance, male/female sterility, altering of flowering time etc. Applications in livestock include improved productivity e.g. muscle of meat, improved quality of products e.g. reduced allergenicity in milk, animal health and welfare e.g. resistance to diseases and hornless cows among others," says the NBA.

Genome editing has been used to improve yield-related traits in rice, such as dense and upright panicles and reduced plant height, develop late flowering soybean, resulting in increased vegetative size and develop citrus plants resistant to citrus canker.

The technology has, however, run into regulatory headwinds in some parts of the world, especially in the EU where gene editing products are classified as GMOs.

The newly published guidelines show that Kenya has followed the more progressive path taken by Argentina, Australia, Brazil, Canada, Chile, Colombia, Honduras, Japan and the US on regulating genome editing.

The East African country is reputed to have some of the most progressive regulations for modern biotechnology and is one of only seven countries in Africa to have allowed commercial growing of GM crops so far.

The country also boasts reasonable technical capacity for biotech research and safety regulation, with its well-equipped modern biotechnology laboratory at the State-funded Kenya Agricultural



Genome editing has been used to improve yield-related traits.
Photo Credit: NBA

and Livestock Research Organisation (KALRO), a credible regulator and a good number of PhD graduates in the field from local and foreign universities.

But a 2012 ban on GMO imports, imposed by the Ministry of Health on safety concerns raised in the discredited Seralini study released by a French university,

have been seen to slow down research and commercial release of GM crops.

The ban has recently emerged as a sticking point in the ongoing free trade negotiations between Kenya and the US, with Washington raising concerns about some of its agricultural exports being locked out of the East African nation's market.



Kenya has in place a robust policy, regulatory and institutional mechanism for the implementation of biotech innovations. ISAAA AfriCenter



With 25 years of commercial cultivation, biotech crops have been shown to be safe for human and animal consumption, and the environment. Source: ISAAA AfriCenter



Ms Tamar Awekonimungu, a young farmer, takes part in harvesting the GM cassava at the at National Crops Resources Research Institute field station. Photo Credit: Lominda Afedraru

Ugandan GM cassava passes field test

By Lominda Afedraru

UGANDA is ranked the sixth-largest producer of cassava in Africa producing 2.9 million metric tons behind Tanzania and Rwanda which produce 5.8 million metric tons and 3.5 million metric tons respectively. Nigeria is the largest producer with figures rated at 55 million metric tons per annum. Cassava is a staple in many communities in Africa.

The country targeted growing its cassava production to 3.5 million metric tons in 2010 from 2.9 million metric tons in 2018.

But two diseases – cassava brown streak virus (CBSV) and cassava mosaic virus (CMV) – continue to be a menace on the farms, suppressing production.

These diseases are spread during flowering by whiteflies, which injure plants by sucking juices from them, causing leaves to yellow, shrivel, and drop prematurely or inserting several viruses from diseased to healthy plants through their mouthparts.

After eight years trying to breed disease-resistant cassava varieties using biotechnology, Ugandan agricultural scientists have edged closer to a lasting solution.

Dr Titus Alicai, who leads the GM cassava research programme at the National Crops Resources Research Institute (NaCRRI) in Namulonge, says the results from the last batch of field trials conducted recently look promising.

He says the clean cassava varieties that his team has come up with can double yields on the farmer fields once adopted.

Their effort began in 2013 through the Virus Resistant Cassava for Africa (VIRCA)

Plus project, a research collaboration established by the Donald Danforth Plant Science Centre in the US.

According to Dr. Alicai, his team reached their final milestone by engineering CBSV resistance into a popular variety called TME204.

More than five field trials have shown that the new varieties are resistant to both CMV and CBSV.

“In one pathway the scientists used already existing varieties Nase13 and 14, which had already succumbed to CBSV, and they were able to generate resistant varieties.

Six candidates are ready for variety release. The second pathway is where the initial varieties generated as parents of Nase13 and 14, 19 and TME204 and crossed to already genetically engineered materials to get resistant varieties,” says Dr Alicai.

At the field trial, Nase 13, 14 and a variety from Nigeria namely 0505 were tested and replicated four times before coming up with the final product.

The product development stage is now complete and the resistant materials will be given names by the variety release committee.

Ms Tamar Awekonimungu, a farmer from Nebbi district in West Nile who participated in harvesting the GM cassava at the field trial site in Namulonge, was impressed by the nice looking tubers she saw.

“I have seen the yield of the GM cassava is good compared to the varieties we grow in Nebbi, which easily succumb to CBSV. I pray that we will be allowed access to the stalks of these varieties for planting soon,” she said

Her wish is to propagate GM cassava on two acres and sell stalk to fellow farmers as income earning initiative.

But in the absence of law regulating the release of GM products for commercialisation, farmers will wait much longer to start growing the disease-resistant GM varieties.

Efforts to have parliament pass the Genetic Engineering Regulatory Bill (GERA) have been futile due to the influence of ant-GM activists on the Ugandan authorities.

Unless GERA is passed and enacted, Ugandan farmers will continue to lag in the adoption of GM crops.

“

I have seen the yield of the GM cassava is good compared to the varieties we grow in Nebbi, which easily succumb to CBSV. I pray that we will be allowed access to the stalks of these varieties for planting soon.

”



Harvested GM cassava. Photo Credit: Lominda Afedraru

Assuring the safety of GMOs

Dr. Roy Mugiira, the Acting CEO of Kenya's National Biosafety Authority, converses with PanAfrican Agriculture the biotechnology regulator's delicate balancing act enforcing policies meant to promote adoption of the modern science while keeping people and the environment safe from any harmful effects.



Dr. Roy Mugiira, Kenya's National Biosafety Authority Ag CEO.
Photo Credit: NBA

What is the role of the National Biosafety Authority?

The National Biosafety Authority (NBA) was established in 2010 with the mandate to exercise supervision and control over the development, transfer, handling and use of genetically modified organisms (GMOs) so as to ensure and assure safety of human and animal health and provide adequate protection of the environment.

NBA is also the Focal Point for the Cartagena Protocol on Biosafety and regulates all activities involving GMO in food, feed, research, industry, trade and environmental release.

What are genetically modified organisms and GM foods?

A genetically modified organism (GMO) is a plant, animal or microorganism that possesses a novel or new combination of genetic material obtained through the use of modern biotechnology techniques.

GM foods are foods derived from modern biotechnology.

Why produce GM foods?

GM technology is only one of the technologies for improving productivity in crops or animals. It is used to develop, for instance, insect-resistant crops, disease-tolerant crops, and weed-tolerant crops. GM foods have many attributes such as better nutritional value through bio-fortification.

What is the process and cost of registering a GMO product in Kenya?

The process starts with a developer or plant breeder who identifies a positive trait in one organism and wishes to introduce the same into another organism through modern biotechnology techniques.

Once the improvement has been done and safety assessments conducted, the developer/breeder makes an application to NBA for consideration. NBA will conduct an extensive safety assessment to ensure the GM product is safe to humans and animals as well as to the environment. A socio-economic impact assessment is also carried out before any release is allowed. Members of the public are also engaged through a structured public participation exercise.

A decision regarding the GMO application is then communicated to the applicant in 90-150 days. Members of the public are informed of NBA decision through the NBA website and internationally through a biosafety clearing house (BCH) platform.

The application fee for biosafety approval is Ksh. 850,000 (an average USD8,500), which covers for a period of 10 years without any further payment.

Are these application requirements the same for all the GMO products?

GMO applicants are required to submit fully filled application forms in prescribed format and payment of relevant applicable fees. One may apply for contained use research, environmental release and placing on the market of GMO or import, export and transit of GM products. The various application forms are available in the NBA website.

How long does it take to register a GM crop?

It takes 90 to 150 days to make a decision and communicate to applicant(s) regarding environmental release and/or placing on the market of genetically modified organisms. Once NBA completes its process, other agencies involved in variety registration in Kenya take over the process.

Who can apply to register a GM crop?

Any Kenyan citizen can make a request for registration of a GM crop in Kenya.

What are the requirements for exporting and importing a GMO product in the country?

The requirements for importation, exportation and transportation of GMOs are as per the Biosafety (Import, Export and Transit) Regulations, 2011. Important information required includes evidence of approval of the GMO by a competent biosafety agency; identity and quantity of the genetically modified organism to be imported or exported; port of entry or exit into or out of Kenya; the intended purpose of importation, exportation or transit of the genetically modified organism; and for transit commodities, evidence of approval or no objection letter by the destination country.

Which GM crops are currently being grown in the country?

Bt cotton that has resistance to the cotton bollworm pest was approved for commercialisation in January 2020 and is now available to Kenyan farmers. Other crops such as insect-resistant maize (Bt maize) and disease-resistant cassava are at national performance trials and final biosafety approval stages. A number of important crops such as sorghum, sweet potato, yams, banana, and Irish potato are still being experimented in the country.

Are GM foods assessed differently from traditional foods?

In practice, very few foods consumed today are subjected to any systematic safety assessment process, but they are rather generally accepted as safe to eat due to the history of safe use. Safety assessment of GM foods is based on international standards (CODEX, OECD, Cartagena Protocol on Biosafety) and national laws, and aims to ensure that the GM food is as safe as its conventional counterpart.



The application fee for biosafety approval is Ksh. 850,000 (an average USD8,500), which covers for a period of 10 years without any further payment.



Are there any issues of concern for human health with the GM products? If yes, explain.

The main concerns over GMOs focus on potential toxicity, allergenicity, and compositional analysis. The GM products currently available on the international market have undergone thorough safety assessment and have shown no adverse effects on human and animal health.

How is the risk assessment of the environment performed?

Environmental risk assessment of GMOs is done in accordance with provisions of the Cartagena Protocol on Biosafety (Annex III), Biosafety Act and Regulations and Environmental Risk Assessment Guidelines developed by NBA for this type of assessment. We also consult independent experts and other government agencies on environmental matters before any decision is made. All assessments undertaken by the Authority are science-based, transparent and are carried out on a case by case basis.

How do you regulate GM foods and crops?

Regulation of GM foods in Kenya is carried out in line with the provisions of the Biosafety Act and biosafety regulations. Biosafety (Contained Use) Regulations, 2011 ensure that potential adverse effects of genetically modified organism are addressed to protect human health and the environment when conducting research of GMOs. Biosafety (Environmental Release) Regulations, 2011 ensure that potential adverse effects of genetically modified organism are addressed to protect human health and the environment before commercialising any GMOs. Biosafety (Import, Export and Transit) Regulations, 2011 ensure safe movement of genetically modified organisms

into and out of Kenya while protecting human health and the environment. Biosafety (Labeling) Regulations, 2011 ensure accurate consumer information regarding GM food, feed or products and traceability for implementation of risk management measures where necessary.

There are certain groups concerned with the growing influence of biotechnology, what's your take on that?

As stated earlier, biotechnology is only one tool that is utilised to improve crops or animals among others. The role of NBA is to ensure that those who choose to use modern biotechnology do it in a responsible manner that guarantees safety of humans, animals and the environment.

At NBA, we recognise the possibilities of modern biotechnology in ensuring food security, fighting poverty and improving livelihoods. We also recognise the concerns of the public regarding the safety of GMOs. As an institution we are committed

to ensuring that any application of modern biotechnology in Kenya is done in a safe and responsible manner.

We can assure the public that any GMOs approved by NBA will have undergone thorough scrutiny to ascertain that they are safe for human or animal consumption.

The biosafety laws also provide for a robust monitoring and evaluation framework for all commercialised GMOs which are monitored for 20 years for any unanticipated effects.

What future developments can Kenyans expect in the field of biotechnology?

It's important to note that there are other emerging biotechnologies such as gene editing that have come up in recent years and some of the research projects in Kenya are already utilizing these technologies though at early stages of development. NBA will ensure that as new technologies evolve, so do the regulations to ensure safety of humans, animals and environment.

Do you think biotechnology will help solve the problem of food security in the country or something else needs to be done?

Low crop productivity is considered one of the main reasons for poverty and food insecurity in the world. Biotechnology has contributed to an increase in food production using different approaches such as introducing high-yielding varieties resistant to biotic and abiotic stresses, reducing pest-associated losses, and improving nutritional values of foods.

Biotechnology should therefore be considered among the key tools we need to meet the rising demand for food for our fast growing population as a country. The Kenya Vision 2030 and Medium Term Plans (MTP) recognise the potential benefits of biotechnology while also cognizant of potential risks, hence the establishment of NBA as a competent body on these matters.



Dr. Roy Mugiira during a past event.. Photo Credit: NBA

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- Africa
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- Sugarcane
- Pineapple
- Safflower

For more information on biotech crops, visit www.isaaa.org



Source: ISAAA. 2019. Global Status of Commercialized Biotech Crops in 2019. ISAAA Brief No. 55. ISAAA: Ithaca, NY.

Source: ISAAA AfriCenter



*Nana Owusu, the founder of Ghanaian agribusiness start-up Agro Kings.
Photo Credit: Justice Lee Adoboe*

Ghana's start-up firm digging for gold in agribusiness

By Justice Lee Adoboe

NANA Owusu-Achau, an under 35 computer science and information studies graduate from America's Calvin University with experience in tech investment skills on Wall Street, founded a real estate firm in Ghana in 2013.

But a small gift of rice given to him by a local chief while working on a housing project in Akuse area, 73 km north of Ghanaian capital Accra, drew him to agribusiness.

"I stumbled on rice, when I went to the Akuse area on a project of building houses on islands. A chief in the town gave me rice from the community to try out. After that, we ended up where we are today.

I started out with an initial capital of 12,000 Ghana Cedis from the real estate business," says Owusu-Achau.

His company Agro Kings today exports quality rice to Europe and sells, among other products, bulk of the rice under the popular brand name, Nana's Rice and chilli pepper sauces known as Shito on the Ghanaian market.

It employs 35 administrative staff, 40 full-time farm workers, and 250 casual labourers on the nucleus farm. About 1,500 farm hands work with the 300 smallholder farmers who serve as out-growers for the company.

On its own nucleus farm the company has planted about 120 acres,

turning out 500 metric tons of rice in the 2021 crop season and plans to do about that same size in 2022. In addition, Owusu-Achau works with about 300 out-growers, each of whom does an average of two and half acres in a season.

The young agro-entrepreneur says that his decision to venture into agriculture was due to its enormous impact on economic growth, food security and job creation for Africa where arable land is in abundance.

"One thing that is common to all of us is that we all eat. We may not all be able to buy cars, and there might be floods, but at the end of the day, we all have to get food to eat. While investments in infrastructure,



electricity, oil and gas, and other socio-economic infrastructure are important, there is an even bigger reason for us to invest in agriculture,” he says.

“We have a population growing at a rate that no other part of the world is experiencing, and nearly 60 percent of Africa’s population is under 25 years. In that case, we Africans must look at our own challenges and find solutions to them. I read somewhere that we were using less than 10 percent of our arable lands in producing crops in 2013. I am of the view that agriculture is the next gold if only we treat it with the sort of seriousness it needs, and that’s one of the things that motivated me to take up agriculture investment.”

Owusu-Achau’s country, Ghana has recorded a steady increase in rice consumption over recent decades due to population growth, urbanisation, and changes in consumer habits, according to the United Nations Industrial Development Organization.

But multiple challenges, including reliance on rain-fed farming, are holding back the potential of rice production.

Agro-King has overcome the seasonality problem by storing rain water in lagoons and channels the water through gravity canals to irrigate its farms, allowing production throughout the year.

It practises circular economy in agriculture, whereby nothing goes waste. Crop and animal waste is used as feed for poultry, livestock and fish and as organic manure.

The company has also invested in warehousing, processing and distribution.

Owusu-Achau says agribusiness start-ups in Africa need to devise more innovative ways of raising capital for their investments with many banks still reluctant to finance them, citing risks associated with agriculture.

“Micro-financing institutions will ask for your house, car and all other things and enslave you for life. But go to people who can buy into your vision, and do that diligently. What we do is the FFF model. We call it “Family, Friends and Fools,” he says.

“I say ‘Fools’, not in a derogatory manner, but people who are foolish enough to believe that the vision we have can come to fruition. But for the first seven acres, I used about 12,000 Ghana cedis from my savings and it worked out well.”

In the early stages of the business, he recalls carrying around the company’s products while out pitching to prospective investors. He would also offer to pay these investors interest rates they could not get elsewhere.

“Some of them actually saw the products on the market and thought that it was something they could put money in. So about five different people gave us money, and whenever we harvest, we give their money back with interest,” he says.

“The goal for me, as I continued with the ‘Family, Friends and Fools’ model, was reach that point where I could approach the banks and convince them that I am a viable enough business that they can support.

And we are right at the point where we are now looking for funding through banks and investment vehicles.”

While he acknowledges the fact that there are challenges financing agriculture, he believes the risks tend to be exaggerated.

Whenever an opportunity arises, he invites prospective investors to the farm to get an experience of practices in a bid to debunk the notion that agriculture is too risky.

“Yes, every business is risky. You can buy a vehicle to use for commercial purposes but get involved in an accident just the first day, but people don’t think about accidents when buying cars. They assume they will keep the car for a while. In the same way agriculture has some risks, but the risks are not insurmountable,” he says.

He believes African governments should lead the way by increasing investments in agriculture, offering the right incentives to attract young people to agribusiness and promoting local products.

“There are programmes, but the problem is not just on the input side. There are severe challenges with post-harvest losses, problems with young people being able to enter into the agriculture space. So we do need to make that 10 percent annual investment in agriculture as prescribed by the Maputo and Malabo declarations,” he says.

“People believe this is part of the colonial legacy. But we hope to change that narrative. Ghana currently consumes over a million tons of rice annually. My farm, even at full capacity, would have produced only 40,000 tons of rice each year. But if the locals embrace the products as much as the foreigners do, I would not even have the volumes to be able to export.”



*David Kimuhu, an agronomist at Kevian, demonstrates vegetative propagation of potato plants.
Photo Credit: Henry Owino*

Inside top juice maker Kevian's potato seed multiplication plan

By Henry Owino

A VISIT to Kevian Kenya Limited Farm in Thika will leave you with a deep understanding of modern potato seed production science.

Nathan Mala, the laboratory technician at Kevian, is immersed in an experiment preparing an in-vitro cell culture or plantlets in a glass.

In another two to three weeks, he expects the cells will have split until they fill up the glass with about 30 new plants.

In a day, he can make up to 60-70 glasses of plantlets using the germplasm conservation technology. "In-vitro is Latin for 'within the glass'. When something is performed in-vitro, it happens outside of a living organism.

The media are stored by freezing the stocking of the seeds in glasses and controlled under a temperature of 16 degrees Celsius," explains Mala.

"In just one month, Kevian has the capacity to produce at least 36,000 new plantlets in the laboratory. After transferring to the greenhouse for vegetative propagation, they are multiplied in thousands."

Upon sprouting, the new plants are transferred to greenhouse for vegetative propagation – a process involving hardening, multiplying and acclimatising them to the outside environment.

Kevian, one of the leading fruit juice producers across East Africa, was in 2020 contracted by the Kenya Agriculture and Livestock Research Organization (KALRO) to undertake

commercial multiplication of high-yielding potato seed varieties to meet the growing demand in the country.

To date the company says it has managed to multiply seven potato seed varieties namely; Rams, Sherekea, Nyota, Shangi, Wanjiku, Kenya Karibu and Unica.

The potato seeds are currently undergoing field trials.

Kevian Kenya has two farms in Timau and Kitengela measuring 2,000 acres and 50 acres respectively.

Commercial distribution to farmers is expected to start in August this year subject to approvals by the Kenya Plant Health Inspectorate Service (KEPHIS).



Potato tubers ready for transplanting. Photo Credit: Henry Owino

Harrison Wachira, the project coordinator, observes that the traditional methods of making potato seeds are slow, consumes time, can easily spread disease to the whole plantation and are associated with poor yields and potato seed shortages.

“The cases of potato produce from Kenyan farmers being rejected by processors or fast food firms are due to poor quality. It is regrettable because it leads to low sales at throw-away prices and losses to the farmers,” Wachira said.

Vegetative propagation is especially important for commercial growers who want to reproduce the highest-quality plants and ensure consistency of a variety of plant or crop for sale. This can also help to maintain consistent quality and taste in products made from plants or crops. For example, Rams potato variety is likely to become popular with most Kenyan farmers because it is good for French fries and crisps.

David Kimuhu, an agronomist at Kevian Potato Farm, says modern technology holds the key to improving the potato productivity and address seed shortages in sub-Saharan Africa.

Modern technology, he says, has the potential to double, or even triple yields, offering opportunities for farmers to increasing production volumes without increasing land use.

“In the greenhouse we have two main methods of multiplying the potatoes seeds: hydroponic and aeroponic technology. The former uses less water and direct feedings that allows for faster growth and higher yields than traditional soil-based growing systems while the later hangs or suspends on air or mist environment without the use of soil or aggregate medium but both methods produce tubers,” Kimuhu says.

The tubers are graded according to sizes: micro tubers, mini tubers, Grade 1, Grade 2 – which are selected for mass farm plantation – and wares.

Wares are for subsistence production. “The advantages to this kind of asexual reproduction are that , it can occur either naturally or artificially, more rapidly than seed propagation and allow genetically superior plants to produce unlimited copies of itself without variation,” Kimuhu states.



**Nathan Mala, Laboratory Technician showing samples of potatoes in-vitros
Photo Credit: Henry Owino**



A group of farmers on banana plantation in Taita Taveta County which is the second-largest banana producer in Kenya after Meru County. Photo Credit: Tataba

Banana factory project whets farmers' appetite for new variety in Taita Taveta

By Marion Wagaki

A DANISH multinational company plans to set up a banana processing factory in Kenya's Taita Taveta County next year, boosting efforts to commercialise production of the crop.

Orana A/S, which has a presence in 45 countries, is partnering with local firm Wanda Agricultural Group on the agribusiness project that will see 2,000 contracted local farmers initially supply 31,500 tons out of the 40,000 metric tons of bananas needed to get the factory in Taveta running. The rest of the supplies will come from a 300-acre nuclear farm run by Orana.

This initiative is being implemented under a Danish-funded Danida Market Development Partnership (DMDP) that seeks to promote sustainable business development and create employment opportunities in developing countries.

Micro Enterprise Support Programme Trust (MESPT), an initiative of the Kenyan and Danish governments, is the local development partner on the project funded by DANIDA.

Apart from capacity building and helping farmers get global accreditation to access global markets, MESPT will also educate the farmers on how the digital contracting system will work.

Since it was launched in June 2021 last year, the project has recruited over 1,200 farmers, grouped into clusters of 50 each, with a target of 40 clusters once the project is fully rolled out.

Each cluster is assigned a MESPT farm estate adviser to guide the farmers on the best farming practices.

"These experts work closely with the county ward agriculture officer since the county government of Taita Taveta is also a key stakeholder with whom MESPT has entered a collaborative MoU," Rebecca Amukhoye, the chief executive officer of MESPT, said.

Ms. Amukhoye said 500 farmers have embarked on growing the bananas organically for the project around Lake Jipe.

“We are working backwards. Once the crop estates are fully established by 2023, Orana will establish a processing factory in a site already identified,” she said.

Wanda is helping the farmers to establish the crop and aggregate it for processing once Orana establishes the factory in the Taveta sub-county in 2023.

The company’s managing director, Marion Atieno, said the recruitment of the 2,000 farmers will be completed by next year when the construction of the aggregation centre for bulking and grading of the produce is complete.

“Orana is our nuclear customer, and we will also target other customers since we expect to get various grades for different markets and diversify to other crops such as Hibiscus,” Ms. Atieno said.

Wanda has created an online system to recruit and contract farmers. Once a farmer opens an account, he or she selects the preferred market contract.

The project is promoting the growing of the fast-maturing Grand Nain variety, which is being introduced in the region for the first time. The banana variety bears fruits in 12 months.

The project has set a target of planting 500,000 trees, with each farmer getting 250 seedlings sourced from locally established nurseries.

Daniel Mumo, a farmer from Njukini village in Taveta Sub-County, who planted the new variety last year on his two-acre farm, is optimistic that the new initiative will help address the challenges of the banana market.

“I have been a banana farmer for the last 10 years. The biggest challenge the Taveta farmers have been facing is the lack of an established market since we sell most of our produce locally. We are also facing tremendous competition from Tanzania, whose produce is

attractive in the Taveta market due to low price and good quality,” Mr Mumo said.

He said there was also a need to help farmers with irrigation systems and the formation of cooperatives so that they can increase production and get new markets.

Jimmy Musyoki, a former lecturer in Tanzania who ventured into banana farming after retiring, has put an acre under the new variety, attracted by the prospects of better market opportunities.

“There is no market for the bananas we produce and I sell to local women for the local market where the price is not good. The rest goes to family consumption,” Musyoki said.

Taita Taveta is the second-largest banana producer in Kenya after Meru, according to a recent study by Kenya Agricultural and Livestock Research Organization (KALRO). Banana production in Taita Taveta grew five percent in 2018 compared to 9.7 percent in 2020.

Currently, there are over 6,000 banana farmers in the county. The current acreage under banana farming stands at 4,104 hectares, having increased from 2,080 hectares in 2017.

The county’s annual banana production in 2020 was 62,580 tonnes, which goes to local consumption, and regional and national banana trade.



Harvested bananas ready for market. Photo Credit: Marion Wagaki

Why handling and transportation, matter for fresh farm produce

By Henry Owino

THE logistics of transporting fresh farm produce to any market may be very complex. Those in the supply chain must always work together seamlessly so that the produce can make it to the end users in good condition. To ensure this happens, they must take into account packaging, temperature, humidity, road network and other factors to ensure the produce stays fresh and intact.

The transportation is essential for the sustainability of agricultural production in sub-Saharan Africa as it impacts positively factors such as mobility, the adoption of high-yielding varieties, high productivity crops and bigger farm size.

In rural parts of Africa, transportation modes include animal traction, car, truck, train and other intermediary means of transport (IMT) such as motorcycle, bicycle, boat and canoe mostly adapted for local transport problems with low and medium loads.

Intermediary modes of transportation (IMT) are crucial to farmers' timely access to farm, markets and agro-services though the level of adoption may be unconnected with availability of quality road.

This waste of energy and time could affect their effective working time and productivity on the farm. It is believed that trekking shorter distances or using IMT would reduce food farmer's walking time and increase productivity.

While good packaging of fresh farm produce reduces losses even further, it makes handling and trading of the product easier and, for retail trading, improves the marketability of the product.

According to experts, selection of the right container and packaging materials by farmers, traders or manufacturers, protects against damage or contamination by micro-organisms, air, moisture and toxins.

Agricultural products cannot be stored indefinitely. The maximum storage duration (the shelf life) of agricultural products varies and can only be a few days for some fruits and vegetables, a couple of months for most tubers and bulbs, and over a year for dried food grains or other seeds, depending on the storage method.

In this edition, *PanAfrican Agriculture* pictorial depicts the transportation and handling approaches likely to lead to further loss of produce.



A trader selling bananas on a handcart at Gikomba Market.



Cattle roam in an urban centre as pasture shortage bites.



Farmers deliver raw milk at a collection point.



Collard greens (sukuma wiki) kept under shade before buyers come out.



A motorbike rider transports bags of mangoes to a local market.



Milk packed in jerrycans and transported on pick-up vehicles.



Fresh farm produce being ferried to the market on a pick-up truck.



A truck turned into a makeshift grocery at Nairobi's Toi Market.

Why handling and transportation, matter for fresh farm produce



Hawkers carry around bananas in open baskets as they look for buyers.



Sugarcane and bananas sold by the roadside in Keumbu, Kisii.



Traders sell fresh produce at Nairobi's Wakulima Market.



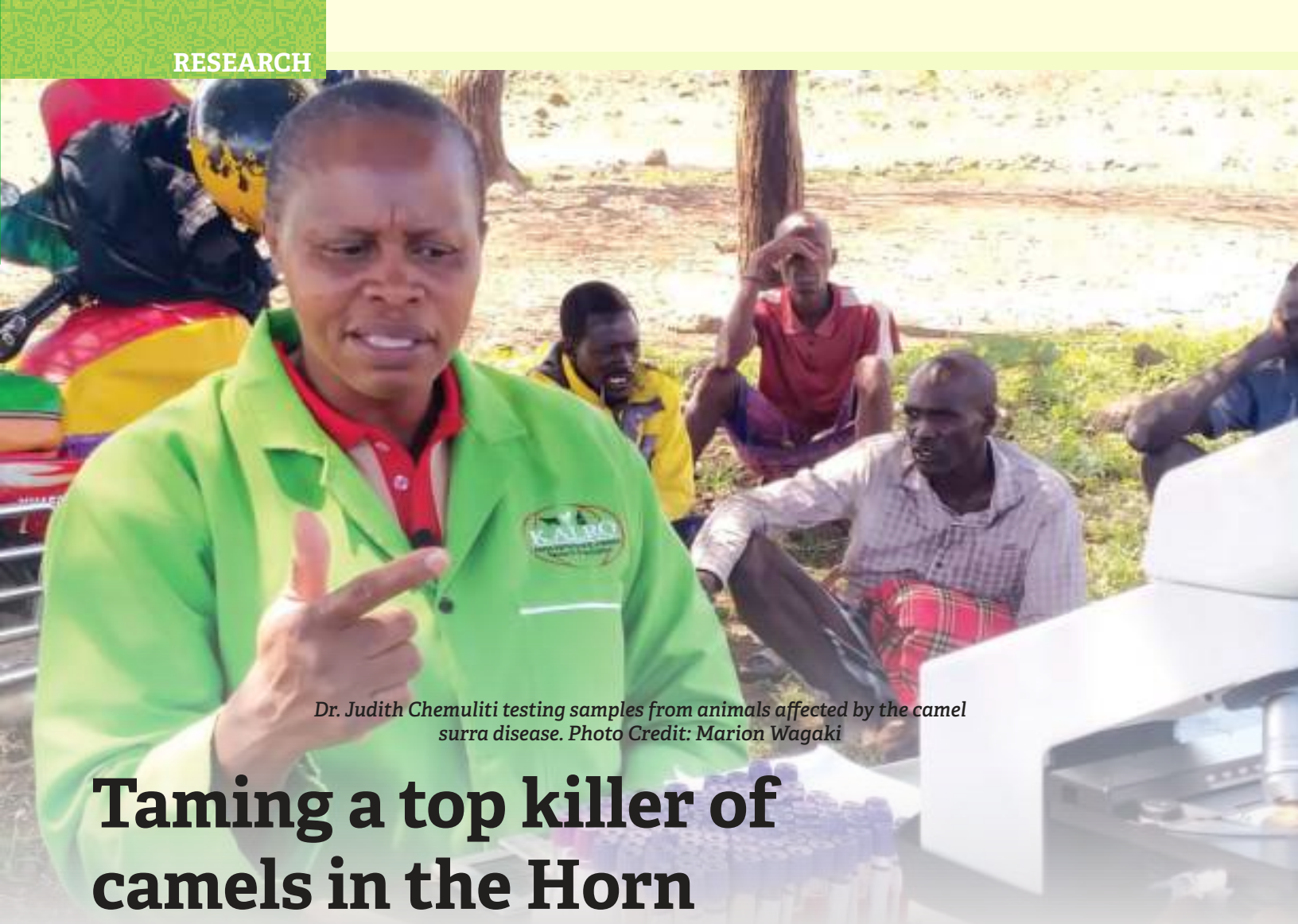
A truck arrives with vegetables at Marikiti market.



Mangoes displayed for sale next to a garbage heap at Wakulima Market.



At Marikiti market vegetables are displayed for sale on handcarts.



Dr. Judith Chemuliti testing samples from animals affected by the camel surra disease. Photo Credit: Marion Wagaki

Taming a top killer of camels in the Horn

By Marion Wagaki

SCIENTISTS are combing the bushes in the Horn of Africa for clues on how to control a top killer of camels in the region.

In Kenya, the research is being conducted in Isiolo and Marsabit counties among five camel keeping communities of Somali, Borana, Turkana, Gabbra and Rendille.

The principal investigator on the research project, Dr Judith Chemuliti from the Kenya Agricultural and Livestock Organization (KALRO) Bio Technology Centre, said the disease control strategies developed from the project would be deployed in other camel keeping areas in Africa.

“One of the biggest challenges of camel keeping is trypanosomiasis spread by tsetse fly. This disease affects camels, reduces the amount of milk that the camel produces and causes death thus affecting livelihoods,” she said.

KALRO is partnering with IGAD Sheikh Technical Veterinary School (ISTVS) in Somaliland and the international development NGO Terra Nouva on the study seeking to improve productivity, incomes and food and nutrition security among camel keepers in the region.

The African Union and the European Union are funding the project to the tune of Ksh 100 million.

Camel trypanosomiasis, known as surra in the Somali dialects, is a major

problem for communities keeping the animal in the region, with its case fatality rate of nearly 100 percent if untreated.

Kenya is home to around three million camels, which are an important resource to many pastoralists inhabiting the environmentally harsh ecosystem in the Horn of Africa.

The animals can withstand droughts better than other livestock species and continue to produce milk, a key source of nutrition and income for the pastoralists.

The Director of Veterinary Services in Isiolo County, Dr Joseph Muriira, said the disease spread by tsetse flies was holding back efforts to promote camel production in the area.

Ninety-five percent of 451 cases of trypanosomiasis last year were reported in camels.

“Isiolo has around 148,000 camels distributed mainly across three-sub counties namely Merti, Garbatula and Isiolo Central. They are resilient and are relied upon by farmers when there is drought because they give milk even when other animals cannot,” he said.

Isiolo sells about 7,000 litres of milk to Nairobi on a daily basis.

Tests on blood samples collected in northern Kenya found that the camel surra and the vector were present in all areas and seasons at varying intensity, with the highest prevalence recorded among the camels in Rendille at 17 percent.

“The prevalence of surra was consistently higher among the Rendille followed by the Turkana, Gabbra and Borana communities in that order while camel herders had varying levels of knowledge about the disease, being higher among Somali, progressively declining among the Borana, Turkana, Gabbra and the Rendille respectively,” said Dr Chemuliti. Once the researchers find an infected animal they treat it on sight to control transmission to the healthy ones.

Dr Chemuliti noted the clinical services they are offering, in addition to data collection and analysis, are delivering results, with the disease prevalence having gone down significantly compared to six months ago.

“With correct treatment and the correct diagnostic tool in place we can be able to bring this disease down to levels that would be beneficial to farmers,” she said.

They are also training the local veterinary staff on how to screen, treat the animals and the advice to offer to the farmers.

“The camel has been a neglected species. But given that we have been able to carry out this research and given remedy, the camel keepers have seen an improvement in their animals. Their camels are now healthier because of the intervention through this project,” said Dr. Chemuliti.

“We will offer any technical support and continue with the training because any new staff coming into the counties will have access to this information that has been generated.”

Livestock keepers in the area have been using traditional methods to control the tsetse fly, including burning of dried dung that acted as a fly repellent, positioning camel enclosures in the direction of wind to blow away flies, moving animals to watering places in the middle of the day when fly activity was low, avoiding wet and muddy places where flies bred and treating wounds promptly before they became infected and attracted flies.

“Since I walk my camels to far places and for many days, I used to notice

them getting very thin and refuse to feed and that is what could tell me they were sick. Sometimes I could give herbal medicine but some never survive,” said Jackson Tololo.

He termed the research and training of extension officers timely, noting that it promises a lasting solution to the camel surra in the county.



With correct treatment and the correct diagnostic tool in place we can be able to bring this disease down to levels that would be beneficial to farmers



Dr. Judith Chemuliti testing the samples to identify animals that have been affected by the Surra disease. Photo Credit: Marion Wagaki



Teff grain harvested at the KALRO Kiboko Station. The grass is widely cultivated in Ethiopia for its edible seeds. Photo Credit: Marion Wagaki

Kenyan farmers to start growing Ethiopian super food crop Teff

By Marion Wagaki

TEFF, the Ethiopian and Eritrean grain, has become a popular health food in the global market.

Its flour is used to make the popular Injera, a fermented flatbread with a slightly spongy texture.

According to Dr Felister Makini, the Deputy Director General, Crops at the Kenya Agricultural and Livestock Research Organization (KALRO), Teff is something of a super food.

It is rich in iron, calcium, magnesium and zinc, and is gluten-free, making it ideal for patients who suffer from the gluten protein allergies.

A crop of all seasons, it has been observed to survive adverse weather where other grains like maize and sorghum fail, show tolerance to pests and diseases, and adapt well to various cropping systems.

With only 300ml of rain, the Teff crop can be ready for harvest in 60 days.

Being less prone to weevil attacks, it has a long shelf life even under traditional storage systems.

“This crop also matures in 45-60 days thus helps in building resilience among the farming communities especially in the ASALs [arid and semi-arid lands],” says Dr Makini about the newest crop on KALRO’s research list.

The Kenyan research body is piloting the production of Teff in Marsabit County under the Kenya Climate Smart Agriculture Project (KCSAP) with support from the government and the World Bank.

KALRO’s Katumani station has developed 10 high-yielding Teff varieties – Marsabit 1, Marsabit 2, Lusike white, KisTeff 1, AilaRed, KIM-1,



A Teff variety under research at KALRO. Photo Credit: Marion Wagaki

KIM-2, KisTeff 2, KIB-26 and KIB-27 – which are in the process of registration following validation trials in parts of northern Kenya.

The dwarf varieties among them are capable of withstanding lodging and are easy to handle.

KALRO is exploring mechanisation to reduce the costs of labour and production.

“Trials on mechanisation are currently ongoing at Katumani, Machakos and KALRO will also provide information on markets soon,” says Dr Makini, adding they are also researching on diversification of Teff food products to meet consumer tastes.

A number of extension officers, service providers and lead farmers from the county in Kenya’s arid north have been trained on the Teff value chain under the project.

Dr Makini says the yield on the Kenyan trial fields are still very low at 1 ton/ha on farmers’ fields compared to the world’s average of 3 tons/ha.

This, she explains, is due to, among others, unavailability of certified seeds, use of poor agronomic practices and inadequate post-harvest technologies.

Rachel Kisilu, the lead research scientist and a plant breeder at KALRO, says they expect to release the varieties later this year, having taken samples to the Kenya Plant Health Inspectorate Service (KEPHIS) for further performance tests.

“This is the first time we are going to release varieties for the farming communities in Kenya and through that we are going to have a good seed system where farmers can access quality seeds of the improved varieties so that they can increase their yields,” she says.

“We are sure that by the end of this year, we will have new varieties released to farmers and with good agronomic practices and the packaging of good planting technologies the seed rate for Teff will be 4kg to 6kg per acre,” Kisilu says.

While Injera, the fermented pancake, as the most popular Teff-based food, KALRO is developing a value addition manual with many more products.

“We have been able to come up with more than 20 value added food products from Teff. Starting with porridge cakes, and ugali which the communities even never thought they could get from Teff. So, we are going to publish soon a food value addition manual for Teff to help farmers and other stakeholders to come up with diverse food products from it,” Kisilu says.



We expect to release the varieties later this year, having taken samples to KEPHIS for further performance tests





Betty Musamali, a green grams grower, on her farm in Mulala, Makueni County. Photo Credit: Henry Owino

Orphan crops spare farmers losses in Kenya's arid region

By Henry Owino

FOR many years, farmers in Kenya's lower Ukambani region would be disadvantaged around the months of July and August because of crop failures.

But no amount of loss would stop them from continuing to grow maize and beans every other season, holding onto traditional beliefs about other crops.

"Most smallholder farmers insisted on growing maize and beans claiming it was impossible to avoid them," said Amos Ndunda, the Director of Agriculture in the Makueni county government.

"Our advice as county agriculture experts, has always been that they venture into other drought-tolerant or resilient crops with high nutritional value."

With the weather conditions becoming more unpredictable and the losses mounting, the farmers have in recent years began to listen to advise on climate-smart production and consumption systems from the county's extension officers.

Today, many smallholder farmers in the region are diversifying to sorghum, millet, pigeon peas and green grams.

Growing of sunflower and fruits such as mangoes, oranges, paw-paw, yellow passion fruits, and bananas on a commercial scale is also catching on.

"We realised that depending heavily on maize and beans using unsuitable techniques affected yields. After attending trainings, we are shifting from growing maize and beans alone to sorghum, millet, green grams and yellow passions among others which have higher nutritional value and fetch money as well," said Joseph Muinde, a farmer at Kaani in Kathiani Constituency.



Strawberry is among the profitable crops in Ukambani. Photo Credit: Henry Owino

Muinde grows the yellow passion fruit on his quarter acre farm and supplies the produce to Mulleys Supermarket, which processes juice and sells to customers.

“Demand for the produce is especially high during festive seasons like December and I have no regrets switching to the crop,” Muinde said.

“Before introduction of alternative cereals, we would end up miserable during Christmas. Reason being, we would not have surplus produce to sell for cheering up our families,” recalls.

Beth Munuvi belongs to the Yatta Farm Growers Community-Based Organisation in Machakos County, which aggregates produce from its 100 members and sells to wholesale buyers.

Before embracing green grams and pigeon peas, she, like many of her neighbours, shunned such crops arguing they were food for poor families.

“I must say, some crops were earmarked by residents as ‘orphan crops’ so none were grown or traded in local markets. Such cereals crops were reserved at homes for poor families’ consumption but currently, are main source of community income,” Ms Munuvi revealed.

Ruth Mutua, the Machakos Agriculture Executive, said the county government’s extension officers had intensified training farmers on organic agriculture, in addition to encouraging them to diversify their farming and produce larger quantities for the export market.

“We have realised it is possible to commercialise produce in this region. We believe the crops can withstand harsh weather and change the lives of Ukambani residents for the better,” Ms Mutua said.

Conventional farming, she said, is both costly to the farmers and the environment as it involves the use synthetic fertilisers, fungicides, pesticides, and herbicides to improve soil fertility, kill pests and protect crops from diseases.

“We are in a semi-arid region and organic farming helps maintain soil aeration by ensuring microbial breakdown of organic residue. It makes possible for crops to grow and for soils to be productive naturally without use of chemical fertilisers,” Ms Mutua said.

In addition to boosting their household incomes, the farmers and their families are also eating healthier, with most of the new crops they are growing having much higher nutritional value than maize.

Safeguarding Kenya's avocado export market



By Hosea Machuki

KENYA is the sixth-largest exporter of avocados in the world and the leading exporter in Africa. The country accounts for 81.6 percent of EAC avocado fruit exports. Most farmers grow the Hass variety, which has a longer shelf life, making it more desirable for the export market. Hass and Fuerte varieties are harvested and exported between March and November every year, while the Jumbo variety is exported in small quantities throughout the year. Kenyan avocado is grown organically and it is the most preferred in the world because of its taste.

The country imposes a two- to three-month close of season every year to prevent the export of immature fruits.

Avocado fruit export is among the leading foreign exchange-earners for Kenya. According to Horticulture Crops Directorate (HCD) 2017-2018 validated report, avocados accounted for 84.48 percent of Kenyan fruits exported by value – equivalent to approximately USD 108.39 million.



Packed and graded avocados ready for export. Photo Credit: FPEAK

Kenya produced 365,000 tons of avocado fruits in 2019, a 60 percent increase from 145,000 tons 10 years before.

The top importers of Kenya avocado fruits are the Netherlands, the United Arab Emirates, France, Spain, Russia, and the United Kingdom.

Many farmers in Kenya have diversified or shifted away from other commercial crops such as coffee and tea to the avocado, which has become lucrative in the export market.

Despite the Covid-19 pandemic's far-reaching economic consequences around the globe, the demand for avocados increased in the international market.

Kenya exported 87,000 tons of the fruit in 2021 from 72,000 tons in 2020, representing a 24 percent increase in volumes. However the value for avocado exports in 2021 stood at USD 133.15 million, a drop from USD 133.63 million in the same period in 2020.

Further, the value per kilo dropped by USD 0.37 from USD 1.90 in 2020 to USD 1.53 in 2021.

The lower prices fetched in the overseas markets was attributed to the export of immature fruits and poor post-harvest handling, underscoring the need for the growers and exporters to improve their practices to gain more value in the market.

To meet international quality standards avocados should be harvested when mature, intact, clean, free from external moisture, and free from pests or damage. The maturity of avocado for fresh fruit is determined by dry matter and oil contents. The recommended dry matter content for fresh fruits is between 21 percent and 25 percent and a minimum of 11.2 percent of oil content. In addition to confirming dry matter and oil contents, exporters must have modern and suitable post-harvest handling technology to be able to export quality fruits.

Avocado harvesting and post-harvest handling practices include using clean tools during harvesting, temporary storage of harvested fruits in appropriate collection sheds, and protecting harvested avocados from dust and other contaminants.

Personnel handling the fruits should have skills and knowledge in food safety. After harvesting, the fruits should be packed in clean crates and transported to pack-houses for grading in refrigerated trucks that are set at 16°C maximum.

Packed and graded avocado fruits are stuffed in reefer containers and transported from pack-houses to the port of Mombasa and shipped to various destinations across the globe in containers designed to maintain the temperature and humidity at a constant value during the whole transit time.

However, Kenya is at risk of losing this lucrative market due to export of immature avocados by some dealers. An estimated 70 percent of Kenyan avocados are produced by smallholder farmers who do not have the capacity to export the fruits themselves. Consequently, these farmers market their produce either through middlemen, who do not adhere to harvesting and post-harvest handling protocols for export companies. Sometimes, the brokers persuade farmers to harvest avocado fruits before they are ready for harvesting just to gain the margins.

These middlemen transport harvested avocado fruits to pack-houses in small open trucks and pick-up trucks, exposing the fruit to the sun and extreme temperatures thereby reducing the fruit quality.

This reduces the desire and preference for Kenyan avocado fruit as compared to avocados originating from Kenya's competitors in the business; Mexico, Peru, and Colombia.

Therefore, there is a clarion call to all the players in this important business to work together and ensure that only mature and good quality avocados are harvested and exported to safeguard and expand the share of Kenyan avocados in the international market.

Hosea Machuki, Chief Executive Officer, Fresh Produce Exporters Association of Kenya
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These middlemen transport harvested avocado fruits to pack-houses in small open trucks and pick-up trucks, exposing the fruit to the sun and extreme temperatures thereby reducing the fruit quality.



The maturity of avocado for fresh fruit is determined by dry matter and oil contents.

Photo Credit: ASK

*Jane Njeri Mwangi inspects a tomato plant on her farm in Rombo area, Kajiado County.
Photo Credit: Marion Wagaki*

Researchers' day out with tomato farmers

By Marion Wagaki

TOMATO farmers have been urged to adopt good agricultural practices to ensure quality and safe produce for the consumers.

Kenya Agricultural Livestock Research Organization (KALRO) Director-General Eliud Kireger said that excess use of pesticides without observing the post-harvest intervals was causing high levels of chemical residues to accumulate in tomatoes, making the produce potentially harmful to consumers.

"The high incidences of chronic diseases being experienced in the country are partly contributed by the excessive use of agro-chemicals thus it is important for farmers to adopt the safe tomato production practices," Dr Kireger said.

He spoke during a farmers' field day organised under the Kenya Climate Smart Agriculture Project (KCSAP) at Rombo in Kajiado County to educate farmers on the availability of tomato varieties, and demonstrate appropriate agronomic practices such as pest and disease control, safe use of agro-chemicals, proper harvesting, post-harvest handling, value addition and marketing.

Tomato is the second-most important vegetable consumed in Kenya, with its fast-growing market edging it towards a vital cash crop.

Tomato production is estimated to contribute more than Ksh15 billion annually to the country's economy,

supplying income and income to the producers and their households.

The major tomato-producing counties in Kenya are Kajiado, Kirinyaga, Taita-Taveta, Laikipia, Bungoma, and Trans-Nzoia.

The production volume of tomato in Kenya currently stands at 574,458 metric tons earning the country about Ksh20 billion from an area of 28,263 hectares.

Researchers have developed several improved tomato cultivars that are high-yielding and resistant to pests, among other attributes, to enhance production.

But most smallholder farmers lack information on the right varieties for specific production systems and the best agronomic practices in specific agro-ecological zones, especially in the arid and semi-arid areas.

Poor post-harvest handling, limited value addition, poorly organised urban and rural markets and poor infrastructure also cause price fluctuations and losses.

“The average yield of tomato in Kenya stands at 15 tons per acre against a potential of 30-35 tons and this yield gap is as a result of various factors including biotic and abiotic stresses which include pest and diseases causing yield losses of up to 100 percent and this will require application of agrochemicals as the main control strategy,” Dr Kireger said.

Moses Murunya, the Chief Officer Agriculture and Fisheries in Kajiado, said tomato farmers in the area also face challenges accessing seeds and markets.

“Our main market is Mombasa and the county government is trying to address the challenge of access to markets through the establishment of a factory that is being built by the Ewaso Nyiro Development Authority,” he said.



*Jane Njeri harvests tomatoes on a farm in Rombo area in Kajiado County.
Photo Credit: Marion Wagaki*

Murunya said that once complete, the factory will address the issue of glut due to excess production or lack of immediate market.

“Value addition is the greatest solution to the glut and excess production and produce that does not go anywhere due to transport and exit point challenges,” he said.

Jane Njeri Mwangi from Rombo area and who moved from Kiambu County 10 years ago to farm tomatoes termed the technologies being brought by KALRO timely as most of them have been suffering from lack of good seeds and pesticides.



Value addition is the greatest solution to the glut and excess production and produce that does not go anywhere due to transport and exit point challenges



*KALRO staff explain the qualities of various tomato varieties suited to the area.
Photo Credit: Marion Wagaki*



*A farmer on a millet plantation in Senegal.
Photo Credit: Agrecol Afrique/ Groundswell International*

New report roots for agroecology in building food, climate resilience

By Murimi Gitari

A NEW report released by the Global Alliance for the Future of Food shows that agroecology can help build sustainable food systems and repair the relationship between people and nature, restoring biodiversity in Africa.

The report, highlighting the successes of agroecology in Kenya, Senegal and Uganda, seeks to demonstrate how agroecology, regenerative agricultural practices and indigenous food ways are transforming the food systems of Africa and the world.

However, the authors argue that evidence biases and narrow thinking hold back food security and climate action.

The report, *“The Politics of Knowledge: Will we act on the evidence for agroecology, regenerative approaches, and indigenous food ways?”*, asserts that the industrialised food system is one of the greatest stressors to the health of the planet, causing 80% of biodiversity loss and generating almost a quarter of global greenhouse gas emissions.

It shows that the world needs to change ways on how to produce, distribute, consume and dispose food

that will eventually see the reduction the greenhouse emissions.

Taking a food systems approach builds climate resilience and results in a diversity of context-specific solutions for food production, distribution, consumption, and waste.

With food systems rarely prioritized in climate policies, the authors of the report presents different types of evidence – such as lived experiences, traditional knowledge, scientific analysis, oral histories, and peer-reviewed articles – to show how together they can support the performance, scaling-up and economic viability of agroecology.



Women carrying firewood after pruning on a farm.

Photo Credit: Center for Indigenous Knowledge and Organizational Development (CIKOD) / Groundswell International

In their findings, the authors found traditional agricultural indicators such as yield per hectare or scalability being insufficient to prove the virtuous capacity of agroecology to feed and nourish humanity. This is through sustainable food systems based on equity, justice and reciprocity, not just large-scale food production according to the report.

They also noted that agricultural biodiversity is, a centrepiece of agroecology, regenerative approaches, and Indigenous food ways, and this diversity is strongly linked to health and nutrition. ENDA Pronat in Senegal stated that farmers participating in their programs show that agroecology can be as productive as conventional agriculture once soil fertility is restored.

Research changing, education and innovation systems, especially short-term approaches, the prioritization of “cheap” food and the design of measures that are insufficient due to their narrow focus are also some of the key elements toward transformation of food systems according to the report.

Speaking at the launch of the report, Lauren Baker, Senior Director of Programs at the Global Alliance for the Future of Food, said that agroecology, regenerative approaches, and Indigenous food ways are systemic solutions that are already delivering positive health and nutrition outcomes, a sense of purpose and dignity, social justice and climate action, across Africa and for millions of people worldwide.

A recent study of the Soil, Food and Healthy Communities (SFHC) program in Malawi concluded that the agro ecological practices used by farmers have increased household food security and nutrition.

“With this new material in hand, donors and researchers alike will be able to leverage the transformative power of agroecology, Indigenous and regenerative practices and accelerate change at a time when it is needed more than ever.”

The report further suggests there is a unique opportunity for public and private donors and funders to collaborate and promote an independent multidisciplinary research and action program, focused

on political and social justice and food sovereignty.

Additionally revaluing cultural and ecological knowledge enhances community well-being as it is the case in Kenya where pastoral systems are regenerating grassland with the government securing customary land tenure rights to enhance sustainable natural resource management.

Seventy authors from 17 teams and 15 countries participated in the preparation of the report led by the Global Alliance for the Future of Food which is a strategic alliance of philanthropic foundations working together and with others to transform the world's food systems today and for future generations.

The teams and countries that participated represented the geographic, institutional, sectoral, gender and racial diversity of the planet. They include organizations and networks of practitioners, researchers, farmers and food providers, indigenous peoples and foundations working in the food systems sector at national and international levels.

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