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# African Farming and Food Processing

January/February 2024

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Bean defects in green coffee

## Livestock
Restoring mineral balance in cattle feed

## Aquaculture
Combatting shrimp diseases with RNA-based solutions

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Dr. Yuval Gilad, CEO and co-founder of FreezeM talks about the company's new cutting-edge technology centred on the black soldier fly.

UAV-based hyperspectral imaging has the ability to capture highspatial-resolution data at a lower cost.


African Farming and Food Processing

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## Farming Calendar 2024

### JANUARY

| | | |
|---|---|---|
| 23-26 | **IPM ESSEN**<br>www.ipm-essen.de/world-trade-fair/ | ESSEN |

### FEBRUARY

| | | |
|---|---|---|
| 19-20 | **Africa Agri Expo**<br>www.africa-agriexpo.com | NAIROBI |

### MARCH

| | | |
|---|---|---|
| 19-21 | **Agritech West Africa**<br>www.agritechwestafrica.com | ACCRA |
| 26-28 | **agrofood Nigeria**<br>www.agrofood-nigeria.com | LAGOS |

### APRIL

| | | |
|---|---|---|
| 18-20 | **Agritech Expo Zambia**<br>www.agritech-expo.com | CHISAMBA |

### MAY

| | | |
|---|---|---|
| 08-10 | **FierAvicola Africa & Mediterranean Poultry Forum & B2B**<br>www.fieravicola.com | RIMINI |
| 16-18 | **agrofood Ethiopia**<br>www.agrofood-ethiopia.com | ADDIS ABABA |

### OCTOBER

| | | |
|---|---|---|
| 02-03 | **VIV Africa 2024**<br>www.vivafrica.nl | KIGALI |
| 08-10 | **agrofood West Africa**<br>www.agrofood-westafrica.com | ABIDJAN |

*Readers should verify dates and location with sponsoring organisations, as this information is sometimes subject to change.*

## IPM ESSEN to celebrate 40th anniversary

IPM ESSEN will be the meeting place for the green sector.

Image Credit: IPM ESSEN

LEADING HORTICULTURAL TRADE fai, IPM ESSEN, is scheduled to take place for the 40th time from 23-26 January 2024 in Essen, Germany.

The event will feature more than 1,400 exhibitors from around 50 nations showcasing their innovations in the exhibition areas of plants, technology, forestry and garden. The special anniversary edition under the motto 'Our heart beats green' has numerous programme highlights in store for the international trade visitors, including several forums, congresses, competitions, tours, live shows, special shows and other side events focussing on current topics in the green industry. These will provide new inspiration for the upcoming business year, while also offering unique networking opportunities.

According to organisers, no other fair offers so much plant diversity alongside so many innovations. At this year's edition, the defining themes will be around climate change and sustainability.

*For more information about the programme and tickets, visit: https://www.ipm-essen.de/world-trade-fair/*

## Reveal the next big business opportunity at Africa Agri Expo

UNDER THE PATRONAGE of the Kenyan Ministry of Agriculture & Livestock Development, Africa Agri Expo 2024 will seek to unleash the potential of African agribusiness.

The conference will be held from 19-20 February at the Sarit Expo Centre in Nairobi, Kenya, and will serve as an opportunity for global agribusinesses and associated professionals to expand into and support the growth of Africa's burgeoning sector (expected to reach US$1 trillion by 2030, according to show organisers).

In Nairobi, attendees will have the opportunity to enhance their brand visibility by making use of a unique space to exhibit their expertise to the people who matter most, unlocking new business opportunities. Government officials, policymakers, business leaders, industry think tanks, suppliers and buyers will all be represented, offering an unmissable chance to network and discuss important industry issues while gauging the market reaction to the presented offering.

The two-day conference will also provide industry insights through panel discussions, competitive analysis and the expertise of all those in attendance.

Image Credit: Adobe Stock

Africa Agri Expo 2024 will feature the latest technologies and solutions for agriculture.

"Many people have underrated the production capacity of Africa and the opportunities it holds, but now people have come to witness through this exhibition the potential of it," commented Philip Kello Harsama, Principal Secretary – State Department for Crop Development, Kenya Ministry of Agriculture & Livestock Development. "Over time, Africa is going through a technological change, mechanising agriculture, digitising information on agriculture, and also trying to access various inputs ensuring all kinds of technologies are utilised. Africa Agri Expo has come to take place at the right time."

It is expected that 5,000 visitors will arrive in Nairobi for the show, including 500+ senior conference attendees. Moreover, over 1,000 companies will be represented including the 100+ exhibitors and sponsors. All of these will be act on behalf of 35 countries from the African continent and beyond.

*Learn more about the show and the opportunities on offer at: https://africa-agriexpo.com/*

## The entire West Africa agriculture industry under one roof

THE AGRITECH WEST Africa with Food & Beverage and FoodPack Tech Ghana exhibition will be held in the Accra International Conference Center, Ghana, from 19-21 March.

The show, which will act as the meeting point for the global technology providers to meet the West African agriculture business community, will welcome more than 100 exhibitors and 5,000 professional visitors from India, South Africa, Turkey, Nigeria, Ghana, UK, Italy, France, and many more. Attendees will represent the full range of product segments relating to the agriculture sector including agrochemicals, agriculture technology, irrigation, biofeeds, food processing and packaging technologies, food innovation, beverage items and beyond.

This year's edition will build on 2023 where 3,300 visitors gathered to learn and conduct business, enjoying the products and services on offer from the 97 exhibitors present. The show received significant media coverage and was subject to high praise from participators: "The exhibition has been really amazing," remarked Morero Moloi, CEO of MC More International. "We made contact with a lot of permanent people in the retail, hotel and agriculture sectors and these are key components to ask for anyone to come to Ghana to grow the business."

The expo is organised under the auspices of the Ministry of Food & Agriculture of Ghana and enjoys the support of the Ministry of Trade & Industry of Ghana alongside the West African Chamber of Agriculture, Croplife Ghana, Ghana Union of Traders Association, Food & Beverage Association of Ghana, Federation of Farmer Organisation Network of Ghana, Federation of Association of Ghanaian Exporters Organisation, Guzakuza and several regional farmers' cooperatives and groups.

With a growing awareness that rising food demand in West Africa will require innovation and mechanisation in agriculture, Agritech West Africa will allow visitors to learn more about the modern technologies helping to shape best practices and enhance efficiency. Moreover, a dedicated B2B matchmaking and prefixed meeting programme will ensure buyers and partners are able to connect with sellers in a profitable business and investment climate.

Image Credit: Agritech West Africa

The conference will feature live demonstrations of technologies.

*Discover more at: https://www.agritechwestafrica.com/*

## Stay ahead of the competition at AgriTech Expo Zambia

FROM 18-20 APRIL at the GART Research Centre in Chisamba, Zambia, more than 19,400 visitors will be descending on the AgriTech Expo Zambia, one of the largest and most professionally attended agri-trade fairs in sub-Saharan Africa.

The attendees will have unique access to more than 150 exhibiting companies who will be present and presenting their range of innovations and services across a 70,000+ sq m expo space. These will be housed among the various featured zones of the 2024 edition, including crop trials; the indoor expo; a machinery & equipment demo area; international pavilions; the SME zone; an energy park; the irrigation zone; a livestock zone & auction; the drone zone; and more.

The conference aims at shaping the future of agriculture for Zambia and neighbouring countries. As such, it serves as an opportunity for all suppliers to the agriculture value chain to share ideas, innovations and solutions for current and future challenges. Those in attendance will have the chance to discover new solutions to this end while also being able to network with government and industry professionals while learning from training workshops, live machinery demos and more.

According to the organisers, participants will be able to meet representatives from the full range of the global and African agriculture industry such as small scale and emerging farmers; large-scale farmers; local & international investors; distributors & agents; commodity dealers & traders; trade associations; local & international industry experts & suppliers; government officials & ministers; consultants; and more.

Image Credit: Adobe Stock

International products and services will be on display at AgriTech Expo Zambia.

*Discover more about the award winning conference at: https://agritech-expo.com/*

## Milling and bakery to be the spotlight of agrofood Nigeria 2024

FOLLOWING THE SUCCESS of the eighth agrofood Nigeria last year, the organisers are back this time for the ninth edition in March 2024 to push the show's benchmark further.

Nigeria with its 224m inhabitants (2023) is the largest foodstuff market in Africa. The population is growing by an additional 4 mn people annually, to reach 411 mn by 2050. To put the Nigerian agricultural sector on a growth path, measures are needed to produce enough fresh, high-quality food. To meet this challenge successfully, Nigeria depends on the support of know-how and agricultural & animal husbandry technology from abroad. (FMARD).

The enormous population growth demands high sustainable investments in Nigeria's food industry.

With food imports worth US$7.375bn in 2021 (WTO), Nigeria remains one of Africa's biggest food importers – despite high investments in local food production. The retail sector is developing rapidly and so is e-commerce (Jumia, Konga).

Starting from 26 to 28 March, the spotlight of this year's show will be 'Milling and Bakery', featuring prominent exhibitors from the milling and bakery sector, engaging workshops and live bakery sessions.

Embracing the wave of innovation, many bakeries have harnessed the power of automation and technology in their production processes. This transformative shift has not only enhanced efficiency and cost-effectiveness but also enabled the creation of an extensive range of delectable products.

The exhibition will see ctive participation of key ministers from the new government, both at the Federal and Lagos State levels.

The 2024 MFI Awards will be held on 26 March, co-sponsored by the MFI Micronutrient Fortification Index and powered by

Image Credit: Adobe Stock

Participants can expect engaging workshops and live bakery sessions.

TechnoServe via a Bill & Melinda Gates Foundation sponsored initiative, the Technical Assistance Accelerator Programme.

Exhibitors can also expect key learnings from 20+ sessions with 70+ speakers in the top level three-day conference.

"The Nigerian market is the biggest African market and they love wine, especially red wine (Cabernet, Sauvigon, Shiraz, Merlot and sparkling wine just to name a few!). I believe there is room for my brand to grow and I have a market share in the economy," said one exhibitor, Simphiwe Xinwa, head international trade – Shumayela Holdings (Trevines Wines).

Another exhibitor, Preecha Chaicharncheep, export manager – Tipco, said, "Nigeria is a huge country with a huge population. A great opportunity for us to sell our products. We have already seen many customers interested in our products here at agrofood Nigeria."

## FierAvicola Poultry Forum back this year with spotlight on highly topical issues

**THE THREE-DAY FIERAVICOLA Poultry Forum & B2B, a biennial international event, organised by FierAvicola, is back featuring conferences, business meetings and scientific sessions. The event will be held at Rimini Expo Centre - Via Emilia, 155 – 47921 Rimini – Italy from 8-10 May 2024, 9.30 am to 6.00 pm. More than 1,000 managers and specialists in the poultry industry are expected to attend the event.**

**The forum will be an opportunity for sector professionals and Italian and international companies operating in the poultry industry to get together and exchange experiences. The topics covered will include highly topical issues such as technologies that promote animal welfare, the digitalisation of the poultry supply chain, and new frontiers in animal nutrition.**

**Couple of years ago, a family-run quality forage business called Gruppo Carli participated in the event with a special interest on the themes 'dialogue with institutions' and 'animal welfare and sustainability'. The company boasts a locally produced offering of a complete agricultural raw materials and products range for the poultry sector. Some of the other themes that year included**

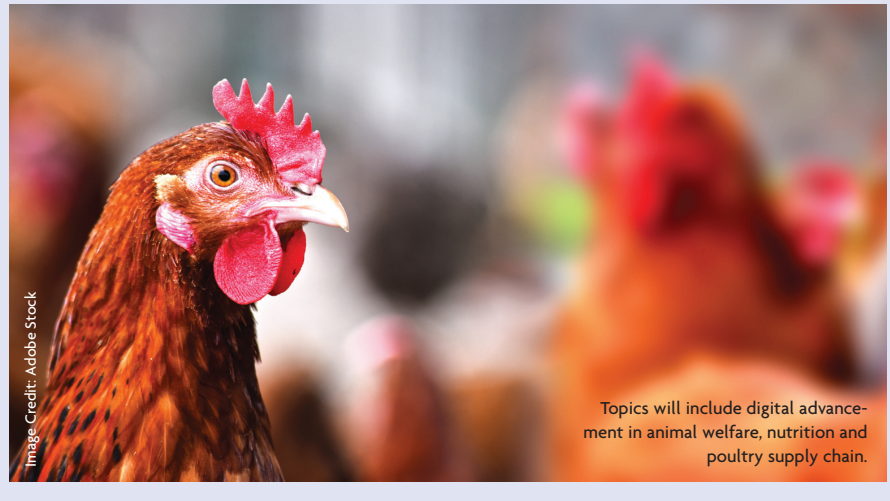

Image Credit: Adobe Stock

Topics will include digital advancement in animal welfare, nutrition and poultry supply chain.

**'production and consumption analysis', 'international market forecasts', 'research and innovation', to name a few.**

**At FierAvicola 2022, the company showcased their straw bedding range, which ensures maximum comfort to animals while considering environmental aspects. Their beddings are made entirely of straw that is sourced solely from cereals grown in Italy, mechanically processed without additives. Besides, these can be recycled as fertilisers on the fields once its primary purpose is served.**

**Another company named CHIMERA participated with a focus on sustainable management of chicken manure, whereby they highlighted from the perspective of a circular economy as to how a waste by-product can be used as a fertiliser.**

**The poultry industry is ever-evolving and interested participants can look forward to a dynamic experience at the upcoming FierAvicola Forum.**

FreezeM's CEO and co-founder, Dr Yuval Gidal talks about the company's new ultramodern technology centred on the black soldier fly.

# Exclusive interview with CEO and co-founder of FreezeM, Dr Yuval Gilad

IN AN EXCLUSIVE interview with African Farming, CEO and co-founder of FreezeM, Dr Yuval Gilad sheds light on their new cutting-edge technology centred on the black soldier fly (BSF), while also highlighting the company's commitment to sustainability.

**African Farming (AF): Can you provide some insight into the technology used by FreezeM for BSF breeding and rearing?**
**Dr Yuval Gilad (YG):** FreezeM's innovative technology, coupled with our expert entomology team, streamlines the production of insect-based protein through controlled and consistent Black Soldier Fly (BSF) breeding and colony supervision. At our EU flagship factory, we provide ready-to-use 'life-suspended' neonates known as PauseM, allowing for the separation of biologically complex breeding from the rearing and processing units. The PauseM technology facilitates the safe transportation of BSF neonates over long distances and enhances stock and process standardisation, addressing current shortcomings in production methodologies. Our customers simply need to retrieve PauseM units from their on-site stock based on their production needs, activate the neonates through a straightforward procedure, and rear them using local feedstock until they are ready to harvest.

**AF: How does BSF contribute to environmental sustainability?**
**YG:** FreezeM champions a circular economy, transforming side streams from agriculture and food industries into sustainable feed and fertilizers through the synergy of nature's superpowers and cutting-edge technology. Additionally, leveraging the Black Soldier Fly (BSF) for bioconversion helps mitigate current carbon and methane emissions resulting from the incineration or landfilling of organic waste and agricultural residues. Lastly, by entrusting the breeding process to FreezeM, our customers can design and position their rearing facilities in close proximity to waste streams, optimising logistics and energy resources.

**AF: Could you provide a brief about the project and the role it plays in waste management?**
**YG:** FreezeM stands as a market leader in Black Soldier Fly (BSF) breeding, driving increased waste management efficiency through patented 'life-suspended', high-performing BSF neonates on a large scale. Our tailored, ready-to-use neonates offer a cost-effective solution by employing a 14-day life-cycle suspension. This approach enhances process efficiency and reduces operational costs, enabling swift market entry for waste management companies. They gain increased scalability potential by being able to order and stock any volume of BSF larvae neonates. Furthermore, it opens avenues for new revenue streams for waste management firms through larvae processing, yielding high-quality protein for animal feed, oleochemicals, and organic fertilisers.

**"BSF helps mitigate current carbon and methane emissions."**

**AF: What makes FreezeM unique from its competitors?**
**YG:** FreezeM is the only company that enables the production of insect protein at scale through outsourced breeding, eliminating the need for setting up a reproduction module at each factory. This achievement is solely possible due to our innovative technologies that are unmatched by any other players in the market. Our approach allows any insect farm, regardless of size, to access stable and consistent production methods and effectively utilise waste streams. This enhances control and efficiency in a sector where current insect farmers are limited in scale due to the necessity of developing costly and complex entomology and reproduction units to manage the eggs and larvae required for sustaining production.

Image Credit: FreezeM

Dr Yuval Gilad, CEO and co-founder of FreezeM.

**AF: What are your future plans to scale up production?**
**YG:** We are expanding the overall production capacity of our factories and will have two breeding hubs operating in 2024, located in Israel and Europe. This expansion will grant us the ability to support multiple industrial BSF protein production sites and demonstrate our model at scale. These breeding hubs will deliver PauseM globally on a bi-weekly basis.

## Kenya's Egerton Univeristy tackles antimicrobial resistance head-on with innovative test

WHILE SOLUTIONS FOR testing antimicrobial resistance currently exist on the market, the cost of using them remains far beyond the means of small-scale farmers who constitute around 80% of Kenya's milk producers.

Kenya's vast dairy sector offers strong opportunities to combat antimicrobial resistance, however the industry faces a plethora of challenges, namely the dominance of small-scale, often unregulated producers alongside the existence of antibiotic residue within milk caused by some animal husbandry practices.

The innovative test will help smallholder dairy farmers detect antibiotic resistance in milk.

Image Credit: Adobe Stock

Teresia Ndung'u, director of Livestock Production in Nyandarua County and a doctoral student at Kenya's Egerton University, is among the Kenyans tackling this issue head-on by devising solutions which help bolster food safety in Kenya as well as East Africa as a whole.

Ndung'u has previously involved herself with the 'Quality Based Milk Payment Systems' project where she came across a reagent that was able to detect whether microorganisms were resistant. After comparing test samples from different cattle, she observed the reagent was successful in detecting antibiotic resistance, however she noted that the cost of testing was very high, emphasising the importance of developing a cheaper solution and simpler test for small-scale farmers.

Ndung'u is now looking at scaling up her smallholder-based solution in order for it to become a mass market player and be a key part of the overall drive to help improve food safety. The revolutionary work has been made possible by a scholarship supported by funding from the World Bank International Development Association (IDA) for the Centre of Excellence in Sustainable Agriculture and Agribusiness Management based at Egerton University.

## Senegal supports cashew export expansion with sustainable packaging training

THE INTERNATIONAL TRADE Centre (ITC) is supporting small cashew processors and brands across Senegal in order to reach new markets and grow their operations.

Established and new brands in Senegal are eager to turn raw cashews into higher value products to export as West Africa is the global leader for cashew exportation. Cashew jams, juices, bars and flour are just a few of the products appearing within the market.

ITC's Alliance for Action sustainable agribusiness initiative organised a training course on product packaging for 30 participants from 11 small businesses. Under the Netherlands Trust Fund V (NTFV) programme, ITC is working with cashew businesses in Senegal to grow their operations sustainably, improve their competitiveness and reach new markets, and improved packaging will aid with this. The NTFV is based on a partnership between the Ministry of Foreign Affairs of the Netherlands and the International Trade Centre to support MSMEs in the digital technologies and agribusiness sectors.

Image Credit: Adobe Stock

Key brands in Senegal are eager to export to international markets with the aid of sustainable packaging.

In line with consumer trends that favour environmental consciousness, a special focus of the training was placed on sustainable packaging, allowing brands to tap into the EU and other international markets.

Tailored coaching was also delivered to eight companies from the NTFV cohort with factories in and around Dakar and in Casamance, Senegal's largest cashew-producing region.

Cashew apple juice company Casadeliz is currently working on a new packaging and marketing strategy that is more adapted to the UK market by utilising cans and tetra packs.

Fatou Mbod, manager of the Casamance Verte GIE, commented, "To promote the 'made in Senegal' model, we need quality packaging because at the international level, the competition is not only on product quality but also on packaging."

Mireille Dovonou, sales and marketing assistant at Lysa & Co, said, "We understood that packaging must be aligned with the company's vision and mission. Packaging must be adapted to the customer's needs, which can be identified through surveys and test trials before validating and commissioning the final packaging."

The ITC will soon replicate this strategy for cocoa in Ghana and coffee in Ethiopia.

## AfDB to research grain quality grading and certification in Ghana

TO IMPROVE THE growth of Ghana's cereal value chain, the African Development Bank has started a three-year research and outreach programme.The bank's Microeconomics, Institutional and Development Impact Division is working with the University of Ghana's School of Agriculture to implement the Grain Quality Grading and Certification project.

The project investigates if appropriate grain grading and certification in sub-Saharan African nations could be used to encourage investments in improving grain quality to raise local food consumption of safe and healthful food and create prospects for grain exports to international markets.

In order to hasten the creation of commodity exchange and to manage and nurture national and regional grain transactions in the new era of the African Continental Free Trade Area (AfCFTA), regulations, quality grades and standards, and certification must be established in Africa's grain markets.

The purpose of the study is to determine whether or not smallholder and market-level grain quality grading and certification greatly boosts investment in grain quality enhancement, facilitates entry to upscale markets, and drives up the price of premium grains. Additionally, it is determining whether there is a viable business model for independent third parties to provide grain certification and grading.

The project has received financial support from the Korea-Africa Economic Cooperation Fund (KOAFEC). The project team anticipates collaborating with the Ghana Standards Authority (GSA), the Ghana Commodities Exchange (GCX), the Ghana Grains Council (GGC), and other institutions in the grain value chain in Ghana. The research team will build capacity in Ghana through extensive outreach aimed at a wide range of stakeholders in the grain value chain.

Africa loses up to US$670mn worth of trade annually due to aflatoxin contamination ,alone, said Dr Francis H. Kemeze, the project lead.

Image Credit: Adobe Stock

## Niger authorities use satellites to prevent food insecurity

THE SAHEL ADAPTIVE social protection programme, funded by the International Development Association (IDA), has helped more than 100,000 families in the region. They benefited from emergency monthly transfers to compensate for the poor harvests that affected the whole country. The government, with the support of the World Bank and other partners, used early warning satellite data to identify drought-affected areas and intervene early with unconditional cash transfers.

When faced with food shortages and climate shocks, social protection programmes are frequently the first to respond. However, the proactive strategy is what's innovative in this instance. Using satellite early warning data, the government is identifying communities affected by the drought and taking immediate action with unconditional cash transfers, with assistance from the World Bank and other partners.

Throughout the past 20 years, Niger, which is at the centre of the Sahel, has seen numerous droughts that have increased food insecurity. It is the first country in the region to build a trigger-based adaptive safety net for drought response to provide early help to impacted households.

More than 10,000 families have benefitted from the scheme.

Image Credit: Adobe Stock

According to the World bank, this is helping poorer families.

Adiza Saydi, a mother of five children who invested in market gardening, told World Bank, "Right now, climate change is affecting our lives in so many ways. When rain isn't plentiful in the rainy season, we have to be very patient."

Adiza and other families also benefited from additional training and seed funding to help them increase their savings and invest in income-generating activities during the off season.

"With what I save, I have enough to buy food to eat," she said. "I've been able to buy a motor pump and it does a good job of watering the crops. It changed our life".

The world's developing nations can apply for grants and concessional loans from the International Development Association (IDA). The IDA is based in Washington, D.C., in the United States, and it is a part of the World Bank Group.

The association seeks to offer reasonably priced development financing to nations whose credit risk is too high for them to be able to borrow money on the open market.

Discover the key role of methionine in poultry nutrition and the exciting steps taken towards sustainability. This exploration is changing the game in poultry farming for a healthier, eco-friendly future.

# Methionine: Poultry nutrition's sustainable revolution

ENSURING OPTIMAL NUTRITION in poultry farming is not only crucial for growth and production; moreover, it is also increasingly aligned with sustainable practices. Among the essential amino acids vital for poultry growth, methionine stands out as a primary limiting factor in poultry feed. This article delves into the multifaceted role of methionine in poultry nutrition, exploring its impact on growth, health, and environmental sustainability.

Methionine, classified as an essential amino acid, plays a pivotal role in facilitating optimal protein synthesis and providing physiological benefits such as acting as an antioxidant, thereby reducing oxidative stress. The choice of methionine isoforms is crucial, with L-methionine proving superior in bioavailability compared to DL-methionine or analogs. This is particularly significant because the reduction of crude protein levels in animal diets is gaining prominence to mitigate nitrogen emissions in livestock farming. This aligns with global concerns about environmental impact and sustainable practices in the poultry sector.

In the midst of advancing poultry nutrition and sustainability, two critical questions emerge: How can the poultry industry effectively address methionine deficiencies during the crucial early growth stages of laying hens?

**The future of food production hinges on developing new tools and technology to help farmers sustainably meet their production goals," emphasised Dr Tom Greene, vice-president, Biotechnology, Corteva Agriscience.**

Image Credit: USDA.gov

New, methionine-rich corn developed.

Research underscores the far-reaching consequences of methionine deficiency during the initial six weeks on the long-term well-being and performance of commercial laying hens. Despite a regular diet from weeks 7 to 24, the negative impact persisted, emphasising the necessity for comprehensive nutritional strategies in poultry farming to ensure lasting benefits. Further investigations into methionine isoforms revealed their influence on the growth and intestinal health of broilers, especially when subjected to both methionine deficiency and Eimeria infection. The study highlighted the critical role of methionine supplementation in addressing challenges like Eimeria infection, with L-methionine demonstrating favorable effects in specific growth phases. These findings contribute valuable insights for optimising broiler nutrition strategies in the face of common poultry farming challenges.

Addressing the need for elevated methionine levels in organic poultry, scientists have developed experimental lines of field corn with enhanced methionine concentrations. This breakthrough, achieved through conventional breeding methods, holds significance for organic poultry producers by potentially reducing the need for synthetic supplementation in organic poultry diets. The new corn lines offer a cost-effective and sustainable solution for the industry, aligning with the growing emphasis on organic and sustainable practices.

In another collaborative effort, Corteva Inc. and Bunge aim to advance soybean varieties for animal feed, particularly in poultry, swine, and aqua feed. The collaboration targets soybean varieties with increased protein content, optimised amino acid profiles, and reduced anti-nutritional factors. This joint venture leverages Corteva's expertise in germplasm, gene editing, and traits discovery. It offers a potential new value stream for soybean farmers and sustainable options for feed compounders. The collaboration seeks to support sustainable innovation while enhancing animal performance and creating greater value opportunities for farmers.

"The future of food production hinges on developing new tools and technology to help farmers sustainably meet their production goals," remarked Dr Tom Greene, vice-president, Biotechnology, Corteva Agriscience. "Our collaboration with Bunge aligns with our commitment to sustainable innovation while supporting improved animal performance and greater value opportunities for livestock and row crop farmers. Our next step is to bring the higher-

protein, enhanced-amino acid profile into a commercial soybean variety that offers the best value for soybean farmers."

"As a global leader in oilseed processing, we are uniquely positioned to leverage upstream and downstream partnerships with leading and innovative industry players to unlock value for our farmers and customers. We are very pleased by the early results of this collaboration with Corteva," said Kaleb Belzer, vice-president of Protein Ingredients at Bunge.

**With a US$500,000 grant from the National Science Foundation's Future Manufacturing initiative, the team aims to use edible microalgae, a nutrient-dense superfood, to organically produce methionine.**

Looking ahead, a team of researchers at the University of Connecticut, led by Mingyu Qiao, is developing a cost-effective and environmentally friendly method to produce the essential amino acid methionine for poultry feed. With a US$500,000 grant from the National Science Foundation's Future Manufacturing initiative, the team aims to use edible microalgae, a nutrient-dense superfood, to organically produce methionine. This innovative biomanufacturing technique combines the advantages of microorganisms and plants, allowing for quick and sustainable methionine production. The proposed method has the potential to offer an affordable organic alternative to traditional petrochemically produced supplements, addressing a crucial need in the poultry industry. The project also includes developing a prototype photobioreactor and an Artificial Intelligence model to optimise production. The grant will facilitate data collection and prototype development for future grant applications. Additionally, workshops for underrepresented students aim to prepare them for the biomanufacturing workforce, contributing to a more equitable community.

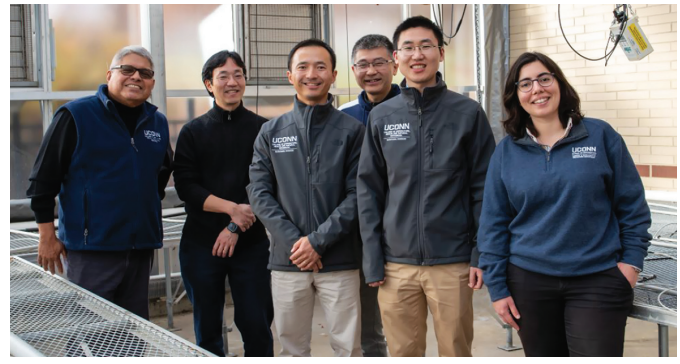

Image Credit: University of Connecticut

The interdisciplinary research team will develop a novel biomanufacturing technology to use microalgae to produce an essential amino acid for poultry feed.

"In order to develop a future biomanufacturing industry in this area you need to have workforce," Qiao commented. "Hopefully we can use this opportunity to make a more equitable society or community. Because in the end it will benefit society as a whole."

In conclusion, the diverse aspects of methionine in poultry nutrition, from addressing deficiencies to exploring sustainable production methods, highlight the industry's commitment to balancing growth, health, and environmental considerations. These advancements underscore the ongoing efforts to redefine poultry farming practices for a more sustainable and resilient future.

To improve poultry productivity, it is important to ensure that chickens are raised in the most humane way possible.

# Cage-free poultry systems gain momentum in Sub-Saharan Africa

OVER THE PAST decade, rapid urbanisation and growth of the middle class have contributed to a significant increase in protein demand in East Africa. According to a report by the Animal Welfare League, commercially farmed poultry in the region is expected to triple from 1.8 billion to 7.4 billion in the next couple of decades. One of the primary factors involved in fulfilling the objectives of improving poultry productivity is ensuring that the chickens are raised in the most humane way possible.

The report stated that a whopping 60% of the several million hens utilised for commercial egg production spend their entire lives confined in battery cages. Although battery cages are generally preferred for their ability to reduce aggression and cannibalism, while improving feeding density and reducing labour and feed waste, this practice is however considered to be one of the most inhumane aspects of animal agriculture.

**To support a successful shift to cage-free production and sourcing in Africa, the National Cage-Free Directory and Farmers' Network was formed.**

Image Credit: Adobe Stock

Accordng to a report, a whopping 60% of the several million hens utilised in commercial egg production spend their entire lives confined in battery cages.

Some of the most common downsides associated with caged hens include their inability to move around freely and engage in their natural behaviours such as bathing in dust, stretching, wing flapping and most importantly, nesting. In addition, extreme confinement prevents hens from taking part in healthy social interactions, with the lack of movement further contributing to the development of debilitating bone conditions, eventually leading to early mortality.

Keeping these disadvantages in mind, many countries including Africa, have gradually began switching to cage-free and free-range systems. While cage-free systems provide hens access to enhanced zones within sheds that include nesting boxes for egg-laying, straw sections for grazing, and perches for climbing, free range caging systems on the other hand, provide hens access to outdoor spaces that enable them to graze on grass or ground. Both these systems enable hens to engage in their natural behaviours and are widely accepted throughout the world.

### Aiding a successful cage-free transition

To support a successful shift to cage-free production and sourcing in Africa, the National Cage-Free Directory and Farmers' Network was formed, comprising of farms practicing and pledging to go cage-free by specific dates. The network will be the primary recommended partners of the Animal Welfare League to international and local corporate bodies that have signed cage-free policies and are committed to sourcing their poultry products from cage-free farms in the country and region.

The directory on the other hand is the end product of Animal Welfare League's strategy, which involves working with both egg producers and stakeholders in Ghana, to put an end to the unimaginable suffering endured by chickens in factory farming. This directory mainly comprises of farmers who have pledged to use cage-free farming systems and other animal welfare practices in the industry.

On 1 March 2023, the Animal Welfare League organised a successful workshop with poultry farmers in the capital of Ghana, on the theme, 'Improving poultry welfare and productivity in Ghana.' According to a report by the Animal Welfare League, a total of 93% farmers have signed into the organisation's national cage-free farmers' network, with the current production of the network reported as being 369,110 hens.

According to the founder of Animal Welfare League, Daniel Abiliba, the organisation arranged two in-person meetings with two hotels in Ghana who expressed an interest in adopting a cage-free policy. One of them is the Grovenest Inn, which has agreed to join other local hotels including the Koforidua Guests' Hotel in signing the cage-free policy. Grovenest Inn is currently

Image Credit: Adobe Stock

Many countries including Africa, have gradually began switching to cage-free and free range poultry systems.

in talks with cage-free egg producers in the national cage-free directory with the support of the Animal Welfare League to streamline their supply to achieve a 100% status by 2025.

Besides the Animal Welfare League, a couple of other notable cage-free projects currently running in Africa include, Tanzania's Education for African Animal Welfare (EAAW) and Zimbabwe's Sibanye Trust.

Following translation, the EAAW shared the Cage-Free Fulfillment report by the Open Wing Alliance and the International Cage-free equity index with poultry farmers and media houses in Tanzania for publication. Moreover, the organisation has also taken part in local, regional and global cage-free campaigns, and led

**A lack of appropriate infrastructure, technology, investments and resources is hampering Zimbabwe's transition to cage-free poultry systems.**

several African media campaigns involving international brands and local restaurant chains in Tanzania. In addition, EAAW has also taken on journalist trainings, organised farm visits and discussions regarding the importance of cage-free poultry farming.

After joining the Open Wing Alliance (OWA) colaition, the Sibanye Trust began cage-free work in 2018 in Zimbabwe. Financial assistance from the OWA enabled the trust to partner with numerous animal advocates, policy makers and farmers to spread awareness and promote cage-free practices, including animal welfare and egg quality.

Unlike Ghana and Tanzania however, the Sibanye Trust noticed resistance from farmers in Zimbabwe, who were not willing to transition to cage-free systems. This comes down to the country's economic setting, along with a dearth of appropriate infrastructure, technology and resources. Transitioning to cage-free systems requires additional investments which most small scale farmers find hard to afford. Besides farmer resistance, policymakers are also not forthcoming towards collaborative work, something that is much needed for the successful implementation of cage-free policies.

Founder of Sibanye Trust, Alfred Sihwa, recommends the provision of funds to support the government's efforts in the creation of policies and regulations that promote and incentivise cage-free systems, while increasing taxes on conventional battery cage systems. Gaining international support through the media, newsletters and petitions to the government is also seen as an option.

Supplementing organic feeds with inorganic phosphates is seen as a popular solution to ensuring that the optimum level of phosphorus required for bone mineralisation and production is met.

# Restoring mineral balance in cattle feed

GIVEN THE INCREDIBLY complex process involved in feed formulation and manufacturing, vegetable feed is often believed to contain balanced proportions of nutrients and minerals that promote good health in poultry and livestock.

However, numerous studies have indicated an imbalance in phosphorus content in vegetable feeds, which only manage to fulfil 30% of the total phosphorous requirement and even then, only half are absorbed. Phosphorus deficiency can have detrimental effects on the appetite and growth of livestock, directly affecting productivity as a result. Calcium is another important mineral that is found to be deficient in dairy feed. High producing crossbred dairy cows experience a daily drainage of calcium through milk, which is why adequate mineral supplementation is required to replenish the daily loss. Calcium and phosphorus are required in comparatively larger amounts than other minerals, which further emphasises the need for these minerals to be fed at a maximum limit, in order to optimise feed intake and milk production.

Image Credit: Adobe Stock

Adequate mineral supplementation is required to replenish the calcium lost through milk on a daily basis by high producing crossbred dairy cows.

**Calcium and phosphorus are required in larger amounts than other minerals, emphasising the need for these minerals to be fed at a maximum limit to optimise feed intake and milk production.**

Supplementing organic feeds with inorganic phosphates is seen as a popular solution to ensuring that the optimum level of phosphorus required for bone mineralisation and production is met. Based on their differences in phosphorus content, inorganic phosphates are mainly divided into three types namely, tri-, di- and monocalcium phosphates, with dicalcium phosphate (DCP) and monocalcium phosphate (MCP) being the most commonly used forms.

The manufacture of feed-grade calcium phosphates takes place under carefully controlled conditions and involves a reaction between limestone and phosphoric acid. The resulting mixture contains monobasic and dibasic calcium phosphate, with the final phosphate feed additive composition being influenced by a number of factors including temperature, raw material purity, phosphoric acid strength, and the limestone to phosphoric acid ratio.

### DCP supplementation in dairy feed

A research study conducted in November 2023 aimed to assess how DCP supplementation in dairy feed would affect dry matter intake, milk composition, blood mineral balance and milk production in lactating crossbred dairy cows. Results from the study revealed that supplementing DCP with the concentrate mix significantly improved dry matter, nutrient intake and milk composition. A supply of 0.6% DM/day of DCP was recommended for optimum dairy cow production and productivity. A larger number of lactating dairy cows would however be required to confirm the study results.

### Switching from DCP to MCP

For a number of reasons, feed manufacturers and producers often prefer switching from DCP to MCP. Firstly, MCP contains the highest phosphorus content by weight. Moreover, through comparative analysis, it was found that phosphates were most digestible when combined with 2% citric acid solution, with the best results recorded by feed phosphates that contained no fluorine. This concluded that utilising MCP prepared from DCP enriched with defluorinated feed-grade phosphoric acid presented an advantage over using other sources of phosphate.

Secondly, taking purity into account, MCP derived from DCP through the hydrochloric acid production process had greater digestibility, thereby increasing the dietary absorption rate.

The application of emerging technologies along with the addition of calcium can significantly enhance the recovery of important macronutrients during the swine wastewater treatment process.

# Macronutrient recovery from swine wastewater

WASTEWATER PRODUCED BY the swine industry is essentially characterised by blood, urine, faeces, hormones, antibiotics, undigested food and other greasy substances. Although rich in nitrogen, ammonia and organic carbon, untreated wastewater from piggeries cannot be directly used as fertiliser due to the presence of harmful cyanotoxin-containing algae that can cause acute intoxication in humans. Moreover, untreated wastewater is extremely harmful for the soil ecosystem, resulting in severe deterioration of soil quality along with reduced crop yields.

Results from a 2020 study showed that untreated swine wastewater fertilisation contaminated the soil with antibiotics and antibiotic resistance genes (ARGs), thus changing the microbial compositions in the soil. Furthermore, vegetable samples collected from plants growing within the contaminated soils were found to contain an abundance of ARGs and intracellular parasites such as Rickettsiales, indicating the potential health risks associated with their consumption.

### Utilising AnMBR technology to obtain high-quality nutrient products

Using appropriate physical, chemical and biological treatment technologies enable the recovery of essential macronutrients such as nitrogen and phosphorus from swine wastewater, thus enhancing its efficiency for use in the fertiliser industry. A novel emerging technology that facilitates the production of high-quality nutrient products is the Anaerobic Membrane Bioreactor (AnMBR).

This technology helps in the recovery of energy and water for indirect potable use, while also using techniques such as coagulation, flocculation, chemical precipitation, and ion exchange for nutrient mobilisation. Studies have shown that the addition of a chemical can improve the effectiveness of P removal from AnMBR treated municipal wastewater permeate.

**The addition of calcium increases phosphorus removal in the up-flow anaerobic sludge blanket (UASB) reactor through particle aggregation.**

Moreover, a number of factors including pH, alkalinity and the presence of impurities affect the purity and quality of the final fertiliser obtained, along with other non-specific product formation. Therefore, the composition of the treated wastewater significantly influences the type of final recovered nutrient products (RNP) formed.

### Calcium addition to enhance phosphorus recovery from pig manure

Swine wastewater contains a mixture of solid (manure) and liquid (urine) components, both of which can be separated and sent to two different units for re-processing. Pig manure has a plethora of benefits, including its potential to be used as an organic fertiliser, having long-lasting efficiency. Besides this, pig manure when treated with reagents and microorganisms can effectively decompose odour, reduce pollution and improve the economic value of pig farms.

Since nutrient-rich pig manure cannot be directly applied to soils, separating nutrients from the manure will allow a more economical geographical redistribution of phosphorus and nitrogen. Studies have shown that addition of calcium increases phosphorus removal in the up-flow anaerobic sludge blanket (UASB) reactor through particle aggregation. These particles that are rich in calcium will undergo calcium phosphate precipitation and granulation. Larger particle size with high phosphorus content simplifies phosphorus separation, ultimately improving the efficiency of recovery from pig manure. The recovered calcium phosphate relieves the use of primary phosphorus sources as fertiliser in agriculture, while also enabling individual use of phosphorus without the presence of other nutrients.

Treated pig manure can effectively decompose odour, reduce pollution, improve economic value of pig farms and be used as an organic fertiliser having lost lasting efficiency.

Image Credit: Adobe Stock

mRNA vaccines for livestock diseases are being widely developed and studied due to their ability to be constructed and manufactured at a rapid pace, thus making them a preferred choice over conventional vaccines.

# Evolution of mRNA vaccines to combat livestock diseases

Image Credit: Adobe Stock

In recent years, numerous mRNA vaccines have entered clinical trials, showing promise for offering solutions to combat emerging and re-emerging infectious diseases in animals.

THE MESSENGER RNA (mRNA) platform technology has emerged at the forefront as a vaccine technology gaining traction in not only human, but also animal health. Ever since the development of the successful mRNA vaccines for COVID-19 in 2020, these vaccines have been widely recognised for their ability to be constructed and manufactured at a rapid speed, thus making them a preferred choice over conventional vaccines.

Animal infectious diseases greatly impact animal health and food security, which makes their early detection crucial to preventing economic losses. The three main types of vaccines that are currently used in veterinary medicine include inactivated vaccines, live attenuated vaccines and recombinant subunit vaccines. These conventional vaccines however present a number of efficacy and safety concerns, which calls for the need for novel vaccine formats such as mRNA vaccines.

In recent years, numerous mRNA vaccines have entered clinical trials, showing promise for offering solutions to combat emerging and re-emerging infectious diseases in animals such as influenza, rabies and Zika. The administration of mRNA vaccines leads to the activation of both innate and adaptive immune systems, with the route of administration influencing the immune responses to these vaccines.

**Administration of mRNA vaccines leads to the activation of both the innate and adaptive immune systems, with the route of administration influencing the immune responses to these vaccines.**

### mRNA vaccines for infectious diseases and zoonoses

So far, only a limited number of mRNA vaccines have been developed for farm animals. Two notable examples include:

- **Influenza:** Currently, the vaccines used to treat this highly contagious disease are either inactivated, or live-attenuated vaccines produced in egg-, cell-, and protein-based systems. Since the design and development of these conventional vaccines take anywhere between 6-8 months, alternatives such as mRNA vaccines have been extensively developed and studied in the past few years. Having the ability to accommodate multiple antigens, multivalent mRNA vaccines containing conserved antigens have been developed, which provide broad-spectrum immune protection

against most strains of the influenza virus. Therefore, given the transmissibility of avian and swine influenza viruses, researchers hope that vaccinating natural hosts with mRNA vaccines matching the emerging virus strains can help control new outbreaks.

- **Foot-and-mouth disease (FMD):** Most commercialised FMD vaccines currently available in the market today are chemically inactivated virulent strains that have numerous drawbacks, including thermal instability and poor immunogenicity, among others. Numerous attempts to develop safer next-gen FMD vaccines have been launched in the past, with studies carried out in a mice model showing that immunisation with the full-length genetically engineered FMD virus (FMDV) mRNA, had the potential to induce strong immune responses to FMDV. Therefore, the development of a synthetic thermo-stable RNA vaccine harboring the FMDV P1-2A plus 3Cpro encoding genes can be developed to protect livestock against emerging FMD strains.

The availability of an mRNA-based vaccine platform will aid in the advancement of safe and effective vaccines to prevent a plethora of other livestock diseases caused by major poultry and livestock viruses such as:

- **African Swine Fever Virus (ASFV):** ASF continues to be one of the most devastating diseases affecting pigs globally, resulting in the death of nearly seven million pigs in 2019. Studies have shown a positive protective effect of live attenuated ASFV vaccine candidates against the lethal ASFV infection. Recently, highly conserved cytotoxic T-cell epitopes have been identified in ASFV encoded proteins through a computational vaccine design platform named iVAX. However, further investigation is required to facilitate the development of a T-cell-directed mRNA vaccine.
- **Porcine reproductive and respiratory syndrome virus (PRRSV):** PRRSV infections mainly affect the respiratory system in piglets, causing reproductive failure and eventually leading to huge economic losses. Currently administered conventional vaccines include live attenuated or inactivated PRRSV vaccines have been found to have significant drawbacks, calling for the need for a safer and more effective alternative. According to a research study conducted in 2022, the fragments in PRRSV encoding regions that potently elicit immune responses could be selected from multiple circulating strains via in silico algorithms and then assembled into a single vaccine using the mRNA vaccine platform. Such vaccines encoding synthetic mosaic antigens are expected to induce more diverse and effective immune responses with greater variant depth.
- **Animal Coronavirus:** Limited vaccines are currently available for animal coronaviruses such as the bovine coronavirus (BCoV) and the recently emerged swine acute diarrhea syndrome coronavirus (SADS-CoV). Currently available licenced vaccines are either live attentuated or inactivated. A promising strategy for combatting these emerging and re-emerging animal coronaviruses involve the use of receptor-binding domain (RBD)-based mRNA vaccines. Further studies are however required to confirm their effectiveness.

## Debunking the myths

Despite its development saving millions of lives during the COVID-19 pandemic, a host of misinformation is being spread about the negative impact of mRNA vaccines on both humans and animals. To ease further advancement of the mRNA technology platform and encourage the use of mRNA vaccines in humans and livestock animals, it is very essential to draw a line between fact and fiction. In an article published by agresearch, chief scientist, Axel Heiser proceeded to debunk the common myths that have been making rounds on the internet during the past year.

Firstly, critics have argued that RNA vaccines are capable of genetically modifying livestock. Heiser however clarified that the mRNA present within the RNA vaccines did not alter the animal's genetic makeup, since it did not integrate into the DNA of the animal. Moreover, the RNA vaccine would be promptly broken down and eliminated by the body, following the process of translation into viral protein.

Secondly, RNA vaccines are often believed to be untested and dangerous. Heiser argued that RNA vaccines have undergone rigorous testing, with adverse events and safety concerns being closely monitored and investigated. Regarding the potential risks associated with the use of these vaccines, those reported in humans mostly range from mild to moderate. In livestock, mRNA vaccines have already been developed against PRRS, which confirms their efficacy.

Thirdly, RNA vaccines are believed to harmful for the environment, and would eventually replace traditional vaccines. According to Heiser, this would not be the case. Despite their ability to be quickly and efficiently produced, mRNA vaccines are still a relatively new technology that are being developed and studied. Therefore, traditional vaccines would not completely lose their value and would continue to be used for protecting both humans and animals. In addition, RNA vaccines have been found to reduce the risk of antibiotic resistance, which indicates their potential benefits for the environment.

## Misinformation circulating on social media

Widespread misinformation regarding mRNA vaccines includes their entry into food supply through vaccinated or genetically modified livestock. Fact checkers have debunked these claims by confirming that mRNA vaccines have not yet been officially used or approved for injecting livestock. They further emphasised that this would only happen when there are substantial amounts of studies and many levels of government assessment and permissions for using mRNAs for livestock.

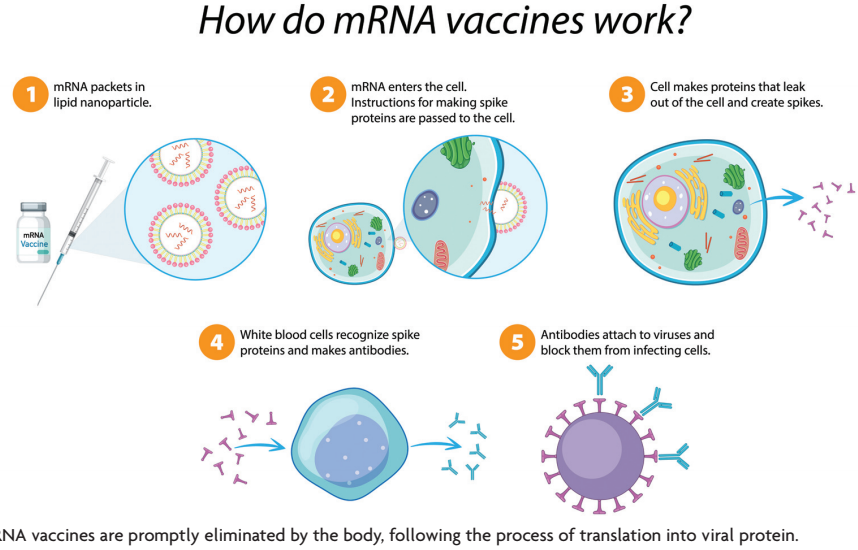


Image Credit: Adobe Stock

RNA vaccines are promptly eliminated by the body, following the process of translation into viral protein.

Studies have shown that the surplus agricultural waste obtained post processing farm crops, carried huge potential for use in animal feed production.

# Reduce and Re-use: Transforming agro-waste into sustainable aquafeed

High fibre content and presence of ANFs means that appropriate processing treatments need to be applied to boost the nutritional value of agricultural wastes.

Image Credit: Adobe Stock

TANZANIA'S AQUACULTURE INDUSTRY is characterised by fish seed and feed production value chains that offer increased fish production opportunities to the private sector for income, employment and consumption. However, a shortage of trained and skilled personnel along with inadequate extension services, has resulted in the country becoming deficient in quality and quantity of seeds and feeds. Other challenges include limited equipment, fragmented fish market and expensive water supply, mainly due to insufficient capital for investment.

### Improving aquaculture value chains in Tanzania

In order to address the aforementioned challenges and enhance the seed and feed production value chains, necessary intervention measures need to be undertaken. These include:

- Establishing an increased number of hatcheries and breeding programmes for mass production of fingerlings.
- Establishing a code of conduct for quality assurance of seed certification, which will have to be adhered to by all seed producers.
- Using medicinal plants such as Aspilia mossambicensis and Azadirachta indica, to minimise the use of expensive hormones on sex reversal and hybridisation during seed production.
- Replacing fish meal with alternative protein sources like algae and black soldier fly (BSF) larvae.
- Providing practical training skills in colleges and universities to equip graduates with the required skills for producing quality fish feeds.

In addition to these measures, the government should enhance research-training-extension and research-farmers-extension linkage to ensure dissemination of research to end-users in the aquaculture value chain. The private sector must also extend its support through the establishment of aquaculture advisory and technical services to complement efforts by the government extension services.

**Nutritional aspects, including the levels of pesticide residues and presence of ANFs need to be considered to determine the suitability of agricultural wastes in aquaculture production.**

### Agricultural wastes as raw materials in aquafeed production

Increasing food demand resulting from rapid population growth has led to large areas of land being utilised for farming agricultural crops such as mango, coconut, banana, pineapple, citrus and sugarcane. Studies have shown that the surplus agricultural waste obtained post processing these crops, carried huge potential for use in animal feed production. While agricultural wastes have long been used as functional feed ingredients in the poultry and livestock industry.

In the aquaculture industry, agricultural wastes need to be carefully analysed before being utilised as ingredients in aquafeed. Factors such as the nutritional aspects, including the levels of pesticide residues and presence of anti-nutritional factors (ANFs) need to be considered to determine the suitability in aquafeed production.

According to a research study conducted by the Aquaculture department at the Southeast Asian Fisheries Development Centre, the agricultural wastes analysed contained low levels of protein and high levels of carbohydrate and fibre. Among the various agricultural wastes studied, okara and citrus by-products showed acceptable nutritional quality. Moreover, ANFs such as lignin were largely present in all agricultural wastes, whereas high levels of phenols, and saponins and alkaloids were found in mango seeds and mango peels, respectively.

Besides nutritional quality, it is also important to ensure that pesticide residues do not exceed the quantification limit. From the study, pesticide residues were only detected in mango and citrus peels, but at levels that were much below the maximum

residue limits of FAO Codex Alimentarius.

Overall, the study concluded that most agricultural wastes including those previously mentioned, had significant potential to be used in aquafeed production. However, high fibre content and presence of ANFs meant that appropriate processing treatments had to be applied to boost their nutritional value. Prior to being used in large scale aquaculture, suitability should also be tested by incorporating these processed agricultural wastes into the diets of omnivorous fish species such as tilapia.

### Combatting East Africa's fish supply-demand imbalances

Throughout the world, particularly in East Africa, the aquaculture sector has been facing significant challenges in regard to fish supply and demand. For instance, Tanzania is currently experiencing an annual fish deficit of more than 480,000 metric tonnes, according to a report by United Nations International Children's Emergency Fund (UNICEF). Moreover, the current feed which comprises mainly of small fish like sardines is found to be neither environmentally nor economically feasible.

Diana Orembe, co-founder and CEO of pioneering blue biotech company, NovFeed in November 2023, was selected as part of the 'UNICEF Innovation30: Young Innovators Shaping the Future,' for developing the unique NovFeed technology to transform the aquaculture landscape in Tanzania's largest city, Dar es Salaam. NovFeed's innovative solution was awarded the US$1mn Grand Prize for winning the Milken-Motsepe Prize in AgriTech.

The company uses advanced bacterial techniques to transform discarded fruits and vegetables collected primarily from schools, universities, and markets into a valuable protein source for fish feed. The use of this alternate protein source helps reduce the overall greenhouse gas emissions by 80%. Moreover, unlike traditional feeds, NovFeed's innovative protein floats, thus bringing down feed loss to a complete stop. It also accelerates fish maturity, allowing them to be sold 40% earlier compared to traditional feed methods. This in turn significantly increases farmers' profits.

In another report, sub-Saharan Africa's fastest growing fish farm, Victory Farms, mentioned that the East African fish supply deficit was one of the greatest supply-demand imbalances in the global food

**NovFeed uses advanced bacterial techniques to transform discarded fruits and vegetables into a valuable protein source for fish feed.**

system today. The aquaculture platform has presented an innovative, climate-smart solution to the various food security challenges faced in East Africa.

In April last year, Victory Farms successfully completed its US$35mn Series B round to gain financial support for the expansion of its operations in Kenya and Rwanda, and potential entry into Tanzania, Ethiopia and Uganda. The Series B funding helps boost the yearly production of top-quality protein meal in East Africa, while also improving employment opportunities in the region and encouraging women-led fishmongers at local markets. Moreover, renewable energy utilisation and increased protein intake at lower levels of emission, enables Victory Farms to significantly lower its carbon footprint.

In the race to achieve the sustainable development goals, numerous studies have advocated for innovation in urban farming.

# Sub-Saharan Africa's move towards smart aquaculture

AS AFRICA CONTINUES to be plagued by food insecurity and climate change, the continent's aquaculture sector has displayed enormous potential in driving socio-economic transformation and providing employment and income particularly in regions of sub-Saharan Africa. According to survey data released by the FAO, aquaculture is one of the fastest growing sectors of food production in the world, with its annual growth rate being 11% in Africa, almost double the global average.

Africa's annual aquaculture growth rate is 11%, almost double the global average.

Image Credit: Adobe Stock

### Recirculating aquaculture system

In the race to achieve the sustainable development goals (SDGs) 2 - zero hunger and 11 - sustainable cities and communities, in sub-Saharan Africa, numerous studies have advocated for innovation in urban farming. One of the most popular innovations that is capable of meeting both the SDGs in an urban context, is the Recirculating Aquaculture System (RAS). This technology enables the cultivation of fish and other aquatic animals within a carefully controlled, land-based environment in which water is continuously recirculated through mechanical and biological filters, removing waste components and maintaining adequate water quality for fish growth.

This system is preferred over conventional freshwater aquaculture systems since it significantly reduces water consumption. However, it demands water quality assessment through the careful monitoring of parameters such as potential hydrogen (pH), electrical conductivity (EC), total dissolved solids (TDS), and temperature. Since the health and productivity of RAS is greatly dependent on accurate and reliable measurements of these variables, the need for utilising appropriate digital tools becomes inevitable.

### Widely used monitoring systems

Throughout the world, including Sub-Saharan Africa, traditional and conventional monitoring systems have been used to assess water quality. While the traditional method relies on collecting and analysing water samples in the laboratory, the conventional approach on the other hand, involves periodic onsite measurements using handheld meters or sensors. Both systems have been found to have their fair share of advantages and drawbacks.

**The evolution of technology has enabled the incorporation of IoT and AI into water monitoring systems , enabling them to monitor and assess water quality in real time.**

For example, the traditional system, although accurate, is costly, labour-intensive and time-consuming. On the contrary, the conventional system is found to be much quicker, providing immediate measurements during office hours, when the staff members are available to keep a check on the variations. However, unexpected variations, changes or alterations that occur outside these unmonitored periods fail to be captured by the system, resulting in detrimental consequences.

### Addressing the drawbacks through technology

The evolution of technology has enabled the incorporation of various advanced techniques including Internet of Things (IoT) and artificial intelligence (AI) into water monitoring systems, enabling them to monitor and assess water quality in real time.

In recent years, numerous water monitoring systems utilising Wireless Sensor Networks (WSN) have been investigated for data capture and storage in a database. These systems incorporate sensors to measure parameters like temperature, pressure, dissolved oxygen (DO), water level, and pH. Upon detecting a problem, users are notified either through SMS or email. The low cost of these sensors has expanded the availability and accessibility of these water monitoring systems, thus enabling fish farmers and/or aquaculturists in remote locations to choose the sensor that meets their requirements, budgets and operational needs.

In Sub-Saharan Africa however, the integration of digital tools in RAS and aquaculture is quite scarce, apart from Kenya, where two water monitoring systems have so far been developed and established. One trial Nile Tilapia hatchery

employing locally adapted RAS was established in Kisumu, Kenya. Through a real-time monitoring and alarm system crafted by OxyGuard International A/S, this facility empowers farmers to retrieve farm data from the fish tanks, facilitating continuous monitoring and control. From the study, successful reproduction of Tilapia with low mortality rate was recorded. Another device designed for remote monitoring in Kenya effectively alleviates the data collection burden on fish farmers while enhancing data acquisition frequency. The device transmits data gathered from pH and temperature sensors, which is then processed and made accessible through a dedicated app.

**Cost and affordability challenges**

Standard water monitoring tools are often expensive and require significant investments. To address these challenges, researchers have been investigating the development of low-cost sensors integrated with IoT technologies. By leveraging advancements in miniaturisation, wireless connectivity, and data processing capabilities, these sensors provide cost-effective and accessible solutions for water quality monitoring. Moreover, real-time data provided by these low-cost sensors integrated with IoT also facilitates early detection of anomalies, timely interventions, and improved overall farm management practices.

**Recent innovations**

Besides water monitoring, digital tools are also being incorporated in other areas of aquaculture production. For example, Kisumu-based aquaculture company, Aquarech is working to meet Kenya's need for fish, which serves as an affordable, healthy protein. Aquarech is filling that gap in the domestic supply chain by streamlining the production behind fish farming with a mobile app platform that allows manufacturers, farmers, and buyers to trade, buy, and sell quality fish feed, as well as learn best aquaculture practices and how to improve their incomes. In December 2023, Aquarech announced the closure of an equity investment of US$1.7mn to hire talent, acquire more feed, and set up infrastructure to support more vertical integration of their technology.

Local farmers often face a lack of resources and access to high-quality feed. Aquarech's mission is to help increase production, improve small-scale farmer economics, and promote the overall growth of the aquaculture industry in Kenya. To achieve this, Aquarech supports small-scale farmers from all angles: by providing quality feed and climate-smart precision fish feeding techniques, market access, technical training, and financial access, including a 90-day credit period to pay for feed.

**In December 2023, Aquarech announced the closure of a US$1.7mn equity investment to hire talent, acquire more feed, and set up infrastructure to support vertical integration of their technology.**

"The proverb says, 'If you give a man a fish, you feed him for a day. If you teach a man to fish, you feed him for a lifetime,' and that is what we have set out to do, starting by improving the aquaculture value chain," said Aquarech founder and CEO, Dave Okech. "The funding and partnership provided by our investors will promote the growth of our mobile-enabled platform, which is unlocking barriers faced by smallholder fish farmers and bringing the various value chain actors together while remaining farmer-centric."

**Knowledge sharing**

In addition to the availability and accessibility of digital tools, awareness and knowledge regarding the use of these tools is also important to improve their rate of adoption among small scale farmers.

As part of FoodTechAfrica, a public-private partnership of 21 companies and universities aimed at improving food security in East Africa, Lattice Aqua and Larive International in partnership with Skretting Africa and Blue Planet Academy, have developed an extensive digital curriculum for African fish farmers. The developed digital curriculum is based upon practical, in-the-field experiences, utilising actual footage from fish farming in the region. The curriculum which is constantly updated, consists of various models covering farm systems, farm management, feed management, genetics and health management.

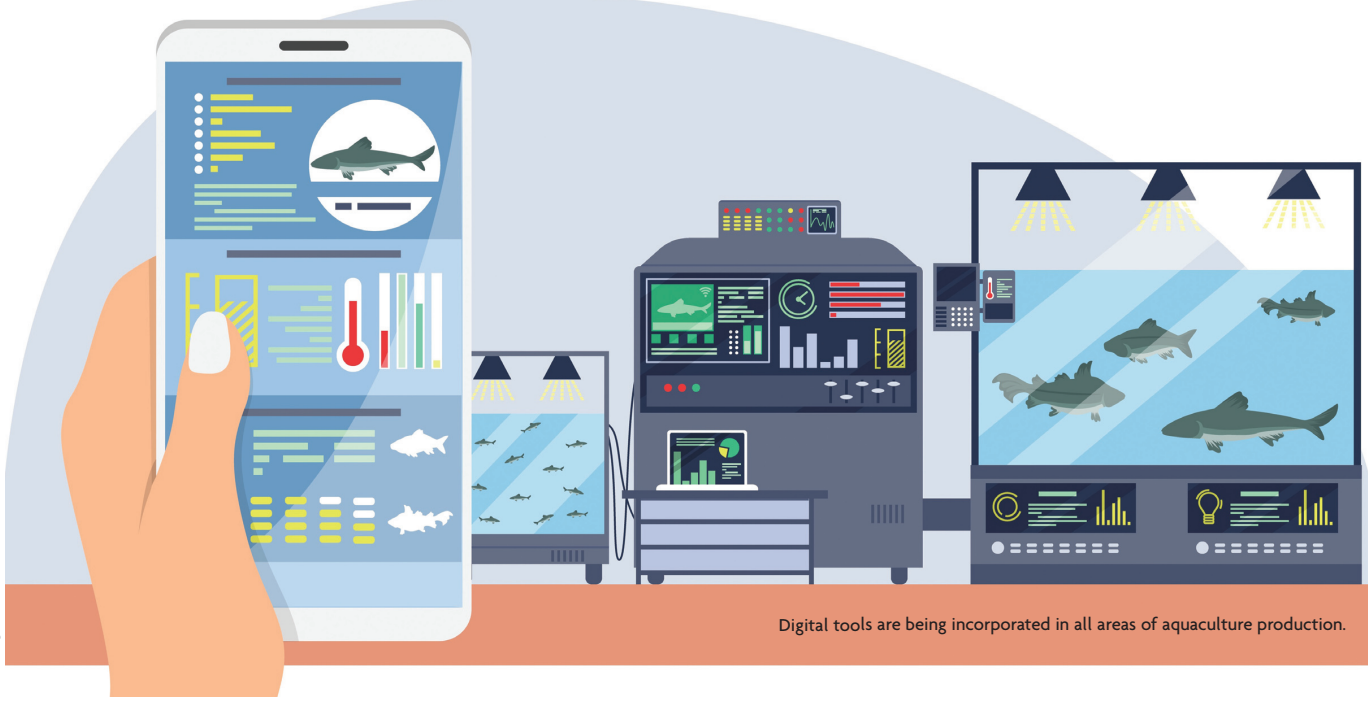

Image Credit: Adobe Stock

Digital tools are being incorporated in all areas of aquaculture production.

While conventional treatment methods have proved ineffective, recent advances in RNA-based technology have opened new doors for combatting shrimp viral diseases.

# Emergence of RNA-based solutions to combat shrimp diseases

Image Credit: Adobe Stock

Shrimp viral diseases have posed significant challenges to the aquaculture industry, causing major economic losses worldwide.

BESIDES ITS CONTRIBUTION to global seafood production, shrimp aquaculture has become a vital industry for a plethora of reasons including its ability to provide employment opportunities and support economic growth in coastal areas. However, shrimp viral diseases have posed significant challenges to the aquaculture industry, causing major economic losses worldwide.

While conventional treatment methods have proved ineffective, recent advances in RNA-based technology have opened new doors for combating shrimp viral diseases. Some of the notable solutions include RNA interference (RNAi) technologies, mRNA vaccines, and gene edition technologies such as the CRISPR-Cas technology.

**Some of the notable solutions to combat shrimp viral diseases include RNAi technology, mRNA vaccines and gene editing technologies such as the CRISPR-Cas technology.**

### Mechanism of RNAi

In this approach, small RNA molecules are used to specifically target and silence the genes of the viruses affecting shrimp, through the process of post transcriptional gene slicing. By introducing double-stranded RNA (dsRNA) substrates, like siRNA, shRNA and lhRNA into the shrimp, the RNAi mechanism interferes with the virus's ability to replicate and spread. Single stranded antisense RNA (asRNA) molecules have also been found to exert gene slicing through the RNAi mechanism.

When the shrimp consume feed containing dsRNA molecules designed to match the viral genes, the dsRNA triggers a natural defense mechanism in the shrimp, leading to the degradation of the targeted viral RNA. This inhibits the virus's ability to replicate, helping control and reduce the severity of viral infections.

Moreover, with the large number of RNAi molecule designing softwares available today, care should be taken to avoid off-target effects.

### Development of RNAi vaccines

RNAi vaccines are extremely beneficial in fighting off viral aquaculture diseases. However, according to an article published in Springer, although the globally developed RNAi molecules possess prophy-

lactic and therapeutic effects, they cannot be considered as true vaccines, since they do not particularly act on the host immune system.

Studies have shown that DNA vector-based RNAi molecules are more stable, and can be conveniently administered to aquaculture species through the immersion route.

The route of administration of vaccines in aquaculture species may vary depending on the size of the fish and the method of preparation of the vaccine. The immersion route is generally chosen when a large number of fish need to be vaccinated.

The immersion vaccination process works by allowing the aquatic animals to absorb the vaccine through their skin, gills, or other mucosal surfaces. This stimulates the immune system to produce a protective response against the targeted pathogens.

Advantages of immersion vaccines include ease of administration, efficiency in treating large populations, and reduced stress on the animals compared to some traditional vaccination methods. However, when compared to other routes of administration such as injection, the immersion route is found to be inferior, mainly because of the limited uptake of antigens by immersion compared to injection. This is why there is usually a lack of classic secondary responses following repeated immersion vaccination. Achieving consistent and optimal vaccine uptake can also be influenced by environmental factors, such as water temperature and quality.

### RNA nanovaccines

While nanomedicine has already made notable contributions to human health, its use in promoting animal health is limited.

A 2022 study noted the development of a RNA nanovaccine for aquaculture applications. This was obtained by combining two platform technologies namely, the RNAi-based virus-specific dsRNA and a polyanhydride nanoparticle-based delivery platform. The effect of nanoparticle chemistry on safety, biodistribution, and persistence was evaluated in vivo in L. vannamei.

Numerous studies have displayed the capability of polyanhydride nanoparticles to provide antigen stability, controlled release, intrinsic adjuvanticity, and protective immunity, making them excellent vehicles for antigen delivery. Polyanhydride nanoparticles were shown to be suitable for the encapsulation and release of dsRNA. Moreover, the presence of nanoparticles in gills potentially contributes to protection against diseases caused by viruses such as Taura syndrome virus (TVS), yellowhead virus (YHV) and white spot syndrome virus (WSSV), which mostly target the gills.

**ViAqua has developed an oral delivery platform for the targeted administration of RNA-based solutions to improve disease resistance in aquaculture.**

### CRISPR-Cas technology

This technology works by introducing specific genetic modifications that enhance shrimp's ability to resist viral infections. The process involves identifying specific genes involved mostly in the immune response or cellular processes, that when modified, are capable of enhancing resistance to viruses. Using CRISPR-Cas technology, a guide RNA (gRNA) is designed to match these target genes. The gRNA guides the Cas enzyme, often Cas9, to the gene location that needs to be modified. The enzyme acts as molecular scissors, cutting the shrimp's DNA at the targeted location. Modifications are introduced soon after the cell repairs the cut portion. The modified shrimp exhibits enhanced immunity that helps it in resisting viral infections or reduce the severity of the disease.

These RNA-based approaches contribute to sustainable aquaculture practices by addressing disease management, enhancing genetic traits, and improving the overall health and productivity of aquatic organisms. Ongoing research aims to refine and expand the applications of RNA-based solutions in aquaculture.

### Recent advancements

Meanwhile, some companies are actively trying to scale RNA-based solutions in aquaculture. One example is ViAqua Therapeutics, that recently announced the completion of a US$8.25mn investment round led by S2G Ventures. The company has developed a biotechnology-based oral delivery platform for the targeted administration of RNA-based solutions to improve disease resistance in aquaculture.

Its first product is a feed supplement to enhance resistance to viral infections in shrimp, with the initial application targeting WSSV. This solution will provide much-needed production stability for farmers while also creating the opportunity to increase production per farm without increasing disease risk.

Produced using commercial, industrial processes, ViAqua is scaling production to take its first product to market, through its established commercial partnership by means of a joint development and marketing agreement with Skretting, a Nutreco company. While ViAqua is currently focused on shrimp production, the delivery technology has numerous applications in aquaculture and beyond, which the company is excited to explore.

CEO of ViAqua, Shai Ufaz emphasised the importance of oral delivery, given the impossibility of vaccinating individual shrimp. He further highlighted its ability to bring down operational costs of disease management, while improving outcomes. Investment director at Rabo Ventures, Shishir Sinha noted that the bank's aquaculture specialists, Gorjan Nikolik and Novel Sharma were impressed by the game-changing impact potential of the solution and believed that it would make a meaningful difference in the lives of the smallholder farmers, who represent 80% of supply. "We are truly excited by the potential of ViAqua's technology because of the value it unlocks for the planet and the farmers."


Image Credit: ViAqua Therapeutics

ViAqua Therapeutics has announced a US$4.3mn investment led by S2G Ventures.

Living wall systems for food production are gradually being adopted in South Africa to address the nation's food security challenges.

# Saving space and boosting productivity with living wall systems

FOOD INSECURITY RESULTING from a growing population, rapid urbanisation, poverty and unemployment has resulted in some African countries resorting to living wall systems (LWS) for food production. Vegetables in particular, are being poorly consumed, which is adversely affecting health, and causing the early onset of cardiovascular diseases like stroke and heart attack.

In South Africa, four types of vertical food growing systems are currently in use, to enhance resilience and address food security challenges.

Image Credit: Adobe Stock

Modular systems comprise separate modules for each plant, which allow them to be pre-grown in advance, while also enabling individual plants to be replaced with minimum effect on adjacent plants grown in the system.

### Modular LWS

These are currently the most widely used LWSs, consisting of structures of specific dimensions that support elements such as trays, vessels, or bags, that can be fixed onto the vertical surfaces of buildings. Modular systems comprise separate modules for each plant, which allow them to be pre-grown off site in advance, while also enabling individual plants to be replaced with minimum effect on adjacent plants grown in the system.

**To ensure optimised plant growth in modular living wall systems, it is important to ensure that the composition of the growing medium is regularly adjusted.**

To ensure optimised plant growth, it is important to ensure that the composition of the growing medium – which is a vital component of LWSs – is regularly adjusted. Moreover, effective moisture retention is also crucial for plant growth, survival and performance.

### Modular systems are of four types:

- An interlocking system of trays consisting of containers or modules made up of lightweight polymeric materials, holding individual plants and growing media. These modules are attached to each other and are generally mounted onto a frame, fixed to the vertical surface, and linked to an irrigation system.
- A number of plants held within containers that can be vertically attached to each other.
- Bags filled with growing media that are made of flexible polymeric material and can be mounted on curved surfaces or sloped walls.
- Planter tiles that serve as modular cladding. These either comprise of hole-containing tiles for individual plants or flat black edges, that are either glued or mechanically fixed to the vertical surface.

### Hydroponic LWS

Based on principles of continuous LWS, hydroponic living walls are systems comprising of lightweight screens, where plants are grown without a substrate. Although extensively employed for architectural green wall projects in South Africa, a lack of air humidity in large parts of the region, especially Gauteng, have caused these systems to become significantly fragile and less effective. Their dependence on a permanent supply of water and nutrients means that even a short term power outage can cause plants to perish.

Moreover, besides the availability of water, other factors such as quality and pH greatly determine the success of these systems. The greater susceptibility of crop yields to algae also makes hydroponic LWSs an unsustainable option. Therefore, in order to address these issues, innovative solutions need to be incorporated into these systems to make them more resistant and sustainable.

### Aquaponic LWS

This system is an emerging practice that involves growing vegetables alongside fish, with fish waste being used as the main nutrient source. Although capable of producing good green leafy vegetable yields, this system is prone to numerous challenges including pollution, vandalism, water quality, harsh local climatic conditions, and limited knowledge, making it unsustainable for urban environments in the long run, especially in places like Gauteng. In addition, food safety issues may also be a concern, since fish from unmanaged aquatic systems are generally considered unsafe for human consumption.

### Aeroponic LWS

This is a fairly recent innovation which involves spraying a nutrient-rich solution onto exposed plant roots with the help of

atomisers. The system offers a plethora of advantages over other LWS systems including limited space requirement, high yield production, low maintenance, reduced nutrient requirement, increased mobility of the system and easy access to root inspection. Moreover, this technology is extremely water efficient and produces quick results, making it a viable choice.

**Although TAVs exhibit tolerance to extreme weather conditions, high quality seeds and cultivars need to be developed to ensure higher yields.**

However, this complex technology comes at a high cost and also requires high control and expertise, thereby make it unfeasible for use in low-key and low-cost urban environments. In addition, these systems are not very resilient in dry climates and have a high moisture content in the root chamber, thus increasing their susceptibility to bacterial growth.

**Crops varieties cultivated**

Given their sustainability and ability to improve diets, a 2022 research study explored the potential of using African Orphan Crops (AOCs) and Traditional African Vegetables (TAVs) as an alternative to commercial crops.

TAVs comprise vegetables like okra, amaranth, collard greens, yams, and cassava, that play a crucial role in African cuisines, offering diverse flavours and nutritional benefits. Although TAVs exhibit tolerance to extreme weather conditions like drought, high quality seeds and cultivars need to be studied and developed, to ensure higher yields.

AOCs on the other hand, include under-researched and under-utilised, locally adapted plants, comprising millets, sorghum, and indigenous leafy greens. Despite being nutritious, AOCs are not widely grown, which is why efforts are currently underway to promote and improve these crops for enhanced food security and nutrition in Africa.

African orphan crops and traditional African vegetables are being studied for their potential as an alternative to commercial crops.

Image Credit: Adobe Stock

Further research is however required to gain a clearer understanding about the application of AOCs and TAV crops in different living wall systems. Moreover, these systems also need to be improved by reducing installation costs, maintenance requirements and carbon footprint, while at the same time increasing resilience, crop performance and social benefits. This can be achieved by utilising local produce and materials that are either recycled and reused, thereby cutting down the reliance on expensive technology.

Dr. Terry Mabbett discusses the different types of potentially damaging defects found in coffee beans that require removal prior to roasting.

# Bean defects in green coffee

Ideally, green coffee comprises beans of uniform size and shape with no cracks, breaks or discolouration.

Image Credit: Adobe Stock

GREEN COFFEE READY for roasting is a picture of perfectness, comprising beans of uniform size and shape with no cracks, chips, breaks or discolouration. That is because a stringent quality control programme will have identified and removed any coffee bean with a defect. Quality control in crop commodities is as old as agriculture itself and has been practised ever since the phrase 'separating the wheat from the chaff' was coined.

Coffee is unique in the variety, range and intensity of post-harvest processing which is carried out in a well-established sequential order, right up to the roasting drum. The downside is a wide range of potential bean defects to match the wide spectrum of events experienced by the red ripe cherry before, during and after picking when processing does not proceed according to plan.

**Coffee is unique in the variety, range and intensity of post-harvest processing which is carried out in a well-established sequential order, right up to the roasting drum.**

'Defect' is term used in the coffee industry to describe quality-related factors that determine the proportion of defective beans and the presence of extraneous [foreign] matter from coffee and non-coffee origins. Particular type and nature of the defect, and the potential problems it may cause further downstream during storage, transit, roasting and cupping, may be due to:

- The presence of hard abrasive objects that can damage machinery.
- The risk of downgrading by buyers due to non-pleasing appearance (shape, colour and smell of green coffee beans).
- The distinct lack of uniformity in coffee bean samples and a range of chemical factors which may interfere with the development of taste and aroma during roasting.

### Defects in coffee beans

There are around 20 different 'defects' that may occur in green coffee beans and which must be removed prior to roasting. Well-established and potentially damaging bean defects which can be determined and categorised on the basis of colour, size, shape or

There are around 20 different defects that may occur in green coffee beans and which must be removed prior to roasting.

Image Credit: Adobe Stock

aroma/taste aberration and presence of foreign matter will include:

- **Black beans –** This is the main and most frequently occurring defect in green coffee and describes any bean that is 50% black, externally or internally. The 'Black bean' defect is caused by extended fermentation of the coffee cherry fruit that were gathered from the ground under the tree.
- **Dark grey beans –** Dark grey is a common colour defect caused by harvesting beans before they are fully ripe and because of insufficient drying.
- **Foxy beans –** Foxy bean describes a rusty red colour caused by carrying out artificial drying over a too longer period of time.
- **Glassy beans –** The glassy bean defect is also called the 'white' or 'opalescent' bean defect and is the result of insufficient drying or failure of the beans to re-absorb sufficient moisture after drying.
- **Blotchy beans –** The blotchy bean defect is characterised by external spots of different colours appearing on the surface of the bean and which are caused by oxidation reactions on the surface of the bean following physical injury.
- **Drought affected beans –** Drought-affected beans are typically under-sized beans which possess a dull grey-green colour and with a tendency for the skin to stick. This defect is caused by harvesting the coffee berries several weeks before they are fully ripe.
- **Broken beans –** A broken bean is classified as any piece of bean which is smaller than normal half bean size.
- **Crushed beans –** Crushed beans have a flattened shape with the median furrow laid open. This defect is caused by the processing of insufficiently dried beans.
- **Pitted beans –** A pitted bean is characterised by its surface being riddled with holes due to insect damage.
- **Elephant beans –** Elephant beans, as the name suggests, are large, over-sized and deformed beans.
- **Aborted beans -** Aborted beans are flat under-sized beans with a dull, wrinkled surface.
- **Stinker beans –** Stinker beans look perfectly normal but release a volatile and putrid odour when they are cut open. This is the most difficult defect to detect and now rivals 'black bean' in its frequency of occurrence.
- **Rancid or acid beans -** So called rancid or acid beans are dark brown in colour and will release an unpleasant odour when they are cut open.
- **Musty beans –** These beans emit an old musty smell due to the growth of fungal moulds on the surface of the bean.
- **Foreign matter –** The term foreign matter covers a wide range of coffee and non-coffee materials related to harvesting and on-farm processing. It includes anything and everything from small stones, glass, metal, soil, dust, dry cherry, pulp, parchment, leaves, twigs and fragments of wood.

**Potentially damaging bean defects can be determined and categorised on the basis of colour, size, shape, or aroma/taste aberration and presence of foreign matter.**

With so many different and discernible bean defects, quality control in coffee is by necessity a complex operation involving many different techniques and a wide range of equipment, some simple and others complex, but that is a story for another day.

# ANNUAL BUYERS' DIRECTORY 2024 EDITION

AN ANNUAL GUIDE to suppliers of equipment and services for agriculture and for the primary processing of produce. The first section of the Directory lists suppliers under classification of their products and services. The second section lists alphabetically company addresses.
The third section lists agents and distributors in Africa geographically. The Directory has been compiled from information submitted by the companies concerned.
**While every care has been taken to avoid errors and omissions, they may occur; the Editor would like to be notified of these so that the digital edition of the Directory can be kept up to date.**

***Supplier Listings*** *start on page 29*

***Agent Listings*** *start on page 32*

## Classified Listings

**Abattoirs**
LIMA S.A.S.

**Agricultural Equipment - General**
CANTONI MOTOR S.A
CNH Industrial Italia S. p. A
Micron Sprayers Ltd

**Agricultural Projects**
CANTONI MOTOR S.A
CNH Industrial Italia S. p. A

**Animal Health Products**
Evonik Africa (Pty) Ltd
Henke-Sass, Wolf GmbH
Socorex Isba SA

**Automatic Chain Feeders**
Big Dutchman International GmbH

**Bagging plant**
STATEC BINDER Gmbh

**Bale Handling Equipment**
JOSKIN S.A.

**Breeding**
Aviagen Ltd
Hendrix Genetics
Lubing System SRL

**Broiler Breeding Stock**
Aviagen Ltd

**Broilers**
Aviagen Ltd
Evonik Africa (Pty) Ltd
Henke-Sass, Wolf GmbH

**Cages & Batteries**
Big Dutchman International GmbH

**Centre Pivot Equipment**
T-L Irrigation Co.

**Chicks**
Henke-Sass, Wolf GmbH

**Chicks - Day Old**
Aviagen Ltd
Henke-Sass, Wolf GmbH

**Coffee Processing, Handling & Storage**
Swingtec GmbH

**Conveyors and Elevators**
Big Dutchman International GmbH
CANTONI MOTOR S.A
Lubing System SRL

**Coolers - Environmental**
Big Dutchman International GmbH

**Coolers - Evaporative**
Lubing System SRL

**Cotton Handling & Storage**
JOSKIN S.A.
Swingtec GmbH

**Crop Handling & Storage**
Swingtec GmbH

**Crop Protection Equipment**
Swingtec GmbH

**Disinfectants**
Intraco Ltd.

**Drinking Systems**
Big Dutchman International GmbH
Lubing System SRL

**Egg Collection**
Big Dutchman International GmbH

**Egg Layer Breeding Stocks**
Hendrix Genetics

**Egg Layer Parent Breeders - Brown**
Hendrix Genetics

**Egg Layer Parent Breeders - White**
Hendrix Genetics

**Egg Layers**
Hendrix Genetics
Henke-Sass, Wolf GmbH

**Engines**
CANTONI MOTOR S.A

**Extruders for Food, Feed**
Farmet a.s

**Extrusion Processing Equipment**
CANTONI MOTOR S.A
Farmet a.s

**Feed Additive Applicators**
Henke-Sass, Wolf GmbH

**Feed Additives**
Evonik Africa (Pty) Ltd
Intraco Ltd.
Unipoint AG

**Feed Concentrates**
Intraco Ltd.

**Feed Ingredients**
Evonik Africa (Pty) Ltd
Intraco Ltd.
Unipoint AG

**Feed Premixes**
Intraco Ltd.
Unipoint AG

**Feed Supplements**
Unipoint AG

**Feeders**
TATOMA Grupo

**Feeding Systems**
Big Dutchman International GmbH
MIK International GmbH & Co. KG
TATOMA Grupo

**Fertiliser Spreaders**
JOSKIN S.A.

**Fertilisers**
Omex Agrifluids Ltd.

**Fish Farming**
Henke-Sass, Wolf GmbH
Socorex Isba SA

**Fogging Machines**
Big Dutchman International GmbH
Swingtec GmbH

**Foliar Fertilisers**
Omex Agrifluids Ltd.

**Food Processing Equipment**
CANTONI MOTOR S.A
LIMA S.A.S.

**Forage Feeding Equipment**
TATOMA Grupo

**Forestry Equipment**
CANTONI MOTOR S.A

**Genetic Research**
Hendrix Genetics

**Grasscutting Machines - Forage**
JOSKIN S.A.

**Greenhouses - Glass**
Big Dutchman International GmbH

**Harvesting Equipment**
CNH Industrial Italia S. p. A
JOSKIN S.A.

**Hatcheries**
Henke-Sass, Wolf GmbH

**Horticultural Equipment & Machinery**
Micron Sprayers Ltd
Swingtec GmbH

**ICT Equipment & Services**
Big Dutchman International GmbH

**Integrated Pest Management**
Omex Agrifluids Ltd.
Swingtec GmbH

**Irrigation & Drainage Systems**
RKD Irrigacion S.L.
T-L Irrigation Co.

**Irrigation Equipment**
CANTONI MOTOR S.A
RKD Irrigacion S.L.
T-L Irrigation Co.

**Livestock Handling**
JOSKIN S.A.

**Material Handling - Bulk**
STATEC BINDER Gmbh

**Meat Processing and Packaging**
LIMA S.A.S.

**Medicators**
Big Dutchman International GmbH

**Micronutrients**
Omex Agrifluids Ltd.

**Mills**
CANTONI MOTOR S.A

**Oil Extraction Equipment**
Farmet a.s

**Oilseed Production & Processing**
Farmet a.s

**Packaging Machinery**
STATEC BINDER Gmbh

**Palletizers**
Big Dutchman International GmbH
STATEC BINDER Gmbh

**Pig Equipment**
Big Dutchman International GmbH
Henke-Sass, Wolf GmbH
MIK International GmbH & Co. KG

**Pig Feeding/Drinking Equipment**
Big Dutchman International GmbH

**Pig Flooring**
Big Dutchman International GmbH
CARFED International Ltd
MIK International GmbH & Co. KG

**Pig Health Products**
Socorex Isba SA

**Pig Housing**
Big Dutchman International GmbH
MIK International GmbH & Co. KG

**Plant Protection Chemicals**
Omex Agrifluids Ltd.

**Plastic Flooring, Poultry**
Big Dutchman International GmbH
MIK International GmbH & Co. KG

**Poultry Equipment - Drinking**
Big Dutchman International GmbH

**Poultry Equipment/Handling**
CARFED International Ltd
Henke-Sass, Wolf GmbH

**Poultry Feeding**
Big Dutchman International GmbH

**Poultry Health Products**
Evonik Africa (Pty) Ltd
Henke-Sass, Wolf GmbH
Socorex Isba SA

**Poultry Housing**
Big Dutchman International GmbH

**Poultry Processing Equipment & Supplies**
CARFED International Ltd
LIMA S.A.S.

**Poultry Stock**
Aviagen Ltd

**Public Health**
Swingtec GmbH

**Pumps**
CANTONI MOTOR S.A
T-L Irrigation Co.

**Roll-out Nests**
Big Dutchman International GmbH

**Silage**
JOSKIN S.A.

**Silos**
Big Dutchman International GmbH

**Slaughtering Equipment**
LIMA S.A.S.

**Slurry Disposal**
JOSKIN S.A.
T-L Irrigation Co.

**Soluble Fertilisers**
Omex Agrifluids Ltd.

**Sprayers**
CNH Industrial Italia S. p. A
GOIZPER GROUP (MATABI - IK Sprayers)
Henke-Sass, Wolf GmbH
RKD Irrigacion S.L.

**Sprayers - Crop**
GOIZPER GROUP (MATABI - IK Sprayers)
Micron Sprayers Ltd

**Spraying Nozzles & Components**
GOIZPER GROUP (MATABI - IK Sprayers)
Henke-Sass, Wolf GmbH
Micron Sprayers Ltd

**Stored Products Protection**
Swingtec GmbH

**Straw Choppers/Grinders**
TATOMA Grupo

**Trace Elements**
Omex Agrifluids Ltd.

**Tractors**
CNH Industrial Italia S. p. A

**Trailer Transporters, Livestock**
JOSKIN S.A.

**Trailers**
JOSKIN S.A.

**Transport Boxes**
CARFED International Ltd

**Transport Crates for Poultry**
CARFED International Ltd

**ULV Spraying Equipment**
GOIZPER GROUP (MATABI - IK Sprayers)
Swingtec GmbH

**Ventilating Equipment**
Big Dutchman International GmbH
CANTONI MOTOR S.A

**Veterinary Products/Equipment - General**
Henke-Sass, Wolf GmbH
Socorex Isba SA

**Waste Disposal Equipment**
Big Dutchman International GmbH

**Water Pipes**
RKD Irrigacion S.L.

**Watering Equipment**
RKD Irrigacion S.L.

**Weed Control**
GOIZPER GROUP (MATABI - IK Sprayers)

**Weighers - Animal**
Big Dutchman International GmbH

**Weighing - Sack Filling**
STATEC BINDER Gmbh

**Weighing Equipment**
Big Dutchman International GmbH

# Supplier Listings

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Aviagen® is a global poultry breeding company that develops pedigree lines for the production of commercial broiler chickens under the Arbor Acres®, Indian River®, and Ross® brand names. The company is based in Huntsville, Alabama, USA with a number of wholly-owned operations across the United Kingdom, Europe, Turkey, Latin America, India, Australia, New Zealand, and the U.S., and joint ventures in Asia and Africa.

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Big Dutchman is the world's leading equipment supplier for modern pig and poultry production. The product range includes traditional and computer-controlled feeding and housing equipment as well as systems for climate control and exhaust air treatment. The scope varies from small to large, fully integrated turn-key farms.

**Agents:**
Algeria - SARL Mecafa Algerie
Egypt - Eslam Ramadan
Egypt - Mohamed Khalil
France - Soproda (Region Dom-Tom + Continent d' Afrique)
Kenya - Agriculture Equipment Kenya Ltd.
Morocco - Agri-Art
Nigeria – Chi Farms Ltd
South Africa - Big Dutchman South Africa (Pty) Ltd.
Tunisia - SEMA

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Cantoni Group is a global leader in manufacturing of electric motors, brakes and tools with almost 150-years-long tradition. Cantoni Motor, the International Sales Office located in Poland, coordinates the sales and purchasing for the whole Group. We offer a full range of IEC asynchro-nous induction electric motors from 0,04kW up to 7000kW, in standard and special executions. Our motors operate in all industry segments, including agriculture.

### CARFED International Ltd

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CARFED LTD is a worldwide known group that specializes in plastic poultry products.
CARFED LTD has the widest range of collapsible and non-collapsible plastic chicken crates, to haul live birds

- Mondial CARFED and Mondial "S" of cms 80x60x28
- Multi 100 of cms 97x58x27
- Muti 110 of cms 108x58x27
- Super, not collapsible, of cms. 99x58x26

CARFED products can be seen in the website www.carfed.it

### CNH Industrial Italia S. p. A

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Case IH represents more than 180 years of industry experience. With a global presence in more than 160 countries, we are recognized today as a global leader in powerful, reliable and highly efficient equipment that helps producers meet the challenges of modern agriculture.

### Compact Seeds and Clones SA

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Evonik's Animal Nutrition business line has been supporting the global livestock industry with science-based products, services and system solutions for sustainable, efficient and healthy animal nutrition. We want to help supply a growing world population with healthy and affordable animal protein – while caring deeply about animal welfare, the efficient use of natural resources and food safety.

### Farmet a.s

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Farmet - CZECH Company founded in 1992 is global producer and supplier of complex oilseeds and vegetable oil processing technologies for feed extrusion. Our hexane free technologies are based on own R&D, production and provide the customers the best cost-effective, economic and environmentlly friendly solution.

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The project will benefit up to 250,000 cereal farmers in the country, boosting their food security and self-sufficiency.

# Tunisian cereals project chosen as prime climate finance transaction

Image Credit: Adobe Stock

This cereal project in Tunisia will strengthen the resilience of the cereals sector to external shocks and climate change.

THE AFRICAN DEVELOPMENT Bank (AfDB) and the UK have announced the selection of the Inclusive and Sustainable Development of the Cereal Sector Project in Tunisia, as a standard-setting project under the Room to Run Sovereign transaction (R2RS).

Approved in July 2023, this cereal sector project in Tunisia will strengthen the resilience of the cereals sector to external shocks and climate change. The project will benefit up to 250,000 cereal farmers in the country, boosting their food security and self-sufficiency. It is estimated that up to US$35mn of the US$87mn Bank financing corresponding to the climate adaptation component of the loan has been unlocked by the UK Government guarantee, which increased the Bank's overall lending capacity.

Room to Run Sovereign, announced at COP26 in November 2021, is an innovative and highly scalable balance sheet optimisation transaction that is helping the African Development Bank lend more funding for critical climate change projects. Under R2RS, a US$2bn guarantee is provided by the UK Government (US$1.6bn in cover) and City of London insurers (US$400mn). By assuming a portion of the credit exposure on a part of the African Development Bank's sovereign portfolio, R2RS enables the Bank to provide up to an additional US$2bn of climate finance to Africa by 2027, split between adaptation and mitigation.

In May last year, the UK and the Bank announced the first two projects that were enabled by R2RS - an US$87.2mn Egyptian wastewater project and a US$40.3mn water sanitation project in Senegal. Both focus on water supply and sanitation and will benefit millions in their respective countries. This project in Tunisia is the third project to be selected by the UK, demonstrating that the unlocked lending capacity provided by R2RS, since the agreement was signed in 2022 is accelerating delivery of very strong climate finance transactions across the continent. This announcement accompanies three other R2RS-enabled transactions in Benin, Kenya and Mauritius, bringing the total climate finance unlocked by the R2RS to over US$400mn.

**Room to Run Sovereign is an innovative and highly scalable balance sheet optimisation transaction that is helping the AfDB lend more funding for critical climate change projects.**

African Development Bank Vice-President for Power, Energy, Climate and Green Growth, Kevin Kariuki said, "This transaction is one of several projects constituting its lending programme through which the African Development Bank fulfils the call by stakeholders at COP27 for MDBs to innovate and scale up climate finance through the Multilateral Development Banks. The African Development Bank is proud to partner with the UK in this initiative and to be at the forefront of such developments."

FCDO's Minister for International Development and Africa, Andrew Mitchell, said, "This project will make a huge difference in the sustainability of food production for millions in the country as it grapples with the harmful effects of prolonged drought."

Thanking the UK for its support, Malinne Blomberg, Deputy Director General for North Africa and Country Manager for Tunisia said, "In the face of increased water stress in North Africa affecting domestic agriculture production and the global crisis in grain prices affecting imports, we appreciate the inclusion of the climate resilient PADIFIC cereal project in Tunisia in the R2RS portfolio as it allows the Bank to further scale up its support to similar essential climate-related interventions. The project is part of the national efforts for strengthening food security resilience and intervenes throughout the cereal value chain, including storage and transport systems, with the aim to increase both production volumes and productivity."

To address the plethora of challenges faced by feed mills, appropriate biosecurity measures need to be implemented to minimise the risk of disease transmission and ensure the production of safe and healthy animal feed.

# Boosting feed mill biosecurity

Image Credit: Adobe Stock

Biosecurity procedures are often implemented based on different levels of severity.

FEED MILLING IS crucial for animal feed production. However, there are several risks involved in the feed milling process, which need to be kept in check. This is why implementing appropriate biosecurity measures helps minimise the risk of disease transmission, ensuring the production of safe and healthy animal feed.

The various challenges faced by feed mills include pathogen contamination in raw materials or during processing; quality control issues arising from inconsistent feed composition or nutrient levels; improper storage conditions leading to mould growth, spoilage or nutrient degradation in feed ingredients; equipment malfunctions that can disrupt production; regulatory compliance issues arising from a failure to comply with safety and quality regulations; supply chain disruptions resulting from issues with the availability or quality of raw materials; and cross contamination caused by mixing different batches or types of feed without cleaning.

**Routine biosecurity procedures are minimum requirements of the feed milling industry and need to be implemented and followed on a daily basis.**

### Levels of biosecurity

Biosecurity procedures are often implemented based on the different levels of severity. Routine biosecurity procedures are minimum requirements of the feed milling industry and need to be implemented and followed on a daily basis.

High risk biosecurity procedures on the other hand, need to be followed only in the event of an urgent plant or animal disease outbreak. These procedures need to only be implemented under the guidance of the state government's agricultural department.

### Routine biosecurity procedures:

- **Input management:** The primary requirement is to prevent the entry of contaminants and hazards into the feed mill.

Firstly, it is important to ensure that the water being used in the feed mill is of suitable quality. Water containing high levels of organic matter is generally considered unsuitable. Therefore, appropriate treatment options need to be applied, with water treatment systems being monitored on a regular basis to ensure effectiveness.

Secondly, the introduction and movement of grains, roughages, additives and feed ingredients need to be carefully managed to minimise the risk of pest and weed contamination and disease spread.

Thirdly, feed ingredients need to be received with extreme caution to prevent feed contamination. Moreover, cleanliness checks on delivery vehicles, along with feed ingredient inspections need to be mandatorily conducted as part of the receival process. Lastly, the movement of people, equipment and vehicles needs to be managed to minimise the risk of site contamination. Protective attire, including clothing and footwear along with personal protection equipment (PPE) needs to be worn at all times inside the feed mill. Moreover, access to visitors and vehicles into the main areas of the feed mill need to be restricted, unless absolutely necessary.

- **Management of production practices:** Regular feed mill maintenance operations need to be conducted between production runs to reduce the attraction of birds and rodents to production areas. Moreover, feed ingredients should be appropriately stored and feed spills need to be cleaned up as soon as practicable.

Feeding of restricted animal material (RAM) to ruminants must also be avoided at all costs. This includes any material that may contain or may have been in contact with RAM, including the flushings.

Furthermore, during the feed manufacturing process, feed movement should only flow in one direction to minimise the risk of contamination. Moreover, cross contamination of feed mixes should be prevented by ensuring that sequencing, cleaning and flushing schedules are taking place on a regular basis.

- **Training and documentation:** All feed mill staff, including delivery drivers, must be inducted and trained in biosecurity practices, including the Emergency Disease Action Plan. It is also essential to make sure that all employees involved in the daily monitoring and handling of feed are aware of the importance of early detection of contamination and the procedures to be followed at the time of detection.

A copy of the property layout, along with an Emergency Disease Action Plan, must be made available for all staff. Batch processing records, verifying the treatment of the products in accordance with established procedures must also be kept handy at all times.

- **Outgoing product management:** Scheduling deliveries is extremely important to minimise the spread of pests and diseases that occur as a result of feed deliveries. Appropriate communication with feed mills, external contractors, and clients need to be established, so that all parties can be kept in the loop about any possible disease outbreak incidents. In such cases, delivery routes need to be altered accordingly, making sure that trucks do not pass by 'clean' farms after delivering to a known 'dirty' farm. During times of disease outbreak, movement restrictions are usually imposed by the government, that need to be deligiantly followed by truck drivers.

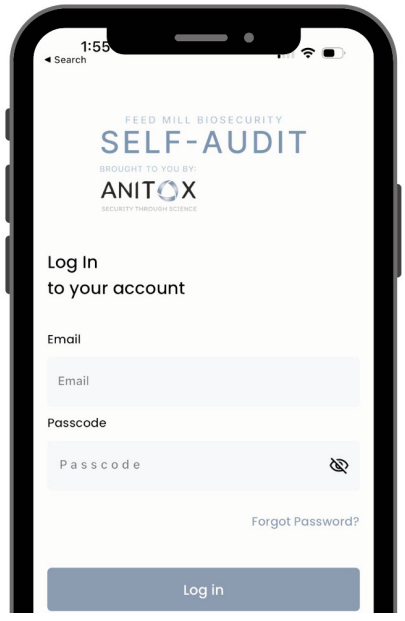
Truck cabins must also be cleaned and disinfected on a daily basis and trucks are required to use feed mill approved wash down facilities prior to returning to and entering the feed mill.

During high level biosecurity incidents, vehicles are only allowed on site under permit by the state/territory government. Stringent decontamination protocols will also be applicable for both the delivery vehicles and the people involved.

**Anitox's new feed mill biosecurity audit app allows users to record past audits, identify areas of concern and establish a baseline for biosecurity.**

### Globally accessible biosecurity audit app

Feed millers around the world now have access to a biosecurity application that allows them to record past audits, identify areas of concern and establish a baseline for biosecurity, thus implementing sound manufacturing practices and adhering to regulatory biosecurity requirements. Anitox, a feed pathogen control specialist, launched this free app to collect and present feed mill biosecurity audit records for all geographies and regulatory bodies.




The app is available for free in both the iOS and Google Play Stores.

Image Credit: Anitox

Anitox has given up the right to track user-given audit data, making the Feed Mill Biosecurity app the most secure and private offering available. App users can therefore be confident that their data is protected and private. The app is available on both iOS and Google Play stores and also mill managers to access a feed mill technologist with just the click of a button.

"Auditing feed mills and amassing the evidence and data needed to produce meaningful biosecurity programmes can be a headache. For years our feed mill technologists have been walking facilities with customers, collecting evidence and preparing reports for regulatory and compliance bodies across the globe," explained Anitox's global director of Nutrition and Live Production, Dr. Enrique Montiel, who further emphasised that the procedure had become significantly easier with the launch of the new feed mill biosecurity audit app.

"Our team of feed milling technologists and technical specialists solve Salmonella, virus and other feed pathogen-related challenges on a daily basis; now that knowledge has been put the good use for the wider community. Having proven the technology with our loyal customers, we have decided it is too useful to keep to ourselves," Montiel added.

As environmental issues continue to dominate global concerns, feed millers are being urged to adopt sustainable practices that are capable of efficiently minimising the industry's ecological footprint.

# Treading the path to net zero

Image Credit: Adobe Stock

Feed millers are required to adopt sustainability practices in their feed milling operations.

HIGH QUALITY ANIMAL feed production is crucial for the health and wellbeing of livestock, poultry and farmed aquatic animals, which is why feed milling is one of the most critical aspects of the animal agriculture industry. As environmental issues like climate change and global warming continue to dominate global concerns, feed millers are being urged to adopt sustainable practices that are capable of efficiently minimising the feed milling industry's ecological footprint.

### Environmental challenges

The feed milling industry faces a plethora of environmental challenges that call for immediate action:

- **Overdependence on natural resources:** Heavy reliance of feed milling operations on natural resources like water and energy exterts excessive strain on the environment, resulting in increased carbon emissions.
- **Water pollution:** Nutrient runoff caused by inadequate management of feed mill effluents can pollute surrounding water bodies, resulting in eutrophication.
- **Waste disposal:** A significant amount of waste is generated during the feed milling process, with the improper disposal of these materials directly contributing to environmental degradation.

To address these issues, feed millers should ensure to adopt the following sustainability practices in their feed milling operations:

- **Sustainable feed sourcing:** Locally sourcing feed ingredients helps minimise transport distances, while also supporting regional agricultural economies. Moreover, promoting responsible agricultural practices like regenerative farming can help foster soil health and carbon sequestration. At the same time, exploring alternative protein sources such as insect-based protein helps reduce environmental impact.

**FFT and JRA plan to improve farm operations and meet a growing demand for sustainably produced animal feed.**

- **Improving energy efficiency:** Switching to renewable energy sources by integrating solar panels and wind turbines on-site play a role in reducing carbon footprint. Conducting regular energy audits is also necessary to ensure that these energy efficient measures are appropriately implemented.
- **Waste management:** Implementing recycling programmes, effective waste management techniques like waste valorisation, along with the adoption of circular economy principles helps minimise waste generation and maximise resource utilisation.
- **Water conservation and management:** Implementing water recycling and rainwater harvesting systems are critical for sustainable feed milling.

### Practical applications

Forever Feed Technologies (FFT) and JR Automation (JRA) have decided to practically implement these measures through their recent partnership, which aims to design and build on-farm controlled environment feed mills for large-scale dairy and beef cattle producers.

Through their partnership, the two companies plan to improve farm operations and meet a growing demand for sustainably produced high-quality animal feed, by delivering custom automated systems that maximise the productivity and effectiveness of FFT's water and carbon emission reduction technology. JRA will provide FFT with a unique single-source solution for complete integration of FFT technology and data information, providing greater speed, flexibility, and efficiencies. This will give agricultural leaders around the world a solid and profitable path to reducing water use and greenhouse emissions.

The project financed by the World Bank through the IDA, has helped build bridges and opened the way for the transportation of mangoes to the market, while also boosting job opportunities in the region.

# Mali's mango road ignites a spark of hope among locals

IN MALI, MANGO production basins were cut off from the rest of the country during the rainy season. Financed by the World Bank through the International Development Association (IDA), the project has helped build bridges, culverts, and inverts, and opened the way for the transportation of mangoes to the market and job creation; Visits to health centres have quadrupled in the project area.

Located deep in the interior of the Bougouni region to the south of Bamako, the villages of Doussoudiana, Kémissala, and Bembougou are now accessible year-round, which allows residents to sell their crops.

The region, known for its famous and delicious mangoes, recently received infrastructure and equipment to help improve the production and sale of its fruits.

At the entrance to the villages lies a small, fully collapsed bridge, a vestige of the 1980s. This bridge, which connected these villages to the rest of the country, was often completely submerged in water because it was not sufficiently elevated. As a result, many villages were cut off from the rest of the country during the rainy season.

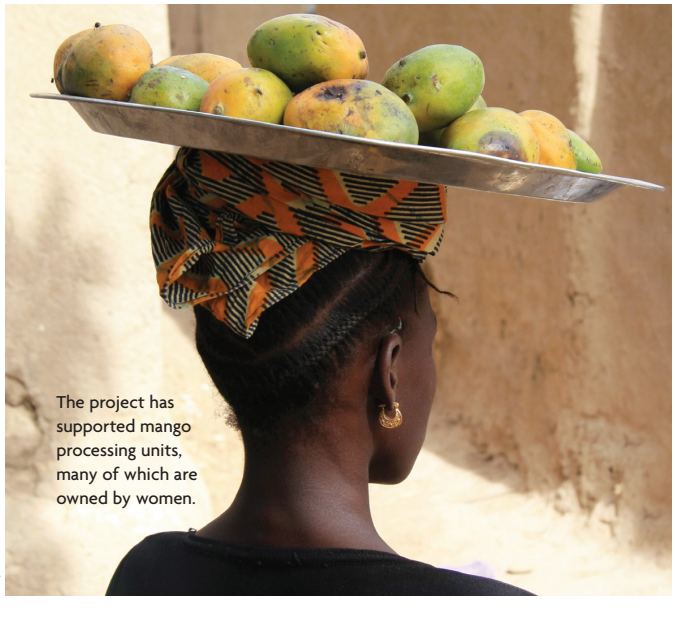
As Dibi Sidibé, the Mayor of Bolo Fouta, put it: "We were isolated and cut off for a long time. But we never gave up and looked for ways to get our community out of this situation."

Since early 2022, infrastructure construction under the Mali Support to Agro-Industrial Competitiveness Project (PACAM) has improved accessibility to this area. The project has rehabilitated 300Km of rural roads and infrastructure to facilitate access to production basins in the districts (cercles) of Sikasso, Bougouni, and Yanfolila. The project works, which were fully transferred to the General Directorate of Roads on 26 June 2023, have opened up access to more than 72 villages in 15 communes.

These new developments have resulted in an economic rebound. The bridges, culverts, and inverts have facilitated travel and trade between local communities, increasing mango production by more than 35,0000 tonnes per year and creating 362 jobs. The project has also supported mango processing units, many of which are owned by women, by training and providing these women with equipment.

**The region, known for its famous and delicious mangoes, recently received infrastructure and equipment to help improve the production and sale of its fruits.**

"The project has helped boost Malian mango exports. Based on its performance, the government is asking the World Bank to consider extending it," said Minister of Rural Development, Mouhamed Diarra. E



The project has supported mango processing units, many of which are owned by women.

CaptionAdobe Stock

Poor soil quality in sub-Saharan Africa has increased the need to integrate increased fertiliser use, along with other aspects of soil fertility management.

# Shaping the future of sub-Saharan Africa's fertiliser market

Fertiliser usage boosts yields, enabling farmers to sell surplus produce.

Image Credit: Adobe Stock

ACCORDING TO DATA by Modor Intelligence, Africa's fertiliser market is estimated at US$9.10bn in 2024 and is projected to reach US$12.01bn by 2028, growing at a CAGR of 7.18% during the forecast period.

Continuous cultivation in the absence of adequate nourishment has led to nutrient depletion in the soil, which has greatly affected soil quality, resulting in low agricultural productivity. Poor soil quality in sub-Saharan Africa has called for the need to integrate increased fertiliser use along with other aspects of soil fertility management. Fertiliser application helps restore essential soil nutrients like nitrogen, phosphorus and potassium that are crucial for boosting crop yields, improving food security and increasing farmers' incomes. This in turn helps in poverty alleviation. With higher yields in hand, farmers are able to sell surplus produce, thus making it easy for them to support their families. All this contributes to an increase in production of staple crops, which significantly contributes to achieving overall food security, something which an agriculture dependent continent like Africa strives to achieve.

According to an article by CABI, the fertiliser approach is capable of empowering 50 million African farmers, thereby contributing to the United Nations Sustainable Development Agenda 2030, particularly Sustainable Development Goal (SDG) number 2. During the period of 2013-2017, the Optimising Fertiliser Recommendations for Africa (OFRA) project was implemented across 13 countries in sub-Saharan Africa including Burkina Faso, Ethiopia, Ghana, Kenya and Nigeria, among others. The objective of the project was to improve the relevance of fertiliser recommendations for stakeholders within the context of the Integrated Soil Fertility Management (ISFM) practices, while also improving access to information and communication materials for extension workers.

**Fertiliser application helps restore essential soil nutrients like nitrogen, phosphorus and potassium that are crucial for boosting crop yields, improving food security and increasing farmers' incomes.**

Field trial data from these 13 countries were collected through an online database along with a variety of tools and methods that were developed to promote crop and

fertiliser recommendations. Using this data, 5,275 crop response functions were developed, with Uganda's data being used to develop practical decision support tools such as a fertiliser optimisation tool (FOT) that advises farmers on amount of fertiliser to be used to maximise their profits, and is tailored to their local locations. More than 1,000 researchers, 3,400 extension workers and and Community Knowledge Workers (CKWs) in 13 countries were trained in their use. In addition, 10 scientists were also trained to utilise their own data to develop similar tools suitable for different agro-ecological zones in their countries.

**Recent partnerships and developments**

Similar to OFRA, several fertiliser projects and partnerships have been established in the past year to enhance agricultural productivity.

- In July last year, MAIRE S.p.A. announced that its subsidiary NextChem Holding, through Stamicarbon, part of the Sustainable Technology Solutions business unit, was awarded licensing and proprietary equipment contracts related to an ammonia and urea complex for an overall value of approximately US$108.7mn. The integrated ammonia and urea complex in Sub-Saharan Africa will have a capacity of 4,600 MTPD of ammonia and 8,000 MTPD of urea in two production trains. The project, which is expected to be operational in 2026, aims to address the growing demand for high-quality fertilisers in the region and globally. The state-of-the-art complex will use Stamicarbon's leading nitrogen technology and proprietary equipment which will allow to reduce energy consumption and minimise ammonia emissions.
- In October 2023, the World Bank collaborated with the OCP Group to improve agricultural productivity and soil health through the use of customised fertilisers and sustainable farming practices. This is a critical partnership to help achieve the commitments made by the Ministries of Agriculture and Food Security of member countries of the Economic Community of West African States (ECOWAS) in the Lomé Declaration endorsed in May 2023. The cooperation aims at accelerating investments and reforms to make fertilisers more accessible and affordable to farmers.

**Various factors such as environmental sustainability, nutritional management and access to resources need to be considered to ensure maximum success through fertiliser application.**

The partnership will focus on five areas of cooperation which include using digital soil mapping analysis and customised fertilisation to improve soil health and fertility; training and supporting smallholder farmers through the establishment of agricultural technology and service centres; fostering local capacities and entrepreneurship through the launch of a Digital Farming School programme; strengthening the capacity of ECOWAS to operationalise its roadmap on fertilisers and soil health; and supporting the establishment of a Regional Centre for Soil Health and Fertility management in West Africa hosted by the International Institute of Tropical Agriculture (IITA).

- Falcon Agricultural Equipment has intoduced the CurveControl software option for agricultural equipment manufacturer AMAZONE's centrifugal broadcasters, that enable precise fertiliser application even around the curves. CurveControl helps prevent under- and over-fertilisation, thereby minimising the risk of nutrients leaching into the ground water. Furthermore, the software prevents incorrect application beyond the field boundary and can further improve the environmentally-friendly use of mineral fertiliser in combination with existing solutions such as ArgusTwin, WindControl and GPS part-width section control.
- AMAZONE in collaboration with Bayer's leading digital agriculture platform, FieldView entered into partnership in November last year, with the aim of further promoting and simplifying the adaptation of smart farming practices. The objective of the collaboration is to improve connectivity and create a link between FieldView's advanced digital tools and AMAZONE's precision machinery. Farmers will benefit from easy digital capture of all agronomically relevant parameters, marking an important milestone in the digital transformation of agriculture. One of the main objectives of FieldView is to provide farmers deeper insights into the performance of their crops and fields. Therefore, their collaboration with AMAZONE aims to ensure seamless integration and communication between AMAZONE machines and the FieldView Drive.

While fertilisers are a valuable tool for farm empowerment, factors like environmental sustainability, balanced nutrient management, and access to resources need to be considered, in order to ensure the long-term success of agricultural communities. E


AMAZONE and FieldView enter into a collaboration with the aim of further promoting and simplifying the adaptation of smart farming practices.

Image Credit: AMAZONE

Hyperspectral imaging is being extensively studied for its potential in precision agriculture.

# Adopting hyperspectral imaging in precision agriculture

AS THE TECHNOLOGICAL revolution enters agriculture, advanced remote sensing techniques are gradually coming into picture. Hyperspectral imaging is one such technique that is being extensively studied for its potential in precision agriculture.

The process of hyperspectral imaging involves capturing and analysing a wide range of electromagnetic wavelengths to gather detailed information about crops. They mostly comprise of hyperspectral sensors that can be mounted on various platforms such as satellites, UAVs, airplanes and close-range platforms to capture images with varying spatial and temporal resolutions. When used in precision agriculture, the process significantly improves crop management by monitoring plant health, detecting diseases, and optimising resource usage.

Image Credit: Adobe Stock

UAV-based hyperspectral imaging is one of the most popular and preferred platforms due to its ability to capture high-spatial-resolution data at a lower cost.

**Hyperspectral sensors can be mounted on a variety of platforms to acquire images with different spatial and temporal resolutions.**

### Types of hyperspectral imaging platforms

Hyperspectral sensors can be mounted on a variety of platforms including satellites, airplanes, UAVs and close-range platforms, to acquire images with different spatial and temporal resolutions.

### Satellite-based hyperspectral imaging

Two of the most commonly used satellite-based hyperspectral imaging sensors include:

- **EO-1 Hyperion:** Hyperion data has been used in numerous agricultural studies for monitoring different crop and soil properties including detecting crop diseases, estimating crop properties, assessing crop residues and investigating soil features. Studies have also been conducted to compare the performance of Hyperion hyperspectral imagery with Landsat multispectral imagery for crop classification. From the results, higher classification accuracy was found to be achieved through hyperspectral imagery.
- **PROBA-CHRIS:** Launched in 2001, this hyperspectral sensor produces data that can be used for retrieving leaf area index (LAI), fraction of vegetation cover (fCover) and the fraction of absorbed photosynthetically active radiation (FAPAR) in an agricultural field. Studies were also conducted to compare the performance of airborne Multispectral Infrared Visible Imaging Spectrometer (MIVIS) data and spaceborne PROBA-CHRIS data for investigating soil texture. Results showed similar performance by both data, although PROBA-CHRIS data had a slightly lower spatial resolution.

### Airplane-based hyperspectral imaging

Airplanes and manned helicopters have widely been used as platforms for hyperspectral imaging. These techniques have been used for both agriculture and forestry purposes, to monitor crop yield, chlorophyll content, crop cover fraction, weed classification and for delineating management zones. Notable examples include the AHS-160 hyperspectral sensor, the SWIR Hyper Spectral Imaging (HSI) sensor and the Pushbroom Hyperspectral Imager (PHI).

### UAV-based hyperspectral imaging

This is one of the most popular and preferred platforms due to its cost effectiveness and ability to provide timely data, thereby enabling its usage in precision agriculture practices for managing crops and improving yields. Since they are capable of capturing high-spatial-resolution data at a lower cost, UAVs are often considered superior to manned airplanes and helicopters. Another plus point of UAVs include their high flexibility in terms of scheduling a flight mission.

### Close-range hyperspectral imaging

This is an emerging technology capable of being used for investigating fine-scale vegetation features like leaf and canopy level, thereby indicating crop growing status and supporting the early detection of crop stress. This technology is either ground- or lab-based and can acquire super-high-spatial-resolution hyperspectral imagery. Mainly consisting of sensors mounted on moving or stationary platforms, this technology can be deployed either outdoors or indoors for collecting images. A source of light that may be natural (sun) or artificial (lamp) is used in the platform.

While this technique can provide detailed information about the plant's

biophysical and biochemical processes, as well as their response to diseases and environmental stressors, there are a number of challenges faced during the image collection and processing, which include illumination effects and shadows, among others.

### Processing and analysing hyperspectral images

Processing hyperspectral data involves extracting valuable information from the captured spectrum. A variety of analytical methods such a linear and advanced regression, machine learning, deep learning, and RTM, have been used for analysing the large amounts of data in hyperspectral images. Regression is the most commonly used method while RTM is very minimally studied. Deep learning and big data analytics tools are also extremely useful for recognising patterns in remote sensing data.

### Preference of hyperspectral imagery over other forms of remote sensing

Commercially-available spectral sensors have traditionally been used to capture crop images over vast areas of land in specific wavelengths that are well beyond the visible spectrum. However, the spectral quality needed to detect minute variations in plant physiology is lacking. Hyperspectral sensors however, have high spectral resolution that is capable of shifting how precision agriculture is managed.

Multispectral imaging for example, is frequently used in agriculture. However, its ability is limited beyond deriving vegetation indices such as Normalized Difference Vegetation Index to measure plant health. This is done by capturing data across a few narrow wavelength bands. Moreover, multispectral sensors lack spectral resolution, resulting in their inability to be ideally used for tasks such as crop variety identification and classification.

### Latest innovations

Recent years have seen some remarkable innovations in the hyperspectral remote sensing market:

- Space data company, Pixxel in 2021, launched the World's Highest Resolution Hyperspectral Smallsat Constellation. Capable of beaming down 50 times more information than the typical multispectral satellites used toda, Pixxel's hyperspectral Earth imaging satellites function by precisely recording chemical signatures and providing more precise answers to problems faced by numerous sectors including agriculture, energy, and environmental preservation. In agriculture, Pixxel supports crop variety classification through hyperspectral imagery. Crop variety classification involves the identification and categorisation of crop varieties based on various parameters such as growth rate, genetic composition, resistance to disease/pests and yield potential, among others. Since spatial signature emissions are unique to crop varieties due to the presence of pigments like chlorophyll, this technique can ideally detect crops that are resistant to natural calamities and disease, thereby minimising the need to use chemical treatments.
- In November 2023, Pixxel introduced its hyperspectral imagery to the European market. The company also has plans to further expand its footprint to other countries. With three hyperspectral satellites already in space, Pixxel aims to build a comprehensive health monitor for the planet. The company is now working towards launching six satellites in 2024 and further 18 satellites by 2025.
- China in December last year, launched March-2D rocket carrying the multispectral satellite, Gaofen-5 01A. Besides agriculture, the satellite serves a variety of other fields such as disaster relief, environmental preservation, land and weather.

**Hyperspectral sensors have high spectral resolution that is capable of shifting how precision agriculture is managed.**

### Primary challenges

Some of the notable challenges faced by hyperspectral remote sensing include:

- A lack of advanced techniques and algorithms to process hyperspectral data, resulting in inaccurate analysis and interpretation.
- High cost of superior quality hyperspectral sensors, that can limit their access to certain industries and applications.
- Requirement of significant storage and bandwidth for transmission, particularly in remote areas.
- Interference caused by atmospheric conditions, thus affecting accuracy in spectral analysis.
- Concerns regarding privacy, data ownership and ethical use of hyperspectral data.
- Complexities in adhering to the use and collection of hyperspectral data in accordance to regulations and international agreements.

### Future of hyperspectral sensor technology

According to a recent research report by Prophecy Market Insights, hyperspectral sensor technology is expected to offer higher resolution in the near future, becoming more compact for versatile deployment, enabling real-time data analysis, integrating seamlessly with other technologies, and becoming more cost-effective.

Moreover, advancements in AI and machine learning will enhance data processing, while customisation for specific industries will simplify adoption. In addition, emerging markets will diversify its applications, and ongoing research and development will drive innovation in sensor technology and data analysis techniques. The technological focus will also increasingly centre on addressing the numerous environmental and sustainability challenges faced by the world today.


The process of hyperspectral imaging involves capturing and analysing a wide range of electromagnetic wavelengths to gather detailed information about crops.

## ALMACO launches new SeedPro Elite Research Planter

ALMACO HAS RECENTLY announced the launch of the new SeedPro Elite Research Planter, which uses cutting-edge plot planting technology to deliver unmatched precision in seed placement, clean alleys, and consistent plot dimensions.

Greater precision provides seed and research professionals with less variables, enabling them to plant with unique customisations to suit different operational requirements. This in turn leads to better harvest data and faster advancement decisions. The planter's electric-drive motors and precision-placement individual-row controls allow for row-by-row population planting, offering ultimate control over research plot data. Moreover, synchronisation between rows and automated timing provide consistent plot starts every time, ensuring consistent seed placement within each row.

SeedPro Elite is designed to enable seamless integration with a variety of tractors, guidance systems, and added accessories for more operational flexibility. In addition, a modern new-user interface was also created to support flexible mapping and individual-row planting controls. The display is used to adjust planter settings, import field maps, export logged data, and monitor performance while planting. The setup only takes few minutes to get to the field faster. The presence of the intuitive platform also indicates that researchers can spend less time training staff and more time in the field operating.

"In research, your data is everything, so the number of variables SeedPro Elite removes from the equation is significant," said ALMACO product manager, Rob Paul. "When border plants in each plot have equal sunlight exposure and soil nutrient opportunity, it removes variables to your data. At harvest time, there's also reduced risk of accidental plot carryover because alleys are so clean."

ALMACO senior engineering manager, Cody Sobotka explained that seed researchers could now plant variable populations and plot lengths in the same pass without stopping the planter. "Researchers can choose flexible mapping with variable rate by row, variable length by row, and variable length in the same pass. The flexibility with mapping to match field geographies and the ability to test more in less passes will provide greater planting efficiency and the ability for each client to plant in the way that best suits their needs," Sobotka said.

ALMACO's SeedPro Elite Research Planter delivers greater precision in planting, leading to better harvest data and faster advancement decisions.

Image Credit: ALMACO

ALMACO CEO, Patrick Clem, expressed pride in his team, saying, "We listened to our clients and developed a planter to exceed what the industry thought was possible. We developed the features our clients need for modern plot planting."

***For more information, visit: https://www.almaco.com/***

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