Agri About

www.agriabout.com

Sustainable agriculture for the future

December | Desember 2025

No 152

Recycling and Upcycling in Agriculture

Closing the Loop

Packaging and Waste Management

Packaging and Waste Management

Sun Drying Bananas

The Hidden Fungi Inside a Fruit Packhouse

Off-The-Grid Aquaculture

Francois Rossouw – Nasionale Jongboer van die Jaar

SERVICE EXCELLENCE

At BKB we value the importance of trust. Trusting that the rains will return and that the land will produce for those who nurture it. Knowing that trust cannot be bought, but rather earned over time through our actions and our commitment to you, through the good times and bad. We take pride in the relationships we have built with generations of clients, each underpinned by integrity and bound through a look in the eye and the shake of a hand.

WWW.BKB.CO.ZA

BKB

The Trusted Home of Agriculture
Die Betroubare Tuiste van Landbou

To scan, download a free QR Code app

#SustainabilitySynergised

PEOPLE | PLANET | PROFIT

SERVICE EXCELLENCE | ENTREPRENEURSHIP | EARNINGS | EMPLOYEES | SUSTAINABILITY

#IntegrityIntegrated

Editorial

As the year draws to a close and the festive season approaches, we bring you the final edition of *AgriAbout* for 2025, published a little earlier than usual to honour the rhythm of the season and the well-deserved rest it brings. This month, we turn our editorial lens toward the transformative power of **Recycling and Upcycling**, exploring how agricultural communities are reimagining waste not as burden, but as opportunity.

In our feature article, *Closing the Loop*, we examine circular systems that reduce input costs and environmental impact, while *The Significance of Packaging and Waste Management – Upcycling and Sustainability* unpacks the role of design, reuse, and innovation in reducing agricultural waste. These stories reflect a growing movement toward regenerative thinking - where what was once discarded becomes a resource for resilience.

The Hidden Fungi inside a Fruit Packhouse reveals the microbial ecosystems that quietly shape post-harvest quality and safety. We also spotlight the *Conservation of Indigenous Animals' Genetic Material*, a vital effort to safeguard biodiversity and cultural heritage.

In a poignant call to action, we highlight the urgent need for *Research on the Conservation Needs of Mopane Worms*, a species deeply embedded in local diets, economies, and ecosystems. And in a story of innovation and empowerment, we explore an *Off-The-Grid Aquaculture Bio-Floc Community Project* - a grassroots initiative that merges food security, water efficiency, and community upliftment.

As we reflect on the year behind us, we extend our heartfelt gratitude to all our contributors, advertisers, and readers.

From all of us at *AgriAbout*, we wish you a peaceful and joyful festive season. May it be filled with rest, renewal, and connection. We look forward to continuing the conversation in 2026 - with fresh themes, bold ideas, and the same commitment to honouring agriculture's past, present, and future.

Until next year,

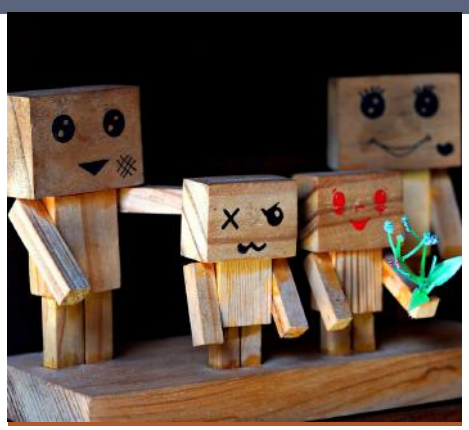
Chris

If you are not a subscriber yet, please subscribe now by using the button.

SUBSCRIBE

Please share with your friends and collegues

In this issue In hierdie uitgawe



Contributors Medewerkers

Theresa Siebert: ARC-Natural Resources and Engineering

Fahimeh Jami: Agricultural Research Council, Plant Health and Protection, Pretoria

Bongani Kubheka: Agricultural Research Council, Plant Health and Protection, Pretoria

Manana Mamabolo: ARC, Economic Analysis Unit

Whitney Matli: ARC, Economic Analysis Unit

Masindi Mphaphathi: ARC, Animal Production, Germplasm Conservation and Reproductive Biotechnologies

Henk Stander: Aquaculture Unit, Department of Animal Sciences, Faculty of Agriscience, University of Stellenbosch.

Ina Paarman

To contribute or to advertise
Om by te dra of om te adverteer

Chris Kriel
Editor

chris@agriabout.com
082 788 2467

Francois Rossouw – Nasionale Jongboer van die Jaar 2025

In die Hexriviervallei, waar tafeldruiwe soos goue lint teen die berge lê, het **Francois Rossouw (31)** van Mooigezicht Estates sy merk gemaak. As vierde geslag op die familieplaas kombineer hy tradisie met ’n vars visie – ’n benadering wat hom eers die **Santam Landbou/Agri Wes-Kaap Jong Boer van die Jaar 2025** gemaak het, en kort daarna die hoogste eer: **Toyota SA/Graan SA Nasionale Jongboer van die Jaar 2025**.

’n Familie-erfenis met toekomsvisie

Mooigezicht, gestig in 1928, is vandag ’n gespesialiseerde tafeldruifboerdery met 18 variëteite wat oor verskeie produksie-eenhede verbou word. Francois se liefde vir die plaas het hom van kleins af gevorm, en ná landboustudies het hy voltyds by die boerdery ingeskakel. Hy bestuur die helfte van die produksie en dien op die direksie van Mooigezicht en die Hexvallei Tafeldruif Assosiasie.

Baie geluk, Francois Rossouw!
Ons is trots op OWRM se vennootskap met Agri Wes-Kaap se Jongboer van die Jaar 2025!
Francois van Mooigezight Estates is ‘n ware inspirasie - ‘n jong landbouleier met visie, passie en toewyding.
Ons vier graag hierdie ongelooflike prestasie saam met jou!

OVERBERG
WEALTH & RISK MANAGEMENT

Donkinstraat 11
Caledon
7230
johanvdsandt@overbergwrm.co.za
www.overbergwrm.co.za

Pilare van sy sukses
Francois glo drie beginsels dra sy boerdery:

- **Aanpasbaarheid** in ’n veranderende omgewing
- **Tegnologie en data** vir ingeligte besluite
- **Sosiale ontwikkeling en volhoubaarheid** deur belegging in mense en gemeenskappe

Hierdie benadering maak hom nie net ’n tegnies bekwame boer nie, maar ook ’n leier wat sy span inspireer en die gemeenskap ophef.

’n Jong leier met waardes
Francois se mense-gefokusde bestuurstyl en sy passie vir opleiding en waardigheid het hom onderskei. Hy werk aan projekte om Mooigezicht se koolstofvoetspoor te verminder en volhoubare stelsels te implementeer wat aan markprotokolle voldoen. Sy vrou, Jean-Mari, is sy stille krag en klankbord, wat balans en perspektief bring.

Nasionale erkenning
Francois is tydens ‘n glansgeleentheid op 26 November 2025 as die algehele **Nasionale Jongboer van die Jaar 2025** aangewys. Jannie Strydom, Hoof Uitvoerende Beampte van Agri Wes-Kaap, het gesê: “Francois verteenwoordig alles wat ons in jong boere wil sien: uitnemendheid, beginselvaste leierskap en ’n ware roeping om landbou te dien.” Hoofbeoordelaar Inus Oosthuizen het sy prestasie só beskryf: “Francois is nie net ’n uitstekende boer nie, maar ook ’n strateeg, mentor en brugbouer oor generasies en diversiteit.”

’n Wenner wat hoop simboliseer
Francois self sê nederig: “Hierdie prestasie is nie myne alleen nie – dit behoort aan die hele Mooigezicht-span, ons gemeenskap en my familie. Dit is ’n fantastiese geleentheid om ons plaas, ons streek en die tafeldruifbedryf op ’n nasionale vlak te verteenwoordig.”

Veels geluk met ‘n welverdiende prestasie Francois! Die AgriAbout Span

Closing the Loop: Recycling and Upcycling in Agriculture

December is a month of reflection and renewal. As fields rest and families gather, farmers across South Africa are reimagining what it means to steward the land—not only by planting and harvesting, but by transforming waste into opportunity. Recycling and upcycling in agriculture are no longer fringe practices; they are becoming central to how young farmers define sustainability, resilience, and legacy.

From Waste to Wealth
For generations, crop residues and manure were seen as burdens to be discarded. Today, they are the foundation of regenerative farming. Composting turns organic waste into nutrient-rich soil amendments, reducing reliance on costly synthetic fertilizers. Farmers in Mpumalanga and the Free State report healthier soils and higher yields after integrating composting into their rotations. One young farmer put it simply: *"What my grandfather burned, I now return to the soil."*

Energy from By-Products
Biogas digesters are another innovation gaining traction. By channelling manure and crop residues into biodigesters, farmers generate renewable energy for irrigation pumps and household use. This not only reduces electricity costs but also cuts methane emissions. In KwaZulu-Natal, cooperative projects have shown how shared biodigesters can power entire rural communities.

Upcycling for New Markets
Beyond recycling, upcycling creates entirely new value chains. Sugarcane bagasse, maize stalks, and even invasive plants like water hyacinth are being repurposed into biodegradable packaging and animal feed. These innovations open doors to agri-business opportunities, allowing farmers to diversify income streams while reducing environmental

impact. As one young entrepreneur explained: *"We don't just grow food—we grow solutions."*

Tackling Plastic and Water Waste
Plastic waste remains a pressing issue in agriculture, from irrigation pipes to greenhouse coverings. Recycling initiatives led by Mpact Recycling encourage farmers to collect and return used plastics for remanufacturing. Meanwhile, water recycling systems are helping conserve scarce resources. Greywater from packhouses and runoff from fields is treated and reused for irrigation, closing the loop in water management.

Spotlight: Food and Harvest Waste Upcycling
Waste is never just waste—it is raw material waiting for a second life. Across South Africa and beyond, farmers are discovering how food waste and harvest residues can be upcycled into products that add value, diversify income, and strengthen sustainability.

Food Waste Upcycling
- **Animal feed from surplus produce**: Reject-grade fruits and vegetables, bakery waste, and packhouse offcuts are processed into safe livestock feed, reducing feed costs and diverting waste from landfills.
- **Fermented products**: Citrus peels and grape pomace are upcycled into vinegar, essential oils, and nutraceuticals, creating premium niche markets.
- **Bioenergy generation**: Food waste streams serve as feedstock for biodigesters, producing renewable energy and organic fertilizer.

Harvest Waste Upcycling
- **Biochar from residues**: Maize stalks, rice husks, and wheat straw are pyrolyzed into biochar, improving soil fertility and sequestering carbon.
- **Biodegradable packaging**: Sugarcane bagasse and maize husks are transformed into eco-friendly packaging, tapping into consumer demand for sustainable alternatives.
- **Fibers and textiles**: Banana stems and hemp stalks are upcycled into ropes, mats, and textiles, creating non-food income streams.
- **Mushroom substrates**: Straw and sawdust become substrates for mushroom

cultivation, turning “waste” into high-value protein.

Value-Adding Dimensions
Farmers are creating new income streams by transforming waste into valuable products such as biochar, biodegradable packaging, and animal feed.

Environmental benefits include diverting waste from landfills, reducing greenhouse gas emissions, and enhancing soil health.

Socially, cooperative efforts in waste upcycling build shared infrastructure and generate rural employment opportunities.

Philosophically, this shift reflects a deeper commitment to stewardship, viewing waste not as refuse but as a resource ripe with potential.

A Circular Future
These practices embody the principles of the circular economy: nothing wasted, everything valued. They resonate deeply with the ethos of young farmers who see themselves as custodians of both heritage and innovation. Recycling and upcycling are not just technical solutions—they are philosophical commitments to stewardship, resilience, and community.

Looking Ahead
As AgriAbout turns its gaze to 2026, themes like “Energy in Agriculture” and “Digital Marketplaces” will continue to highlight how waste management intersects with broader transformations. By celebrating farmers who close the loop, we position agriculture not only as a provider of food, but as a driver of ecological renewal and economic opportunity.

Bibliography

- Agricultural Waste Management in South Africa – A-Thermal (2025)
- 10 Techniques South African Farmers Can Use to Reduce Agricultural Waste – Farmers Magazine (2024)
- Resolution/Revolution: Your Role in South Africa’s Recycling Movement in 2025 – Mpact Recycling


Husqvarna
WE ARE LANDOWNERS
The power
to perform
Power through tough digging tasks with the Husqvarna 541 EA Earth Auger. Engineered for both professionals and homeowners, its ergonomic design and low-vibration technology keep you comfortable, while intuitive controls and versatile auger bit options deliver unmatched efficiency and precision - making every dig faster, cleaner, and more effortless.
Scan the QR code to locate your nearest dealership.
www.husqvarna.com/za
#WeAreHusqvarna

The Significance of Packaging and Waste Management - Upcycling and Sustainability

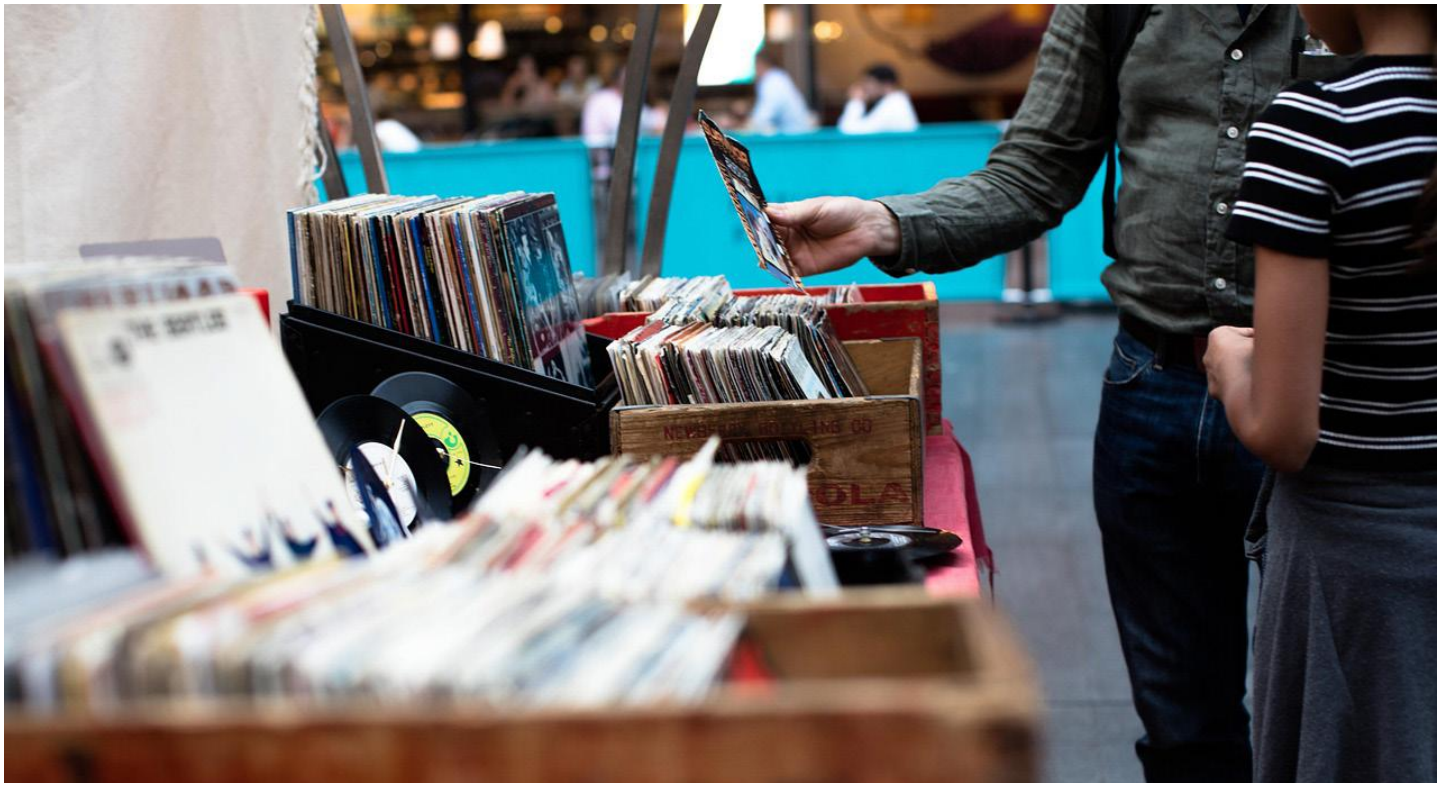
Theresa Siebert
ARC-Natural Resources and Engineering

The term 'packaging' encompasses many disciplines and functions. Packaging is used to enclose or protect products for distribution, storage, sale and use. The term also refers to the designing, evaluation and production of various types of packaging.

In a sense, packaging is fully integrated into our daily lives with numerous benefits:

- Packaging provides physical protection against mechanical shock, vibration and temperature.
- It gives barrier protection against oxygen, water vapour, dust.
- Packaging provides containment and agglomeration where small items can be combined into one package for ease of transport or storage. Similarly, liquids, powders and granular materials need containment.
- Packaging is mostly responsible for the transfer of information regarding, but not limited to, the use of the packaged item, transport, storage, tracking and tracing

Plastic in river



Old wooden packing crates used as store displays

of items etc. to users, distributors or consumers.

- Packaging is one of the most important and efficient tools available to marketers to influence and encourage prospective buyers to purchase a certain item.
- Through innovative design, packaging can reduce the risk of pilfering, tampering and theft. Packages may be made with tamper resistant seals and tamper-evident features and can also include authentication seals and security printing to indicate that the package and its content are not counterfeit.
- Packaging can be designed to include convenience features to aid in the handling, stacking, display, opening, reclosing, and dispensing of the content.
- Controlled usage is possible through single serving or single dosage packaging.

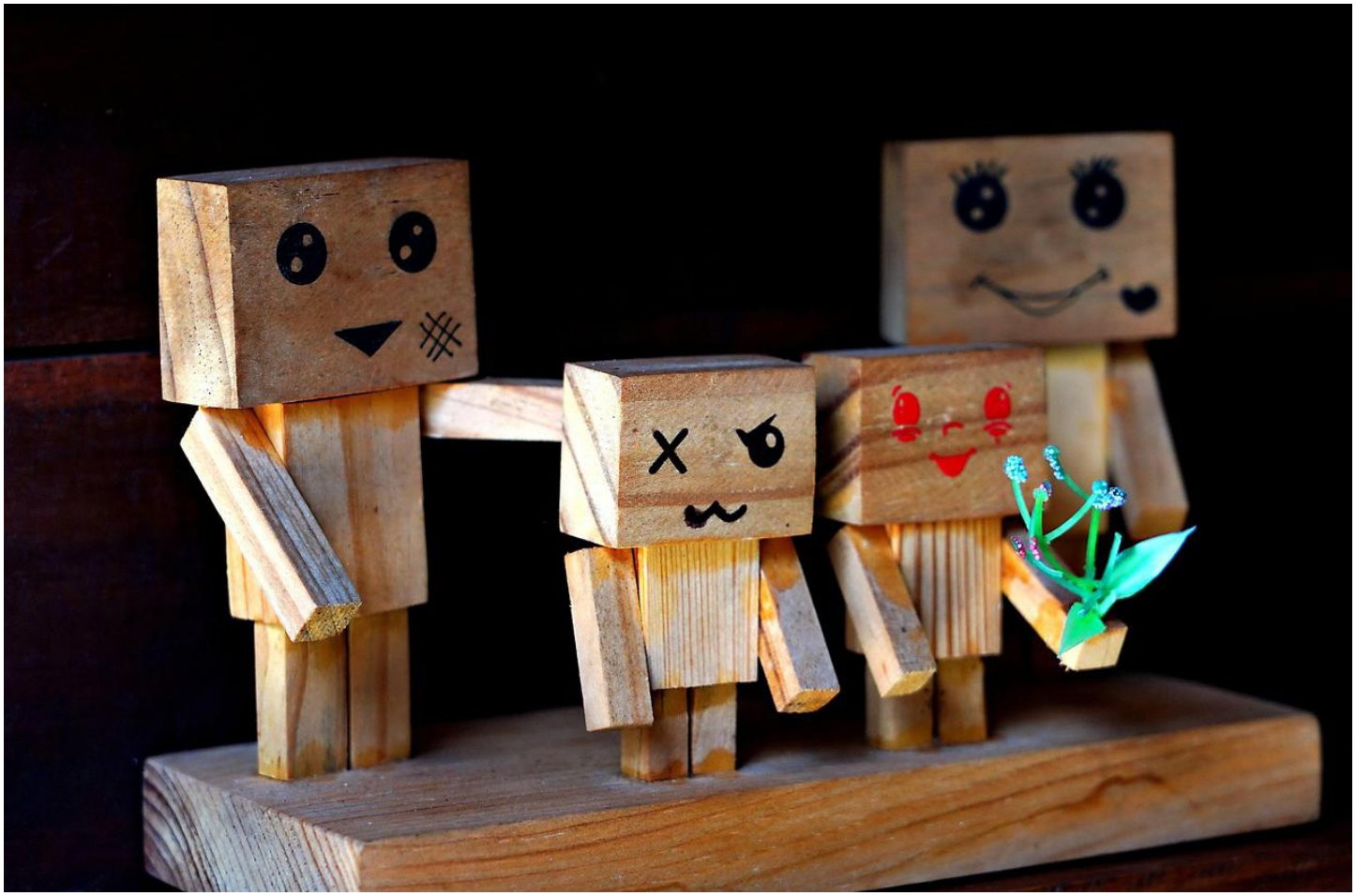
Negative Impact of Plastic and Polystyrene Waste:

Plastics are inexpensive and durable, which is both strength and weakness. Plastic pollution has a negative, unfavourable effect on lands, waterways and oceans, impacting both man and beast through entanglement, ingestion and chemical exposure.

Pollution-causing plastics fall into three main size-based categories: micro-plastics, meso-plastics and macro-plastics. The various sizes of plastic pollutants may also be divided into primary or secondary. Primary plastics are in their original form and include items such as bottle caps. Secondary plastics result from the degradation of primary plastics. Macro debris is larger than 20mm in size, micro-plastics are between 2mm and 5mm in size, with mega and macro debris both being reduced to micro-debris through degradation. Micro-plastics are easily released into the environment because of their small size and often end up in marine environments after being washed down by streams and rivers.

The ease with which plastic pollutants spread is due to factors such as the concentration of human population, trade routes, coastline geography, wind and ocean currents, with devastating effects:

- Land: Landfills and other concentrated areas of plastic debris may contain many different types of plastic waste. Some plastics, although biodegradable by certain types of microorganisms, are dangerous in that the breakdown process of these plastics release methane gas



Art from wooden packing cases

into the atmosphere. Methane is a very powerful greenhouse gas that contributes significantly to global warming. Chlorinated plastic waste releases harmful chemicals into the surrounding soil as it degrades. As these chemicals in turn have the potential to seep into the groundwater and other surrounding water sources.

- Ocean: The largest percentage of litter around and in the ocean are made up of plastic products. It has been estimated that 5 trillion pieces of plastic waste are afloat at sea. These plastics are toxic to marine life with the toxins released by the degrading plastics ranging from diethylhexyl phthalate, lead, and cadmium, to mercury. Throughout the food chain, plankton, fish and ultimately humans, ingest these toxic carcinogens and chemicals.
- Effects on animals: Entanglement in plastic waste in responsible for the deaths of countless marine animals such as fish, sea turtles, seals and sea birds. Sea turtles are especially vulnerable as some species consume jellyfish and often mistake plastic bags for their natural prey. Similarly, whales are susceptible to swallowing large amounts of plastic waste. Plastic pollutants do not only affect aquatic animals, but also birds which often mistake trash for prey. Ingested pollutants can obstruct and damage the animal's digestive system, often leading to malnutrition, starvation and death.

Similar issues arise with the use of polystyrene. Polystyrene is not biodegradable and can remain in the environment for hundreds of years and is impervious to photolysis. It simply breaks down into smaller pieces rather than disappearing posing significant threats to wildlife and the ecosystem.

Alternatives Through Agriculture – Sustainability, Reuse and Upcycling:
However, packaging need not be an evil that we need to learn to live without – agricultural resources such as paper (from wood), wood and cotton offer viable, renewable and sustainable alternatives that are effective and gentle on the environment and have uses beyond that for which they were originally

intended:

- For the environment to stay healthy, we will need to promote sustainable practices within our industries and sustainable packaging form an important part of this practice. Paper-based packaging solutions, including bags, boxes, corrugated paper trays, etc. are completely renewable, bio-degradable and recyclable. Trees, although requiring time to grow to a usable high, can be replanted and so renewed and with careful planning, this is a resource we will never have a shortage of, which in turn means that the supply of paper and paper-based products is renewed as quickly as it is depleted. An important factor to also take note of here is that paper can be recycled, which means trees do not actually need to be replanted at the same rate as they are cut down. Litter, however, will always remain, no matter how intensive the efforts for recycling are. Paper packaging breaks down completely in the environment and decomposes back into the earth. Even in the home environment, paper packaging can be added to composed heaps by the avid gardener and so add benefit to the garden and home-grown crops.
- Because of their wide array of uses and benefit, wooden packaging (cases and crates) is one of the most popular types of packaging and are deemed to be the best storage and packaging material for many products. Wooden crates and cases are extremely durable and because of this they can be reused many times. Wooden packaging has an array of benefits in that they are insect and corrosion free, stackable for efficient storage and shipping, and moisture proof. They are easily disposed of and recycled and so cause no harmful residue in the environment. Wooden cases and crates also have a second life once they are no longer fit as packaging materials: there is a lively market for items in the woodworking and art markets where used wooden packaging materials are upcycled for furniture, household ornaments or incorporated in art and sculpture.
- Cotton offers a unique combination of characteristics for packaging, storage and display of goods. It is free from toxic chemicals and dyes, which means the packaging will not trigger allergic reactions in consumers. Cotton is a moderately strong fibre that is durable and does not stress easily; it is able to absorb approximately 27 times its own weight in water and is available in a variety of weights for manufacturing different types of packaging. Cotton is extremely breathable and allows for air circulation and moisture evaporation. This characteristic makes cotton bags ideal for storing fruits, vegetables and for wrapping baked goods. Cotton is durable and easy to sew which makes it the optimal choice for producing long lasting canvas reusable grocery bags, which when eventually discarded, is biodegradable.

Cotton field

Final Thoughts:

While it is unlikely that we will be able to do away with plastic packaging anytime soon, along with all the conveniences we experience because of efficient packaging and packaging materials, we as consumers, designers and producers also have a responsibility towards the environment to ensure that we manage packaging waste effectively. To this end, we must find a way of mitigating the negative impact of some packaging materials and of incorporating more environmentally friendly options. It is time we turned to agriculture for renewable answers to our packaging needs so that we may live in harmony with our planet and protect the Earth and its resources by steering towards biodegradable materials with the potential for re-use and upcycling by the consumer.

Inquiries: SiebertT@arc.agric.za

Sun Drying Bananas

Theresa Siebert
ARC-Natural Resources and Engineering

Bananas and plantains are today grown in every humid tropical region and constitute the 4th largest fruit crop in the world. The plant needs 10–15 months of frost-free conditions to produce flower stalks. The fruit, which is technically a berry, turns from deep green to yellow or red as it matures. Stalks of bananas are usually formed in the late summer and then winter over. For sun drying, the fruit is harvested as soon as the peel turns yellow. It is important that the bananas should not be overripe.

Banana slices are dried in direct sun, on racks on the ground for 5-7 days. Hot, dry climates are required for the successful drying of any fruit. Sun drying reduces the moisture content of the bananas to 15%. The final product is soft and leathery with a characteristic banana flavour.

Sun drying bananas:

1. **Sorting and inspection:** Sorting and inspection is done to select the best possible raw material for processing. The harvested bananas are inspected for fullness of the fruits, size, freedom from defects, infections or any other damage inflicted during harvesting. Only sound bananas can be processed.

   The bunches of bananas are divided into smaller bunches by cutting the “hands” from the central stems. Any remaining floral relics are also removed from the tip of the fruit. The hands are placed in water to prevent bruising and to remove the latex that seeps from the cut surface. After being removed from the water and allowed to drain, they are sorted according to size. Large hands are subdivided into 4-10 fingers of matching size, and any blemished, damaged or deformed fingers are removed.

2. **Peeling:** The bananas may be manually peeled by first topping and tailing the fruit and then by slitting the skin lengthwise with a sharp knife. The rest of the peel is stripped by hand. Careful handling should be practiced during peeling since even slight bruising will lead to severe browning upon drying.

3. **Brining:** If for some reason, slicing cannot be performed immediately after peeling, the peeled bananas should be placed in a brine solution containing 1-1.5% salt, until processing resumes to prevent browning from taking place.

4. **Slicing:** The bananas are sliced along the long axis into 6mm thick "coins" to ensure maximum yield. Longitudinal slices or halves can also be made but are not uniform in size and would not favour uniform dehydration. It is particularly important that the bananas should be always handled hygienically and with great care to prevent bruising during slicing. For the same reason, the knives used should be of high-quality stainless steel and always kept sharp.

5. **Pre-treatments:** There are a variety of pre-treatments that can be given to the sliced banana coins to preserve the product colour, extend the keeping quality and increase the drying rate:
   - Sulphuring: Sulphur dioxide preserves the natural colour of the product, while prohibiting enzymatic browning reactions and limits the loss of important nutrients such as ascorbic acid. It can be applied in several ways, as a gas or as a liquid.
   - Brining: Discoloration can be effectively prevented while increasing the drying rate by placing the banana slices in a brine containing 1-1.5% salt for 5-10 minutes.
   - Acidification: The banana slices can also be dipped in a 2.5% lemon juice mixture or mixture of ascorbic and citric acid solution (0.3-0.5%) for 5-10 minutes. A pure ascorbic acid solution can also be prepared from 5-15ml ascorbic acid per 1 litre of water for dipping purposes. The treated fruit pieces are rinsed in fresh, potable water prior to further processing to remove excess chemicals, salt or acid on the surface of the fruit that could otherwise affect the taste of the final product.
   - Honey dip: A dip is prepared by heating 700-750ml water and 250ml sugar until dissolved, before 250ml honey is added. The banana coins are dipped in this mix for 5-10 minutes to give it a glaze that improves taste and colour retention.
   - Blanching: The banana slices can be blanched with exposure to steam for 2-3 minutes to inhibit enzymatic browning and increase the drying rate.

6. **Osmotic treatment:** The banana slices may be soaked in a 70°Brix (or 80%) sugar syrup at 50°C for 2-3 hours. The treatment can be hastened with occasional, careful stirring. A 3:2 ration of sugar syrup to fruit is regarded as suitable. Up to 50% of the moisture in the fruit may be removed by this treatment

through the process of osmosis. This not only reduces the subsequent drying time but also produces a sweeter product with better colour retention. The coins are removed from the syrup, strained and rinsed prior to dehydration. Rinsing is important to prevent a sticky product.

7. **Sun drying:** The banana slices are spread out in a single layer on a support/tray and placed in the sun. The time required to reach the final moisture content (15-20%) varies according to the weather conditions, especially temperature and wind conditions. Under fair weather, drying is usually complete within 5-7 days. Osmotically treated pieces dry within 3 days. The drying process can be further accelerated through practices that make maximum use of solar heat. For example, the support can be painted black to absorb as much heat as possible. This simple practice can cut drying time down by as much as 40%.

8. **Tempering:** The trays of dried banana coins are unloaded into bulk bins and stored under controlled conditions to allow the dried product to temper. Tempering is important to allow the moisture content to equilibrate within and amongst the dried pieces. Tempering takes a few days to complete and once done, the dried pieces are ready for further processing.

9. **Cleaning:** The dried banana slices are placed on a screen shaker where foreign materials are removed. Any fine materials fall through the screen. Further cleaning may be obtained by aspiration. An air current is blown either through or over the fruit to lift off dust and contaminates lighter than the fruit. Finally, the coins are washed in potable water. The water removes any residual dirt and loosens anything adhering to the surface of the fruit. The clean bananas are partially dried in a spin-dryer and finally dried on the sorting tables in controlled conditions to prevent recontamination.

10. **Packaging:** Packaging is defined as the containment of a food product in a protective barrier that prepares goods for transport, distribution, storage or retailing as well as end-use. The final product requires packaging that will protect it against moisture gain, light, air (oxygen), dust, and any other sources of contamination to further enhance the keeping quality of the dried bananas. If the product is intended for resale, it is important to keep in mind that dehydrated products do not always look attractive or appetising, so the visual impact of the packaging is also very important.

Inquiries: SiebertT@arc.agric.za

The Hidden Fungi Inside a Fruit Packhouse: What We Found and Why It Matters

Fahimeh Jami, Bongani Kubheka
Agricultural Research Council, Plant Health and Protection, Pretoria,

When fresh fruits enter a packhouse, it goes through washing, sorting, cooling, and packing before reaching the shelves. The environment may appear clean, but on a microscopic level it is full of fungal spores—some harmless, others capable of causing fruit rot, food spoilage, or even affecting people. Some packhouses are not operational during the off-season, and it is important to keep them clean during this recess. In one particular case, the packhouse showed extensive mould growth (Fig. 1), and the owner was unsure whether these moulds could affect the fruits in the coming season and whether the problem should be taken seriously. Therefore, samples were collected from different parts of the building, including entrance doors, trays, water baths, floors, cooling fans, and machinery. A detailed investigation revealed a wide range of fungi present on entrances, surfaces, water, equipment, and even in office areas. Many of these are common environmental moulds, while others are major postharvest pathogens known worldwide.

Fungal Species Detected and Their Importance

Alternaria alternata
Found on: **Entrances, dirty trays, water bath**
This fungus is one of the world's most common plant pathogens, attacking a wide range of crops and causing postharvest black-mould rot on many fruits (1). It thrives in damp, poorly ventilated conditions, which explains its presence near entrances and in moist areas like the water bath.

Aspergillus niger
Found on: **Floors, cooling room**
This fungus is one of the most important fungi causing postharvest decay of grapes, citrus, apples, peaches, melons, mangoes, onions, and many other fresh fruits. It is also extremely common on nuts, cereals, oilseeds, dried foods, and even smoked meats (2). Its presence on floors and in cold rooms shows how easily it spreads through dust and air.

Bipolaris species
Found on: **Water bath**
Species of *Bipolaris* are typically indoor moulds often associated with water-damaged materials, stored foods, grasses, and grains. They include serious plant pathogens causing leaf spots and blights in crops like wheat, rice, and sorghum (3). Finding this mould in the water bath suggests that water can act as a powerful spreader of spores.

Cladosporium cucumerinum
Found on: **Clean trays, fans, cooling room**
This fungus causes cucumber gummosis (scab) and crown blight and is known from several countries, including South Africa (4). It is airborne and often detected in humid indoor environments, making fans a perfect vehicle for spreading it.

Curvularia spicifera
Found on: **Entrances, floors**
This fungus causes leaf blight and fruit rot. It is also recognized as an allergen affecting humans (5). Its presence at entrances suggests spores may be coming from surrounding vegetation or soil.

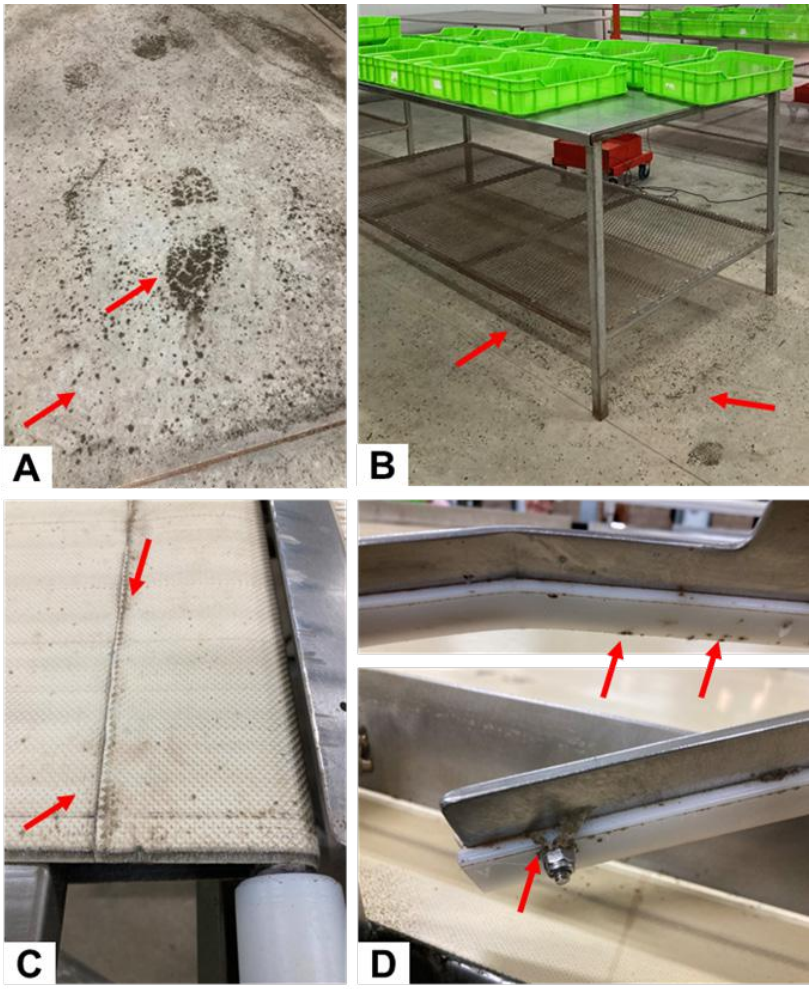


Figure 1. Mould growth in the packhouse: A. on the floor with denser growth along the foot-path likely due to wet shoes. B. On the machines. C. Under the machine. D. On the floor where the clean baskets were kept.

Exserohilum rostratum
Found on: **Water bath**
Several *Exserohilum* species are known plant pathogens that cause distinct leaf blights. *Exserohilum rostratum* has been found on wheat in South Africa and can also infect banana and pineapple. Under certain circumstances, it may infect humans or domestic animals such as cats, dogs, horses, and cattle and it affects both immunocompromised and healthy individuals (6). Its appearance in the water bath highlights why water sanitation is critical.

***Fusarium sambucinum* species complex (FSSC)**
Found on: **Entrances, boxes, plastic liners, sorting machine, cooling rooms, offices, water bath**
This group is associated with dieback and dry rot on many crops. It is also known to cause postharvest fruit rot on tomatoes and winter squash (7). Because FSSC was found throughout the building—from entrances to offices—it is one of the most widespread contaminants.

Penicillium species make up a diverse group of fungi that play important roles in our lives. Many are incredibly useful in medicine, agriculture, and maintaining healthy ecosystems. However, some species can also pose problems by causing diseases or producing toxins that affect human health and crop quality.

Penicillium brevicompactum
Found on: **Everywhere in the packhouse**
This fungus is a weak plant pathogen but a frequent contaminant of stored apples, grapes, cassava and potatoes. It also commonly infects mushrooms and produces the mycotoxin botryodiploidin (8). Although it has not been reported as causing postharvest disease in South Africa, it was one of the most dominant species in the packhouse.

Penicillium crustosum
Found on: **Entrances, trays, machines, fans, tables, cooling rooms, boxes, plastics**
A well-known mould most frequently found in food products. It is also known as a major producer of the mycotoxin penitrem A. This species has been isolated from a wide range of foods, including meat, cereal grains, nuts, dairy products, fruits, and vegetables. Interestingly, some strains do not produce penitrem A on synthetic media, showing that toxin production can vary between strains (9). However, isolates recovered from fruits such as lemon, grape, and mangosteen have been shown to produce this mycotoxin.

Rhizopus stolonifer
Found on: **Everywhere in the packhouse**
Commonly known as white bread mould, *Rhizopus stolonifer* is one of the most important postharvest pathogens of soft, ripe fruits. It thrives on wounded fruit with high sugar content (10). Its presence in every location—from boxes to cold rooms—shows how rapidly it spreads and why it remains a leading cause of fruit spoilage.

What Does This Mean for Packhouse Hygiene?
The packhouse environment supports a wide range of fungi, many of which:
- cause postharvest rot,
- survive on packaging, equipment, floors, and water,
- move easily through airflow or human activity,
- persist even after cleaning.

The fungi most consistently detected—*Penicillium crustosum*, *Penicillium brevicompactum*, *Rhizopus stolonifer*, and *Fusarium sambucinum* —are among the most important postharvest pathogens globally.

Why This Matters
Understanding the fungal landscape of a packhouse:
- helps reduce fruit losses,
- improves shelf life and marketability,
- strengthens food safety practices,
- guides targeted sanitation efforts,
- identifies high-risk contamination points like water baths, fans, and sorting equipment.

A packhouse may look spotless, but effective hygiene must also tackle the invisible world of fungi.

References

1. Zhu, X.Q. and Xiao, C.L., 2015. Phylogenetic, morphological, and pathogenic characterization of Alternaria species associated with fruit rot of blueberry in California. Phytopathology, 105(12), pp.1555-1567.
2. Zakaria, L., 2024. An overview of Aspergillus species associated with plant diseases. Pathogens, 13(9), p.813.
3. Manamgoda, D.S., Rossman, A.Y., Castlebury, L.A., Crous, P.W., Madrid, H., Chukeatirote, E. and Hyde, K.D., 2014. The genus Bipolaris. Studies in mycology, 79(1), pp.221-288.
4. USDA Fungal Databases, U.S. Department of Agriculture. https://fungi.ars.usda.gov
5. Cui, W.L., Lu, X.Q., Bian, J.Y., Qi, X.L., Li, D.W., Huang, L., 2020. Curvularia spicifera and Curvularia muehlenbeckiae causing leaf blight on Cunninghamia lanceolata. Plant Pathology, 69(6), pp.1139-1147.
6. Sharma, K., Goss, E.M., Dickstein, E.R.., Smith, M.E., Johnson, J.A., Southwick, F.S., van Bruggen, A.H., 2014. Exserohilum rostratum: characterization of a cross-kingdom pathogen of plants and humans. PloS one, 9(10), p.e108691.
7. Baturo-Ciesniewska, A., Lenc, L., Grabowski, A., Lukanowski, A., 2015. Characteristics of polish isolates of Fusarium sambucinum: molecular identification, pathogenicity, diversity and reaction to control agents. American Journal of Potato Research, 92(1), pp.49-61.
8. Pitt, J.I., Hocking, A.D., 2009. Penicillium and related genera. In Fungi and food spoilage (pp. 169-273). Boston, MA: Springer US.
9. Gao, S., Hong, S.Y., Jung, G.M., Om, A.S., 2025. Effects of Temperature, pH, and Relative Humidity on Growth of Penicillium crustosum OM1 Isolated from Pears and Its Penitrem A Production. Journal of Fungi, 11(10), p.741.
10. Mesquida-Pesci, S.D., Morales-Cruz, A., Rodriguez-Pires, S., Figueroa-Balderas, R., Silva, C.J., Sbodio, A., Gutierrez-Baeza, E., Raygoza, P.M., Cantu, D., Blanco-Ulate, B., 2025. Rhizopus stolonifer exhibits necrotrophic behavior when causing soft rot in ripe fruit. Phytopathology, 115(3), pp.306-315.

For more information contact:
Dr Fahimeh Jami (JamiF@arc.agric.za)
www.arc.agric.za

Conservation of Indigenous Animals' Genetic Material through ARC's NPGAs

Manana Mamabolo: ARC, Economic Analysis Unit
Whitney Matli: ARC, Economic Analysis Unit,
Masindi Mphaphathi: ARC, Animal Production, Germplasm Conservation and Reproductive Biotechnologies

The Germplasm Conservation and Reproductive Biotechnologies Unit of the Agricultural Research Council (ARC) Animal Production campus in Irene is a custodian of several National Public Good Assets (NPGAs) used to conduct research for the benefit of the agriculture sector and society. Among these NPGAs are the Mobile lab, Germplasm unit laboratories and the Small Stock unit. The joint purpose of these assets is to conserve indigenous animals' genetic material, while also ensuring research that is aligned with achieving Sustainable Development Goals (SDGs). The assets are further used for information dissemination and training through demonstrations in exhibitions, workshops, and research projects.

These facilities represent the heart of South Africa's ongoing efforts to combine science, conservation as well as practical farming solutions. Through them, the ARC continues to bridge the gap between laboratory research and rural livelihoods, making innovation accessible to ordinary farmers.

Users and beneficiaries of the assets

The assets have been part of the Animal Production campus for approximately 20 years, and over that time, have been used

Figure 1: The Agricultural Research Council Mobile lab

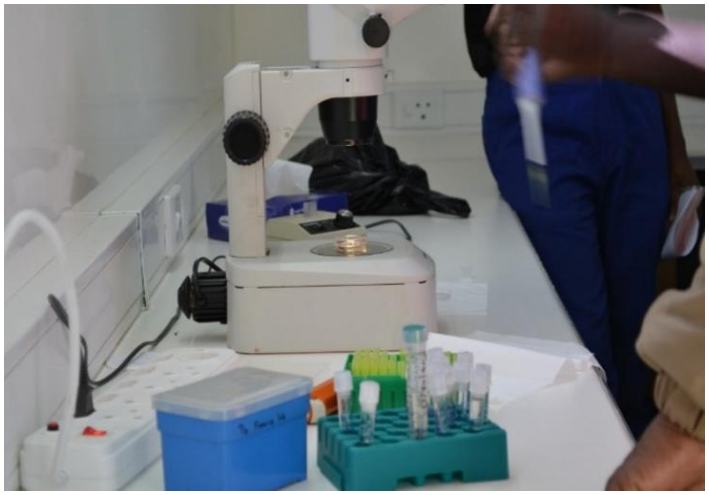


Figure 2: Preparation of embryo warming solutions

Figure 3: Evaluation of embryos and loading warming solution

in various research projects. The process includes collection of samples (semen/ sperm, oocytes, and embryos) from the specie of choice, analyses and evaluations in the laboratories and conservation of those gametes where necessary. In instances where the work is carried out in the field, the Mobile lab is used in replacement of fixed or standard laboratories, especially when doing semen collection (male fertility test), cryopreservation/freezing, synchronization, artificial insemination, and other assisted reproductive technology activities.

The main users of these Assets are ARC Researchers, Universities Researchers and Animal Science- Masters and PhD students for their respective projects and experimental learning. Farmers also make use of and benefit from these facilities through requests for artificial insemination services. This has allowed farmers to secure food and livelihoods through improved production and sales. These facilities have also resulted in employment opportunities for students who, after completion of their training have been absorbed and promoted in the organization. The facilities have also ensured access to essential services such as animals with good genetic make-up for human consumption.

Maintenance and management of the assets

Maintaining these assets requires financial and human resources. The annual cost of maintenance is approximately R 770 000, mainly sourced from the parliamentary grant. Technicians, Researchers, and animal attendants are also employed to service, clean and maintain the assets.

Contribution of the assets to the agriculture sector

The assets contribute to the sector in several ways, including:

- **Safeguarding indigenous livestock genetics and building farmer resilience**

The Mobile laboratory, Germplasm and Small Stock unit at the ARC Animal Production Campus are not just research facilities, they are strategic assets supporting South Africa's livestock and conservation. Together, these facilities have strengthened the country's ability to conserve valuable animal genetic material, enhance research innovation, and transfer technologies to smallholder and emerging livestock farmers.

- **Conservation of indigenous genetic resources**

The Germplasm unit laboratories play a significant role in collecting, analysing, and preserving semen, oocytes, and embryos from indigenous livestock species such as cattle, pigs, chickens, goats, and sheep. This work ensures that South Africa's unique genetic material is not lost and remains available for future breeding, climate adaptation, and research for resilience.

- **Applied research and technology transfer**

Through the Mobile lab, ARC scientists take research directly to the field which allows them to offer on-site artificial insemination, synchronization, and fertility testing for farmers in remote areas. This mobility has

Figure 4: Sheep breeds at ARC Small Stock section

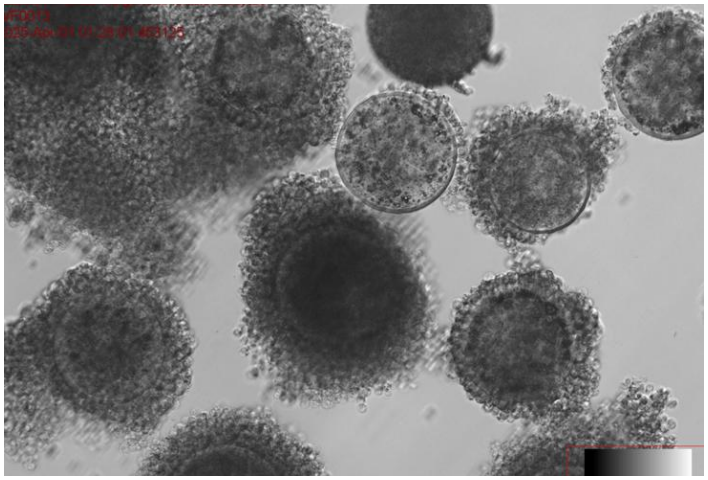


Figure 5: Goats immature oocytes

in turn bridged the gap between scientific research and practical farming, allowing farmers to benefit from advanced breeding technologies without leaving their remote communities.

- **Enhancing productivity through the Small Stock unit**

The small stock unit provides an environment where controlled breeding, performance recording, and phenotype evaluations are conducted to identify animals with superior traits. This supports the development of improved breeding lines, which small-scale farmers can access to strengthen herd performance and enhance their market competitiveness.

- **Capacity building and experiential learning**

These assets have also served as a training platform for students (under-graduates & post-graduates), technicians, and early-career researchers. Many of those trained through these facilities have been absorbed into the ARC or other agricultural sectors, outlining their role in developing South Africa's next generation of Animal Scientists.

- **Socio-economic impact**

Through improving reproductive efficiency and genetic quality of the livestock, these assets have directly contributed to food security, income generation, and poverty reduction in remote rural communities. Farmers who are supported through artificial insemination and improved breeding services can attain higher productivity, better market prices, and sustainable herd growth.

Looking ahead

Going forward, public awareness of the value of these assets should be strengthened through media partnerships, community demonstrations, and farmer outreach programmes. In addition, making sure that South Africa understands the importance of conserving animal genetics will create stronger public support for continued investment in these national assets.

Dependence on state funds such as the parliamentary grant to fund research and research facilities such as these is challenging, given that the general trend in public investments towards research has been declining over time. This calls for innovative and cost-effective approaches to funding research that will also ensure additional revenue generation.

Thus, institutional arrangements should focus on strengthening governance and capacity, establishing clear, cost-reflective tariff structures, leveraging technology and data for better performance management, fostering collaboration between public and private sectors, and aligning financial planning with strategic objectives through outcomes-oriented approaches. Implementing such measures can help optimize resource allocation, improve service delivery, and achieve financial sustainability for these facilities that are playing a critical role in the agriculture sector.


Husqvarna
WE ARE LANDOWNERS
The power
to perform
Power through tough digging tasks with the Husqvarna 541 EA Earth Auger. Engineered for both professionals and homeowners, its ergonomic design and low-vibration technology keep you comfortable, while intuitive controls and versatile auger bit options deliver unmatched efficiency and precision - making every dig faster, cleaner, and more effortless.
Scan the QR code to locate your nearest dealership.
www.husqvarna.com/za
#WeAreHusqvarna

New research highlights conservation needs for mopane worms

Mopane worms are widely harvested as a food source in Southern Africa. Containing three times more protein than beef or chicken, as well as more calcium, iron and zinc, and less fat than conventional livestock, they are often fried or boiled and eaten as a snack or a meal.

Although mopane worms play an important role in local livelihoods, culture and the environment in mopane woodlands, little is known about their genetic diversity or how their populations are distributed across different regions. Considering reports of overharvesting in Botswana, Namibia, South Africa and Zimbabwe, we must gather this information to help ensure the species' long-term sustainability.

This is according to researchers at Stellenbosch University (SU), the South African National Biodiversity Institute, the Botswana International University of Science & Technology and the Ongava Research Centre in Namibia.

They analysed the DNA of mopane worms in Namibia and the Limpopo River Basin (South Africa and Botswana) to understand their genetic diversity and how populations have spread and changed over time. They collected adult moths and caterpillars from different trees and at different stages in South Africa, Botswana and Namibia.

The findings of their study* were published recently in the journal *Conservation Genetics*.

"We offer the first look at how mopane worm populations are related and distributed across Namibia and the Limpopo River Basin, and how their numbers have changed over time. Genetic data can help guide wildlife conservation by showing how different populations are related, how big they are and how they move or connect with one another," says lead author Dr Barbara van Asch from the Department of Genetics at SU.

She adds that identifying areas with high genetic diversity is important as this information can help guide conservation efforts, local policies and how resources are allocated.

"This genetic data is crucial for planning effective conservation strategies as concerns about the species' sustainability have grown over the past two decades due to rising demand, habitat loss, climate change and a dramatic increase in cross-border trade between Botswana, South Africa and Zimbabwe worth millions of dollars."

According to Van Asch, the mopane worms they studied show clear genetic differences across long distances, and populations from Namibia and the Limpopo River Basin don't share the same maternal lineages.

She notes that in both Namibia and Botswana, mopane worm populations are genetically similar, with little variation between areas that are close to each other – 51 to 160 km apart in Namibia and 19 to 78 km apart in Botswana. Mopane worms collected in South Africa have the highest genetic diversity and genetic differentiation.

"Strikingly, half of the sampling areas had only one **unique genetic 'fingerprint' or pattern i**n their DNA. The fact that these sampling sites all have the same genetic 'fingerprint' suggests that the genetic diversity is very low across the Limpopo River basin to the west of Musina. Worms from the southernmost sampling areas have the highest genetic diversity and can be potential candidates for targeted conservation. These sampling areas are not located within protected areas.

"In Namibia, mopane worms show less genetic variation between different areas. In Botswana, they have the lowest genetic diversity of all the regions studied. Genetic evidence suggests that mopane worm populations in Namibia have expanded over time, while those in South Africa and Botswana have remained stable.

"Nonetheless, the low genetic diversity in mopane worm populations, especially in Botswana, suggests there are fewer variants, which could limit their ability to adapt to environmental changes."

Van Asch says their results suggest that mopane worm populations in South Africa and Botswana may need conservation support, such as moving individuals from healthier populations to help restore those that have become weaker. More importantly, it is crucial to protect mopane woodlands from the rapid destruction now taking place.

According to her, information about the genetic diversity of mopane worms or their distribution across different regions is valuable because the absence of formal, standardised record-keeping and consistent monitoring makes it very difficult to trace harvesting activities.

"A significant portion of harvesting activities remains undocumented. Because mopane worms are harvested widely and without proper controls or monitoring, the practice may have become unsustainable, making the species more vulnerable to extinction."

Van Asch says they hope to expand their analyses to more populations in the Limpopo River Basin, Zimbabwe and Zambia, where mopane worms are also commercially harvested.

- **Source:** Nethavhani, Z et al. 2025. Multimarker genetic analyses of *Gonimbrasia belina*, the most harvested wild edible insect of mopane woodlands in Southern Africa, support concerns over the sustainability of the species. *Conservation Genetics*. DOI: 10.1007/s10592-025-01687-1

***The study was conducted by Zwannda Nethavhani (Stellenbosch University), Ruan Veldtman (South African National Biodiversity Institute/Stellenbosch University), Casper Nyamukondiwa (Botswana International University of Science & Technology), William Versfeld (Ongava Research Centre) and Barbara van Asch (Stellenbosch University).*

Off-The-Grid Aquaculture Bio-Floc Community Empowerment Project

Henk Stander
Aquaculture Unit, Department of Animal Sciences, Faculty of Agriscience, University of Stellenbosch.

The off-the-grid Aquaculture Bio-floc Community Empowerment Project is an innovative approach to sustainable aquaculture, combining renewable energy sources, eco-friendly practices, and community involvement. The goal was to create a self-sustaining system for fish farming using bio-floc technology in an off-the-grid environment, typically in rural or remote areas with limited access to centralized power or infrastructure. Stellenbosch University constructed this system just outside of Stellenbosch on a farm in the Lynedoch area for the Stellenbosch district Farmers Production Support Unit (FPSU) Secondary Co-operative. The system consists out of a greenhouse with 16 circular fishtanks diameter 2700mm and 1200mm in height. Volume of each tank is approximately 6.870 m^3. The electricity for the water pump and 5 air pumps is supplied by 10 x 550W Trina Solar panels on the roof of a shed close to the greenhouse. Mozambique Tilapia fish was stocked in the tanks and molasses was used to kick-start the bio-floc production.
Practical dosage:
Add 250–300 ml of molasses per 1000 L of water (for the startup stage).

Wat is an Aquaculture Bio-floc System?
An aquaculture bio-floc system is a sustainable fish-farming method that uses beneficial microbes to maintain water quality, recycle nutrients, and reduce the need for water exchange. First developed as a natural way to treat wastewater, bio-floc technology systems (BFTs) have since become popular aquaculture production techniques, particularly in Asia, India, and Brazil. BFTs harness the nitrogen cycle to simultaneously treat culture water and provide farmed shrimp or filter feeding fish with extra

food, while offering a host of natural probiotic benefits.

As early as in the year 1976, Steve Surfling put forward the 'microbial soup' concept that eventually led to the development of "bio-floc" based aqua farming. The dense heterotrophic bacterial community is developed to make the system bacterial dominated. Accumulation of these bacteria, called flocs, engulf up the nitrogenous wastes ten to hundred times more efficiently than algae, and turn them into high-protein feed. In early 1980s BFT was developed at IFREMER-COP (French Research Institute for Exploitation of the Sea, Oceanic Centre of Pacific) with different penaeid species including *Penaeus monodon, Litopenaeus vannamei.* Later, Prof. Yoram Avnimelech from Israel, contributed immensely for the further modification and promotion of this encouraging technology.

The technique developed in Israel subsequently spread to many other countries due to its numerous advantages.

BFTs use algae, bacteria, and other microorganisms to recycle waste nutrients and augment the growth of cultured stock. Diverse types of bacteria either break down toxic ammonia and nitrites into nitrates or assimilate ammonia into microbial biomass.
Free-floating algae also help to improve water quality, while being eaten by zooplankton, filter feeding fish and shrimp, these tiny microbes can also be populated in aggregate structures by an ever-growing host of organisms – including fungi, protozoans, and other useful lifeforms. It is these floating masses that are known as bio-flocs.

Bound by bacterial slime, most of these floating aggregates are mainly microscopic, but larger aggregations can be seen by the human eye as brown or green suspended flakes.

One of the main advantages of BFTs is that they require only certain nutrients and continuous aeration to provide a highly functional culture habitat. Water supplements such as minerals and probiotics greatly help improve stability. BFTs can sometimes be less complex, in terms of infrastructure, compared to other super-intensive systems. BFTs also improve circularity in aquatic systems, are more ecologically-friendly and efficient, and can reduce the spread of deadly pathogens – making them a promising farming tool.

How a Bio-floc System Works:
1. Fish produce waste → ammonia builds up
Fish excrete ammonia (NH_3), which is toxic if it accumulates.
In traditional aquaculture, farmers must frequently change the water to remove ammonia.

2. Adding a carbon source feed "Good" microbes
To turn harmful ammonia into something useful, farmers add a carbon source such as:
- molasses
- rice bran
- tapioca
- sugar

This increases the C:N ratio (carbon-to-nitrogen) in the water, which stimulates heterotrophic bacteria—microbes that consume nitrogen (including ammonia).

3. Beneficial bacteria convert ammonia → microbial biomass

These bacteria use the carbon you added plus the ammonia from fish waste to grow and multiply.

They convert ammonia into:

- microbial protein
- harmless nitrogen compounds
- bio-floc particles

These microbes form clumps called bio-flocs—tiny balls made of bacteria, algae, protozoa, and organic matter.

4. Bio-flocs become natural fish feed

Many species such as:

- Tilapia
- Catfish
- Shrimp

can eat bio-flocs.

This provides:

- high-quality protein
- immune-boosting microbes
- reduced need for commercial feed.

Feed savings of 20–30% are common.

5. Constant aeration keeps the system alive

Bio-floc systems require:

- strong aeration → keeps microbes alive and suspended.
- good water movement → prevents settling and anaerobic zones.

Blowers, paddlewheels, or diffusers are commonly used.

6. Water quality stabilizes

Because the microbes consume waste products, water quality becomes:

- stable
- low in ammonia/nitrite
- high in beneficial microbial activity

This drastically reduces (or eliminates) the need for water exchange.

7. Minimal water exchange = low environmental impact

Bio-floc systems are attractive because they:

- save water.
- reduce pollution.
- reuse nutrients
- increase stocking density (2–3× traditional systems)

Main Components of a Bio-floc System:

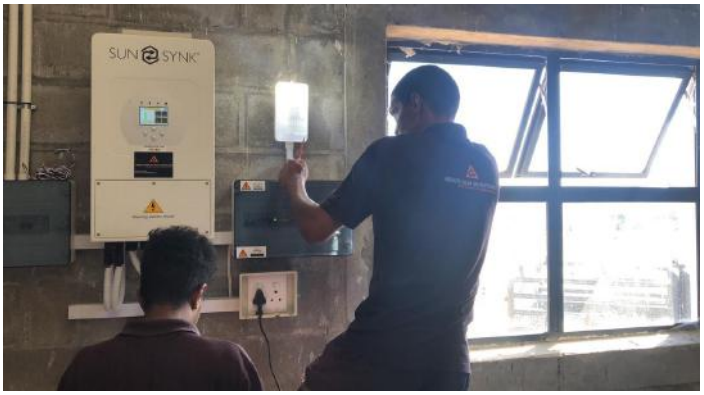
- Aeration/blowers
- Tanks or lined ponds.
- Carbon source supply
- Monitoring tools (DO, pH, alkalinity, temperature, TDS)
- Backup power (aeration cannot fail)

Bio-floc = waste-eating microbes + aeration + carbon source.

They turn toxic ammonia into useful protein that fish can eat, creating a self-cleaning, nutrient-recycling, low-water-use aquaculture system.

Benefits of this technology:

- Reduced need for large water volumes or frequent water changes.
- Cost-effective and sustainable since it uses waste as a resource.
- Encourages nutrient recycling and reduces dependence on external feed sources.
- Biosecurity of the system can be maintained with zero/minimal water exchange system.
- Heterotrophic bacteria can reduce toxic metabolites (NH_3 -NNO_{2-} -N)
- Easier management and environmentally friendly approach (reduced protein requirement, fish meal usage, and water/nutrient discharge), diurnal changes (pH, O_2, CO_2) in pond water are reduced.
- Doubling the protein utilization as the shrimp use proteins twice - eat feed and then harvest flocs. Enhance digestion (with enzymes and



growth promoters)
- Probiotic action - more diverse aerobic gut flora reducing pathogenic bacteria (Vibrios).
- Role in immune response by stimulating humoral and cellular immunity.
- Reduced costs (15-20% lower cost of production) including 30-50% cost savings in feed.
- Augmentation of natural food and improvement of Feed Conversion Ratio
- Reduced sensitivity to light fluctuation.
- Major advantage of growing shrimp/tilapia in bio-floc will not require of multiple external filtrations. It reduces the start-up operational expenses.

What to monitor:
- Ammonia (NH_3/NH_4)
- Nitrite (NO_2)
- pH (7.0–8.0 ideal), should stay between 6.5 and 8.0
- Dissolved oxygen (must be > 5 mg/L)

Stocking the tilapia:
- Only stock tilapia when:
  - NH_3 < 1.0 mg/L
  - NO_2 < 1.0 mg/L
  - pH 7–8
  - Water is brown and floc volume is 5–15 ml/L (using an Imhoff cone)
- Stocking density:
  - High-density bio-floc: 200–300 fish/m³
  - Medium-density: 80–150 fish/m³
- Start with smaller fish:
  - 10–30 g size fingerlings are ideal.

Managing Floc Volume:

Floc Volume	Action
< 5 ml/L	Add more carbon (molasses)
5 – 15 ml/L	Ideal - maintain
> 20 ml/L	Remove sludge/partial water change (5-10%), reduce carbon input, increase aeration

Off-the-grid Energy Solutions:
- Renewable Energy: Since the project is off-the-grid, renewable energy systems such as solar, is used to provide electricity to run pumps, aerators, and other equipment.
- Solar Panels: Solar power is often the most feasible option for off-the-grid aquaculture systems, providing energy to run water filtration, oxygenation, and monitoring systems.
- Battery Storage: To ensure a stable power supply, energy is stored in batteries or other storage systems, enabling the operation of critical systems even during cloudy days or at night.

Community Involvement & Education:
- Training Programs: Education and capacity building for local communities are crucial. Training should focus on sustainable aquaculture practices, renewable energy technologies, and bio-floc management.
- Community Collaboration: In an off-the-grid setting, it is important to build a sense of ownership within the community. Collaboration could include local farmers, entrepreneurs, and even schools to foster long-term success.
- Job Creation: The project can provide jobs in fish farming, renewable energy maintenance, system operation, and monitoring, supporting the local economy and improving food security.

Conclusion:
Bio-floc technology like eco-based technologies will enable aquaculture practices towards an environmentally friendly approach. With the appearance of emerging disease problems and escalating costs for energy, Bio-floc technology can be an innovative strategy for disease prevention and control in contrast to usual tactics such as antibiotic, antifungal, probiotic, and prebiotic application. bio-floc technology with bio-secure modular systems may be an answer for more efficient, sustainable, profitable aquaculture production. This technology has the obvious advantage of minimizing water requirement, recycling in situ nutrients and organic matter and in turn improving farm biosecurity by exclusion of pathogens, augmentation of natural food and improvement of FCR, providing stress-free environment. Use of chemicals and other medicines could easily be avoided thereby having negligible environmental impact. Availability of natural food in the form of microbial bio-floc compensate for higher protein requirement of aquatic species. Bio-floc technologies have potential to revolutionise the aquaculture sector. However, this is still in an initial stage and lots of research is necessary for its modification, standardization, and implementation in Southern Africa.

Pictures by the author
E-mail: hbs@sun.ac.za

Chicken & Mushroom Pie with Pour-Over Crust

Ina Paarman

South Africa's favourite pie – this time made with an easy pour-over pastry, topped with a mushroom garnish.

Serves: 6

You Will Need:

Roasting Chicken

1 large free range chicken, fresh

1 t (5 ml) Ina Paarman's Lemon & Black Pepper Seasoning

1 t (5 ml) Ina Paarman's Chicken Flavour Stock Powder

1 cup (250 ml) dry white wine

1 onion, peeled and cut into quarters

Pastry

2 eggs

½ cup (125 ml) oil

1 cup (250 ml) full cream milk

1 cup (250 ml) cake flour

2 t (10 ml) baking powder

2 t (10 ml) Ina Paarman's Lemon & Black Pepper Seasoning

3 - 4 button/portabellini mushrooms, thinly sliced

2 t (10 ml) olive oil

Sauce

1 t (5 ml) hot English mustard powder (or 1 T (15 ml) Dijon mustard, omitting the water below)

2 T (30 ml) water

¼ cup (60 ml) butter

¼ cup (60 ml) flour

2 cups (500 ml) chicken stock cooked from bones

(add fresh milk, if the stock is not enough)

200 g - 250 g button/portabellini mushrooms, sliced (reserve a few for topping)

¼ cup (60 ml) fresh parsley, chopped

1 x 200 ml Ina Paarman's Ready To Serve Mushroom Sauce

Method:

Chicken:

Adjust the oven rack to one slot below the middle position, and preheat the oven to 180°C.
Place the chicken in an oven roasting pan.
Season it with Lemon & Black Pepper Seasoning and Chicken Stock Powder.
Carefully pour the wine down the side of the pan and scatter the onion quarters around the chicken.
Roast for 1¼ hours, until the chicken is cooked.
Allow it to cool.
Remove the skin and bones, and flake or cut the meat into smaller pieces. Set aside the meat for later.
Put the skin and bones back into the roasting pan.
Add 2 cups (500 ml) water and bring to the boil to deglaze the pan and to extract all the flavour from the skin and bones.
Simmer for 10 minutes.
Strain and reserve the liquid, discarding the solids.
Blot the excess fat off the surface of the sauce with a double layer of absorbent kitchen paper, if necessary.

Sauce:

Soak the mustard powder in 2 T (30 ml) of cold tap water.
Melt the butter, add the flour, and cook over medium heat, while stirring continuously with a wooden spoon.
The mixture must become “puffy”, full of air bubbles, and the colour will turn light cream.
Add all the strained chicken stock (and milk, if used) at once.
Using a wire whisk, stir the sauce until it thickens and comes to a slow boil.
Add the mushrooms, mustard, parsley, and Mushroom Sauce.
Season to taste.
Pour the sauce over the flaked chicken and stir to mix.
Place the mixture into a pie dish.

Pastry & Baking:

Preheat the oven to 180˚C.
Whisk the eggs, adding the oil gradually.
Whisk in the milk.
Sift together the flour, baking powder, and 1 t (5 ml) Lemon & Black Pepper Seasoning onto baking paper.
Pour the dry ingredients into the wet ingredients, and whisk until smooth.
Pour the batter over the hot chicken and mushroom filling in the dish.
Mix the thinly sliced mushrooms with the other 1 t (5 ml) Lemon & Black Pepper Seasoning and a little oil, and arrange on top of the batter.
Bake for 40 minutes, until golden brown.

Upside Down Shallot Tart

Ina Paarman

A real conversation piece, savoury with a hint of sweetness. Ideal for New Years Day, served with goats milk cheese or feta. If shallots are not available, use red onions cut into small wedges.

Serves: 6

You Will Need:

Cheese Pastry

2 cup (240 g) flour

½ t (2,5 ml) Ina Paarman's Chilli & Garlic Seasoning

½ cup (125 g) cold butter, cut into cubes

1 cup (250 ml) grated Cheddar cheese

1 egg yolk (reserve white)

3 T (45 ml) cold water, enough for a pliable dough

Tart

700 g shallots

1 T (15 ml) olive oil

Ina Paarman's Garlic Pepper Seasoning

½ cup (125 ml) cider vinegar

2 T (30 ml) Ina Paarman's Balsamic Vinaigrette Dressing

2 T (30 ml) sugar

2 T (30 ml) butter

¼ cup (60 ml) grape or fig jam

100 g plain goats cheese, crumbled (or feta)

1 T (15 ml) fresh thyme, chopped

Method:

Cheese Pastry:
Place all the ingredients in the food processor, except for the egg yolk and water.
Process until the mixture resembles coarse crumbs.
Add the egg yolk and water, and process until the pastry starts coming together.
Turn the pastry out on a floured surface and work lightly by hand until it forms a ball.
Flatten the ball into a disk and wrap it up in cling film.
Refrigerate to chill.

Shallots:
Adjust the oven rack to the middle position and preheat the oven to 190˚C.
Trim the root ends of the shallots and halve them from root to tip, leaving the skin intact.
Drizzle the cut sides with oil and sprinkle with Garlic Pepper Seasoning.
Arrange cut side down on a lined baking sheet.
Roast until tender and a pairing knife meets no resistance when slipped into the centre, 30 - 33 minutes.
Lift off the dry skins of the shallots.
In a 24 - 27 cm skillet, bring the vinegar, Balsamic Vinaigrette, and sugar to the boil to dissolve the sugar.
Reduce to a syrupy consistency.
Stir in the butter and remove from heat.
Arrange the shallots in the skillet as demonstrated.
Dot and spread with jam.
On a lightly floured surface, roll out the pastry to ± 3 mm thick.
Cut into a circle slightly bigger than the skillet.
Prick all over.
Position the pastry over the shallots, tucking in the sides.
Bake at 190 °C for 30 - 35 minutes until golden brown.
Cool for 5 - 10 minutes.
Loosen the outer edge of the pastry with a knife.
Invert a serving plate over the skillet and carefully turn the tart out onto the plate.
Top with crumbled goats cheese (or feta) and thyme leaves.
Cut into wedges. Serve warm or at room temperature.

SERVICE EXCELLENCE

At BKB we value the importance of trust. Trusting that the rains will return and that the land will produce for those who nurture it. Knowing that trust cannot be bought, but rather earned over time through our actions and our commitment to you, through the good times and bad. We take pride in the relationships we have built with generations of clients, each underpinned by integrity and bound through a look in the eye and the shake of a hand.

WWW.BKB.CO.ZA

BKB

The Trusted Home of Agriculture
Die Betroubare Tuiste van Landbou

To scan, download a free QR Code app

#SustainabilitySynergised

PEOPLE | PLANET | PROFIT

SERVICE EXCELLENCE | ENTREPRENEURSHIP | EARNINGS | EMPLOYEES | SUSTAINABILITY

#IntegrityIntegrated