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Smallholder & Communal Farming

Feeding Millions and Preserving Rural Livelihood

From Survival To Stewardship

Black farmers mentoring black farmers

Unlocking Rural Wealth

Agroecology in Action

Sustainable Spuds

The Problem with Symptoms

Hydrogen from Brewery Wastewater

Nutrient Deficiency In Aquaponics Systems

Essential Oils: Small-Scale Extraction Methods

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Editorial

"Farming is community, resilience, and innovation."

This time, we place the spotlight on smallholder and communal farming - the everyday practices that quietly feed millions and sustain rural life. These are the stories of farmers who work with limited means but endless determination, weaving together tradition, ingenuity, and community spirit.

Within these pages, you will discover a rich blend of content: practical insights into unlocking rural wealth, bold ideas on reframing farming through regenerative and climate-smart systems, and inspiring accounts of mentorship and knowledge-sharing. There are glimpses of innovation as well, circular solutions, new energy from old waste, and fresh approaches to aquaponics. Our special series, *Symptoms to Systems*, promises to change the way we think about agricultural challenges and opportunities.

This edition is a celebration of resilience and creativity in the fields. It is about survival, stewardship, and the promise of rural wealth, reminding us that agriculture is not only about food, but also about dignity, community, and hope.

Until next time.

Chris

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In this issue In hierdie uitgawe

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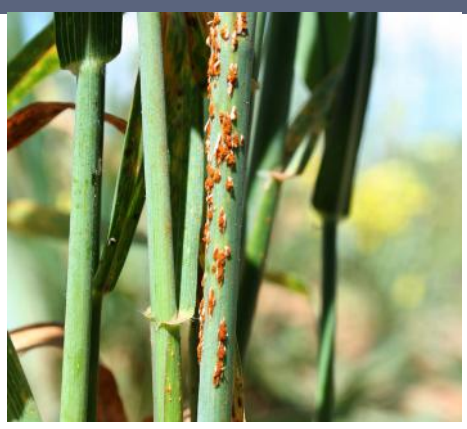

Smallholder and Communal Farming: **Feeding Millions and Preserving Rural Livelihood**

Across South Africa and much of subSaharan Africa, smallholder and communal farming remains the backbone of rural life. While largescale commercial agriculture dominates export markets and national statistics, it is the informal, subsistence, and communal practices that sustain millions of households, preserve cultural traditions, and provide resilience in times of crisis. As the Food and Agriculture Organization (FAO) has repeatedly emphasized, smallholder systems are central to global food security, even if they are often overlooked in policy debates.

The Scale and Importance of Smallholder Farming

Smallholder and communal farmers cultivate relatively small plots of land, often less than two hectares, and rely on family labour. Despite their modest scale, they collectively produce a significant share of staple foods consumed locally. In South Africa, communal farming areas cover nearly 13% of agricultural land, supporting millions of rural residents (Department of Agriculture, Land Reform and Rural Development). These farmers are not only food producers but also custodians of indigenous knowledge, seed diversity, and traditional practices that have evolved over generations.

Informal and Subsistence Practices
Informal farming practices are deeply embedded in rural life. Families grow maize, sorghum, beans, and vegetables primarily for household consumption. Livestock such as cattle, goats, and chickens are kept for meat, milk, eggs, and cultural functions. These systems are rarely mechanized and often depend on rainfall, traditional seed varieties, and organic soil fertility management.

Subsistence farming is not merely about survival. It represents autonomy, cultural continuity, and a safety net against poverty. In times of economic downturn or unemployment, subsistence plots provide food security and reduce reliance on purchased goods. Informal markets—roadside stalls, village trading, and community exchanges—circulate produce within local economies, ensuring access to affordable food. As noted in FAO's rural livelihoods reports, these informal exchanges are critical for resilience.

Communal Systems and Social Cohesion
Communal farming is characterized by shared resources: grazing lands, water points, and collective decisionmaking. In provinces such as Limpopo, Eastern Cape, and KwaZuluNatal, communal grazing systems remain central to livestock management. These systems allow households with limited land to keep cattle, goats, and sheep, reinforcing cultural practices such as lobola, initiation ceremonies, and communal feasts.

Communal farming also strengthens social cohesion. Labor is often shared during planting and harvesting seasons, while knowledge is passed down through generations. Elders play a critical role in guiding land use decisions, maintaining customary law, and ensuring equitable access to resources.

Contribution to Food Security
Smallholder and communal farming contribute directly to food security in several ways:

- Household nutrition through diverse crops and animal products.
- Local markets that provide affordable food to nearby communities.
- A buffer against shocks such as droughts or economic downturns.
- Seed preservation, maintaining indigenous varieties adapted to local conditions.

The FAO has highlighted that while smallholder farmers may not supply national supermarkets, they are indispensable in feeding rural populations and reducing dependence on external food systems.

Challenges Facing Smallholder and Communal Farmers

Despite their importance, smallholder and communal farmers face persistent challenges:

- Land tenure insecurity under communal land rights.
- Low productivity due to limited access to improved inputs and irrigation.
- Climate vulnerability in rainfed systems.
- Market access difficulties beyond informal trading.
- Youth disengagement from farming.
- Limited extension services.

These challenges are well documented in South African government assessments and FAO's regional agricultural reviews.

Opportunities for Transformation

Opportunities exist to strengthen smallholder and communal farming:

- Climatesmart agriculture techniques (FAO, 2025).
- Cooperatives and farmer groups for collective bargaining.
- Digital tools for weather forecasts and market prices.
- Policy support through schemes such as Kaonafatso ya Dikgomo (KyD).
- Value addition through processing and storage.
- Youth engagement via entrepreneurship programs.

Preserving Rural Livelihoods

Beyond economics, smallholder and communal farming preserves rural livelihoods in profound ways. Farming is intertwined with identity, culture, and spirituality. Livestock are not only assets but symbols of wealth, status, and cultural continuity.

By sustaining rural livelihoods, smallholder farming prevents mass migration to cities, reduces urban poverty, and maintains balanced demographic structures. It also preserves landscapes, biodiversity, and traditional ecological knowledge.

Case Examples

- **Eastern Cape:** Communal grazing systems supporting cultural cattle herds.
- **KwaZuluNatal:** Smallholder vegetable gardens supplying schools.

- **Limpopo:** Women's cooperatives cultivating maize and beans for roadside markets.
- **Mpumalanga:** Agroforestry integrating fruit trees with staple crops.

Policy and Institutional Support
Government and research institutions play a critical role in supporting smallholder farmers. Extension services, training programs, and subsidies can bridge knowledge gaps and improve productivity. Policies must be tailored to communal realities, respecting cultural practices and local governance structures.

Partnerships between government, NGOs, and private sector actors can provide inputs, training, and market linkages. Contract farming arrangements, when equitable, can help smallholders access larger value chains.

The Future of Smallholder and Communal Farming
Looking ahead, smallholder and communal farming must be recognized not as relics of the past but as vital components of sustainable agriculture. They embody resilience, diversity, and community values that commercial systems often lack. With appropriate support, these farmers can contribute to national food security, rural development, and climate adaptation.

Conclusion
Smallholder and communal farming in South Africa represent more than food production. It is a way of life, a source of resilience, and a foundation for rural livelihoods. Informal, subsistence, and communal practices feed millions, preserve cultural heritage, and sustain communities through adversity.
For our readers, farmers, extension officers, and rural leaders, the message is clear: smallholder and communal farming deserve recognition, investment, and respect. By strengthening these systems, South Africa can build a more inclusive, resilient, and sustainable agricultural future.

Acknowledgement:
This article draws on insights from the Food and Agriculture Organization (FAO) reports on smallholder farming, and assessments by the South African Department of Agriculture, Land Reform and Rural Development.

From Survival To Stewardship

Reframing Smallholder Farming through Regenerative Systems, Climate-Smart Agriculture, and Measurable Impact

G.P. Viljoen (PhD), Director,
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Across Africa, smallholders and communal farmers serve as the backbone of food security, rural livelihoods, and local economies. However, these farmers increasingly face challenges such as land degradation, climate variability, and rising production costs. Incremental improvements are no longer enough; a **systemic shift in how farming is understood, managed, and measured** is required. This means moving from survival-driven production to the **intentional stewardship of natural and economic systems**.

A Systemic Shift Enabled by Complementary Approaches

This transformation is being driven by the convergence of three major approaches: **Sustainable Intensification (SI), Regenerative Agriculture (RA), and Climate-Smart Agriculture (CSA)**. These are further supported

by practical decision-support tools, such as a **Regenerative Index Framework** and a **Farmer Toolkit**.

The Stewardship Imperative
At the heart of this transformation is a redefinition of the farmer's role. Rather than simply producing commodities, the farmer becomes a **steward of natural capital**, responsible for maintaining and restoring:

This perspective shifts agriculture away from short-term extraction, toward a **long-term regenerative system of care, productivity, and resilience**. It also calls for a disciplined decision-making process that balances production with ecological integrity and sustainability.

Integrating Three Complementary Systems
1. Sustainable Intensification: Producing More with Less
Sustainable intensification is about increasing productivity from existing land without expanding environmental pressures. For smallholder farmers, this involves:

- Precision in planting and timing
- Improved seed selection adapted to local conditions.
- Crop diversification and intercropping systems.
- Efficient use of inputs and labour

The focus is on **higher system efficiency**, not simply using more inputs.

2. Regenerative Agriculture: Restoring the Resource Base

Regenerative agriculture is based on the principle that soil is a **living system that can be improved over time**. Key practices include:

- Minimum soil disturbance
- Permanent soil cover through mulching and cover crops
- Crop diversity and rotation.
- Integration of livestock into nutrient cycles

These practices improve:

- Soil organic matter
- Water retention capacity
- Biological activity
- Long-term resilience to climate stress

Regeneration is not just a philosophy, but a **measurable biophysical improvement process**.

3. Climate-Smart Agriculture: Managing Risk and Resilience

Climate-Smart Agriculture (CSA) offers an adaptive framework for handling unpredictable climatic conditions. It aims for three outcomes:

- Increased productivity
- Improved climate resilience
- Reduced emissions intensity

For smallholders, CSA is implemented through practical methods like:

- Drought-tolerant crop varieties
- Rainwater harvesting and soil moisture conservation.
- Agroforestry and intercropping systems
- Conservation agriculture practices

These approaches work together as a mutually reinforcing framework.

From Practice to Performance: The Role of a Regenerative Index Framework

A major limitation in smallholder agriculture is the lack of consistent measurement beyond yield.

A **Regenerative Index Framework** addresses this by allowing assessment of farm performance across several dimensions:

- Soil health and organic matter
- Water management and infiltration
- Biodiversity and system diversity
- Productivity and efficiency
- Economic resilience and input dependency
- Stewardship and management behaviour

This approach marks a shift from **assumption-based improvement** to **evidence-based progression**.

By establishing a baseline and tracking changes, farmers and institutions can see what works, identify areas for intervention, and observe system evolution. This also fosters a shared language among farmers, advisors, funders, and markets.

The Farmer Toolkit
Transformation requires turning knowledge into action. A structured **Farmer Toolkit** puts regenerative and climate-smart principles into field-level practices:
Soil Systems
- Composting and organic matter cycling
- Mulching and residue management
- Cover crop integration.

Crop Systems
- Intercropping and rotation design
- Seasonal planning aligned to rainfall patterns
- Risk-spreading diversification strategies.

Livestock Integration
- Manure management and nutrient cycling.
- Rotational grazing principles
- Crop-livestock integration systems.

Water Management
- Rainwater harvesting techniques.
- Soil moisture conservation structures
- In-field water retention methods

Monitoring and Learning
- Simple farm record systems
- Index-based scoring tools
- Visual field assessment guides.

The goal of the toolkit is **repeatable simplicity that drives consistent improvement**. The toolkit evolves as new knowledge and practices prove their sustainability.

The System Loop: Measure, Plan, Implement, Improve
When used together, the Index Framework and Farmer Toolkit establish a cycle of continuous improvement: **Measure → Plan → Implement → Monitor → Improve**

This cycle enables farmers to:
- Understand their current system state.
- Make informed decisions.
- Implement targeted improvements.
- Track progress over time.
- Build cumulative gains in productivity and resilience.

Over time, this transforms farming systems from static production units into **adaptive learning systems**.

Broader Impacts: Beyond the Farm Gate
The benefits of this integrated approach reach far beyond individual farms.

At the community level, it promotes:
- Shared learning and peer-to-peer knowledge transfer
- Stronger local food systems
- Improved nutritional diversity.

At the system level, it enables:
- Access to sustainability-linked financing
- Entry into regenerative and ethical markets
- Participation in ecosystem service and carbon frameworks
- More effective public and private sector investment targeting
- Participation in quality control and monitoring initiatives to enhance product quality.

Thus, regenerative, and climate-smart agriculture serve not only as environmental strategies but as pathways for economic and institutional transformation.

Conclusion: A New Agricultural Logic
The future of smallholder farming will be defined not by scale, but by **system intelligence, ecological function, and measurable stewardship**. By combining sustainable intensification, regenerative agriculture, and climate-smart practices—supported by structured measurement and practical tools—farmers transition from vulnerability to resilience and ultimately to regeneration.

g value from the land to actively restoring and improving it while producing food and livelihoods.

This is more than a technical adjustment; it is a **new agricultural logic grounded in stewardship, measurement, and continuous improvement**. This innovative approach is already within reach.

Black farmers mentoring black farmers:
a success story from KwaZulu-Natal

Dr Siphe Zantsi and Zawie Mbatha, Agricultural Research Council

South African agriculture continues to reflect a stark divide between established commercial farmers, who are predominantly white, and smallholder farmers, the majority of whom are black. This gap remains evident even on redistributed land reform farms, where productivity and market access often lag that of commercial operations. Bridging this divide requires innovative and practical solutions, and mentorship has emerged as one of the most promising approaches.

While mentorship programmes are often associated with established commercial farmers supporting emerging black farmers, there are far fewer documented cases of black farmers mentoring one another. Yet, this form of peer-led development is proving to be both powerful and transformative. A compelling example comes from Mooi River in KwaZulu-Natal, where a group of smallholder farmers have taken their future into their own hands.

The Hlanganani Beef Cattle Study Group was established in 2018 by Mr Themba Dlamini, an experienced land reform beneficiary. The idea was born out of informal conversations among farmers who met at a local agricultural supply store while purchasing animal remedies. During these encounters, a common concern emerged: despite investing heavily in animal health products, many were not making a profit from their cattle enterprises.

At the same time, they observed that nearby commercial farmers were consistently profitable. The difference, they realised, lay largely in the quality of livestock. Commercial farmers were producing animals that fetched higher prices in the market, while smallholders relied on non-descript breeds with limited market value.

Recognising this, Dlamini challenged his peers to rethink their approach. Drawing on his own

experience, he encouraged collective action and learning. The group sought guidance from a local commercial farmer, Angus Williamson, who is fluent in isiZulu and willing to share his knowledge. This partnership helped build trust and provided valuable technical insights.

To formalise their efforts, the farmers began recruiting others through the agricultural supply store, eventually forming a group of 38 members. Their initial strategy was to contribute R200 per month towards purchasing improved cattle breeds. However, they soon realised that this amount was insufficient given the prohibitive cost wsof quality livestock.

In response, the group made a bold decision. Each member agreed to sell two of their existing cattle, and the proceeds were pooled. Through a collective auction, they raised enough capital to purchase 14 Brangus pregnant heifers and one bull—marking a significant turning point for the group. The farmers organised themselves further by employing a full-time herder and renting grazing land from one of the members. Monthly meetings became a cornerstone of the initiative, where members shared knowledge, tracked progress, and contributed a modest R100 per animal to support maintenance and infrastructure.

Their efforts began to pay off. With improved genetics and better management practices, the herd steadily grew. A further boost came when a donor contributed 28 pregnant heifers and two Tuli bulls, accelerating the group's progress.

By 2026, the Hlanganani herd had expanded to 92 cattle. The group has already sold more than 15 high-quality animals, demonstrating clear market success. Importantly, they have also involved their children in the project, nurturing a new generation of farmers and addressing the ageing demographic within the livestock sector.

Despite these achievements, challenges remain. Access to land has become the most pressing constraint. As the herd continues to grow, the need for larger grazing areas has intensified. The group has applied for land through government programmes, but without success so far.

In addition, they face ongoing risks common to many livestock farmers, including veld fires and stock theft. While these challenges are not unique, they highlight the vulnerability of emerging farming enterprises.

The Hlanganani Study Group stands as a powerful example of what can be achieved through collaboration, determination, and peer mentorship. It demonstrates that black farmers are not only capable of driving their own development but can also uplift one another in meaningful and sustainable ways.

With the right support—particularly access to land—initiatives like this could play a vital role in transforming South Africa's agricultural landscape.

Dairy Production and Agroprocessing: Unlocking Rural Wealth

Dr. Yandi Sanarana, Ms Tondani Neluvhalani & Dr. Walter Shiba: Agricultural Research Council

Imfuyo Bubu Tyebi Benu "your livestock is your wealth" is a phrase that carries deep cultural and economic meaning for the communities in the Eastern Cape. For generations, livestock among amaXhosa has represented much more than an agricultural commodity; symbolizing dignity, identity, and food security. During the Farmers Information Days held in the three localities of Chris Hani Municipality including Engcobo, Indwe and Dordrecht this theme became a reminder that livestock must be treated not merely as animals but as the foundation of family survival, cultural continuity, and rural prosperity. Through initiatives such as the Agricultural Research Council DairyRise Project aimed at equipping low to medium smallholder dairy farming, farmers were empowered with knowledge and tools that transform livestock into sustainable and growing wealth.

Livestock in Christ Hani District Municipality: Culture, economy, and household survival

The economy is deeply rooted in livestock ownership. For many households, animals serve as a form of savings or insurance, offering financial stability in times of need. Cattle support cultural ceremonies such as imbeleko, umgidi, and lobola, reinforcing the social fabric of the community. Amongst other livestock farming practices, it became evident and no doubt, that dairying in the localities of Christ Hani may be one of the few agricultural activities that can support viable smallholder farming. This is simple because farms in these areas have limited portion of land supporting them to farm while reproducing to enlarge their herds and producing milk. Milk supply supports child growth and household food security. Umvubo also referred as the "African salad" is a popular protein rich traditional Xhosa dish made from the blend of sour milk (amasi) and dry maize meal porridge (umphokoqo). It is consumed by people of all ages, in rural and urban hence reducing the problem of malnutrition. Llivestock manure enhances crop production, Most households

continue to use livestock manure to enhance their crop production, while others still rely on oxen for ploughing. When animals are healthy and productive, families have a reliable source of income and food making the theme "Imfuyo Bubu Tyebi Benu" not only symbolic but a practical guide to rural development.

Enhancing dairy productivity through milk recording

Milk recording is a powerful tool promoted under the ARC nationwide to help farmers understand the performance of each cow. Through regular analyses of milk yield, butterfat, and protein content, farmers can identify genetically superior animals, which eventually may improve herd quality. Milk recording also helps in early detection of udder infections such as mastitis, allowing farmers to address problems before they cause major economic losses. In communal areas, where many farmers use crossbred cows or traditional breeds, milk recording provides clear evidence of animal's value on genetic basis. This transform dairy farming from guesswork into informed decisionmaking, improving milk production and strengthening the herd over time. This approach aligns with the belief that says, when livestock is managed through knowledge and data, it becomes a growing source of wealth.

Dairy Agroprocessing: Turning milk into higher value products

Value addition is one of the most effective ways to increase income from dairy farming. Instead of selling raw milk alone, farmers can produce items such as amasi, yoghurt, cheese, butter, and flavoured milk. These products have longer shelf life and fetch higher prices in local markets, making dairy investments a potentially lucrative business opportunity for smallholder farmers. Agroprocessing also creates employment for youth and women, especially in small-scale cottage industries that thrive in rural settings. By learning hygiene standards, packaging techniques, and basic business skills, farmers can enter local markets confidently. The ARC supports these efforts by offering training on processing methods, product quality, and compliance with food safety requirements. Through agroprocessing, dairy farmers multiply the value of each litre of milk, further reinforcing the theme that livestock wealth grows when knowledge is applied.

Ruminant nutrition: Feeding animals for growth and productivity

Nutrition is one of the most important drivers of livestock performance. Just like many other smallholder dairy farming, farmers from the three localities of Chris Hani Municipality struggle with seasonal shortages of feed, especially during winter, leading to weight loss and reduced milk yield. Ruminants require a balanced diet made up of high-quality roughage such as hay and silage, energy-rich concentrates, minerals, vitamins, and clean water. When cows receive balanced nutrition, their fertility improves, milk production increases, and their vulnerability to disease decreases. ARC training support farmers to formulate cost-effective rations using locally available materials and teaches proper feeding strategies for cows at different stages whether they are in early lactation, late pregnancy, or production peak. A well-fed animal is a productive animal, and productive animals are the basis of rural wealth.

Planted pastures: Ensuring yearround feed supply

Planted pastures remain one of the most cost-effective strategies to support dairy production in rural areas. The Chris Hani Municipality climate makes it suitable for a

variety of pasture species, including summer grasses such as kikuyu and Smutsfinger grass, winter forages like oats and ryegrass, and legumes such as lucerne and clovers. Properly managed pastures reduce feed costs, improve milk yield, and help maintain animal health. Rotational grazing practices also protect soil health and prevent overgrazing in communal areas. The ARC along with the local Department of Agriculture provides farmers with guidance on establishing, managing, and fertilising pastures and planning fodder flow to ensure feed availability throughout the year. When farmers invest in planted pastures, they directly strengthen livestock productivity and household income.

Managing poisonous plants to protect livestock wealth

One of the major challenges faced by farmers is livestock poisoning. This is no exception in the Eastern Cape as plants such as Lantana camara, Gifblaar, Oleander, and Crotalaria species pose serious threats to cattle and other ruminants. These plants can cause sudden death, diarrhoea, neurological symptoms, and long-term organ failure. Many farmers lose animals simply because they are unable to identify these harmful plants or detect early signs of poisoning. The ARC has been instrumental in educating farmers about plant identification, risk seasons, and preventative grazing strategies. By removing toxic plants from grazing lands and monitoring animals closely, farmers can prevent unnecessary losses. Protecting livestock from poisoning is a central part of preserving rural wealth, as each animal represents years of investment and cultural value.

Market readiness: Preparing livestock for profitable sales

Transforming livestock into income requires proper market readiness. Farmers must ensure that their animals are healthy, properly conditioned, and compliant with regulatory standards. Health certification for diseases like brucellosis and tuberculosis is essential for accessing formal markets. Maintaining good body condition scores and practising hygienic milk handling ensures that farmers can sell milk and animals at competitive prices. Accurate record-keeping, including milk yields, calving intervals, and animal weights, helps farmers make strategic decisions and attract buyers who prefer transparent information. Market readiness also includes basic financial literacy understanding pricing, costing, and break-even analysis which the ARC promotes as part of its farmer training programmes. When animals are prepared for market, farmers unlock the full economic value of their livestock.

Conclusion: Living the message—Imfuyo Bubu Tyebi Benu

The theme “Imfuyo Bubu Tyebi Benu” captures the essence of sustainable rural development in the Eastern Cape. Livestock is not only a cultural treasure but a practical source of wealth that must be nurtured through knowledge, improved management, and modern farming techniques. By embracing milk recording, agroprocessing, balanced nutrition, planted pastures, poisonous plant awareness, and market readiness, farmers can transform their livestock into powerful engines of economic growth. With ongoing support from the Agricultural Research Council along with the Departments of Agriculture, the dairy and livestock farmers are well-positioned to build a more resilient and prosperous future one in which their livestock continues to sustain and enrich their households for generations to come.

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Agroecology in Action:
Echoes from the Phawu Likum Agripak Famers and Exhibition Day

Thabiso Andries Benedict Koatla
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On a bright morning of 26 February 2026, four hundred farmers, students, researchers, departmental officials and community leaders gathered at the Phawu Likum Agripak in Busila village, Willowvale (Eastern Cape Province). It became a vibrant hub of learning, exchange, and celebration; a powerful demonstration of agroecology in practice, rooted in resilience, knowledge sharing, and community empowerment. But what makes agroecology more than just farming? It is the stories of soil restored, seeds preserved, livelihoods strengthened and communities reconnected to the land.

Agroecology in Practice: A Living Laboratory

Walking through the exhibition grounds felt like stepping into a living laboratory... Demonstration plots illustrated the principles of agroecology in practical terms:

- Intercropping maize with legumes
- Companion planting
- Composting systems
- Natural pest repellents

Visitors could see the difference - healthier crops, darker soils, buzzing farms Exhibitors explained how agroecology reduces dependency on expensive inputs. Unlike conventional approaches that rely heavily on external inputs, agroecology demonstrates that biodiversity itself is the foundation of productivity.

Seeds of Sovereignty: Preserving Heritage

Seed sovereignty is critical since it's the right of farmers to save, use, exchange and sell their own seeds. Carefully labelled jars and woven baskets held varieties of millet, sorghum, beans and vegetables passed down through generations. Seed exchange sessions are not only about farming, they are moments of cultural preservation and empowerment.

Women Leading Transformation

Women were not merely participants; they were at the forefront... Exhibits included packaged vegetables, herbal products, and organic spices. Many shared how agroecology reduced costs while diversifying income streams. Empowering women in agriculture is not just fairness, it is a pathway to broader social and economic transformation.

Youth Engagement: Farming as the Future

A standout feature was the enthusiasm of young farmers and students. Interactive sessions included climate-smart talks, record-keeping tutorials, and business planning. For many youth, agriculture is being redefined. It is no longer synonymous with hardship but with innovation, entrepreneurship, and stewardship.

Climate Resilience in Action

Climate change is no longer a distant threat; it is a lived reality. Farmers presented strategies such as mulching, agroforestry, rainwater harvesting, and diversification. Resilience here was not only ecological, but social - communities working together are better equipped to face climate challenges.

Reclaiming Our Roots: Keynote Reflections

The keynote address, "Reclaiming our roots for a resilient Future: Ukubuyel' Embo - Going back to go forward," reminded participants: "Our ancestors farmed without degrading the land." Key messages included: soil restoration, valuing farmers as knowledge holders, food sovereignty, and youth opportunities. Claiming our roots does not mean rejecting innovation; it means blending traditional wisdom with modern science.

From Event to Movement

As the sun set, seeds had been exchanged, networks strengthened, and ideas planted. The day showed that agroecology is practical, viable, and transformative. At Phawu Likum Agripak, agroecology was not simply discussed, it was lived.

Conclusion: Toward Resilient Food Systems

The Phawu Likum Agripak Agroecology Farmers and Exhibition Day reaffirmed that agroecology offers a hopeful pathway toward inclusive and resilient food systems. From seed sovereignty and soil restoration to women-led enterprises and youth-driven agribusiness, the day reflected the multidimensional strength of agroecology.

The challenge now is to ensure that the seeds planted here grow into policies, practices, and partnerships that sustain agroecology across South Africa.

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Sustainable Spuds and Circular Solutions:

Evaluating Bioslurry in Smallholder Potato Systems

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Potato production remains a cornerstone of food security and rural livelihoods across South Africa, especially among smallholder farmers navigating resource constraints and climate variability. As the agricultural sector seeks more sustainable and cost-effective nutrient solutions, bioslurry, a nutrient-rich byproduct of anaerobic digestion, has emerged as a promising biofertilizer. Rich in essential nutrients and beneficial microbes, bioslurry offers a circular economy alternative to synthetic inputs, aligning with national goals for regenerative agriculture and waste valorization.

To explore its potential, ten farmers across North West Province participated in the Bioslurry Living Labs potato trials


Figure 1: Potato trial in Rustenburg during vegetative stage

during the February–July 2025 season. This article presents key findings from the first season, highlighting bioslurry's agronomic performance, physiological effects, and market relevance.

Trial Design and Data Collection

The trials were conducted across seven location: Zeerust, Rustenburg, Matile, Ramatlabama, Jagersfontein, Lomanyaneng and Taung. Each trial site had four fertilizer treatments:

- Control (no fertilizer)
- Kraal manure
- Bioslurry
- Synthetic fertilizer (N:P:K)

All treatments, except the control, were applied at agronomically optimal rates based on local recommendations. Weekly field monitoring included physical, physiological and phenotypic data were collected. At physiological maturity, a standardized 2-meter strip was harvested from each plot. Tubers were sorted into size categories (large to baby), and damaged tubers were recorded. Yield metrics included:

- Total fresh tuber mass (kg)
- Average tuber mass per size class (g)
- Total tubers count per plot
- Average tuber length per size class (cm)

Post-harvest, composite soil samples were collected for microbial and physicochemical analysis, including microbial biomass, nutrient content, pH, and organic matter levels.

Yield Performance Across Sites

Across the trial sites, bioslurry consistently delivered higher yields than other treatments. At Jagersfontein, bioslurry produced over 50 tons per hectare, outperforming both kraal manure and synthetic fertilizer (Table 1). Rustenburg and Taung showed similar trends, with bioslurry producing the highest total tuber mass and average tuber size. Even at Zeerust, bioslurry ranked second but remained comparable to kraal manure, confirming its agronomic viability.

Table 1: Potato yield data for Lomanyaneng, Rustenburg, Taung, Jagersfontein and Zeerust

Site	Control (t/ha)	Manure (t/ha)	Bioslurry (t/ha)	Fertilizer (t/ha)
Lomanyaneng	16.45	7.67	**24.86**	21.44
Rustenburg	22.95	44.13	**48.94**	42.91
Taung	18.69	15.84	**31.81**	22.09
Jagersfontein	27.67	35.30	**50.34**	42.80
Zeerust	18.10	**26.36**	25.46	23.50

These results demonstrate that bioslurry is not only competitive with conventional fertilizers,

Figure 2: Potato fry colour – a)bioslurry; b)synthetic fertilizer (N:P:K)

but it also often surpasses them in yield performance. Farmers observed visibly healthier plants under bioslurry treatment, with improved canopy development, stronger stems, and more uniform tuber formation.

Post-Harvest Quality: Fry Colour and Specific Gravity

Tubers were analyzed for fry colour and specific gravity (SG), a proxy for dry matter and starch content. SG is a reliable indicator of starch accumulation and processing quality. Tubers with higher SG values absorb less oil during frying, resulting in lighter and crispier fries, key traits for processing. Fry colour values above 50 relatively result in lighter or brighter colour of potato chips. Bioslurry-treated potatoes showed elevated SG and improved fry colour, making them more suitable for processing and consumer markets. However, fry colour is also influenced by sugar content. High levels of reducing sugars can cause darker fries due to Maillard browning reactions. While bioslurry improved SG, its effect on sugar concentration must be considered in future trials to fully understand its impact on processing quality.

Tuber Size Distribution: Marketable Advantage

All treatments predominantly produced small to baby-sized tubers, but bioslurry and kraal manure promoted a higher proportion of medium-small and small tubers (Table 2), preferred by consumers for uniformity and cooking quality. Tuber size is a critical factor in marketability. The trial revealed that bioslurry shifted tuber size distribution toward these commercially desirable categories. Control treatments often produced baby-sized tubers, indicating poor nutrient availability. Synthetic fertilizer increased total tuber count but spun toward baby and extra-small sizes, which may limit market value. Kraal manure showed moderate improvement but lacked consistency across sites. Bioslurry-treated plots produced a higher proportion of medium-small and small tubers, with fewer damaged or undersized tubers. This suggests that bioslurry not only boosts yield but also improves the quality and market readiness of the harvest.

Table 2: Tuber size distribution as influenced by four fertilizer treatments

Size Category	Control	Manure	Bioslurry	Fertilizer
Medium-Small	Low	Moderate	**High**	Moderate
Baby	High	Moderate	Low	High
Damaged	Moderate	Low	Low	**High**

Figure 2: Harvesting of potatoes from bioslurry living labs in NW for size classification.

Synthetic fertilizer increased total tuber count but spun toward baby and extra-small sizes, limiting market value. Bioslurry showed greater potential to shift size distribution toward commercially desirable classes.

Site-Specific Responses

Tuber size analysis revealed varied responses across locations:

- **Rustenburg**: Strong response to synthetic fertilizer; increase in medium-sized tubers.
- **Ramatlabama**: Broader size distribution; bioslurry moderately enhanced medium-sized tubers.
- **Taung**: Predominantly small and extra-small tubers; limited responsiveness.
- **Matile**: Best performance under control and bioslurry; fertilizer caused high damage rates.
- **Zeerust**: Spun toward extra-small tubers under control and fertilizer; bioslurry improved small tuber yield.
- **Lomanyaneng**: Most balanced size distribution; bioslurry and manure produced medium-large and large tubers.

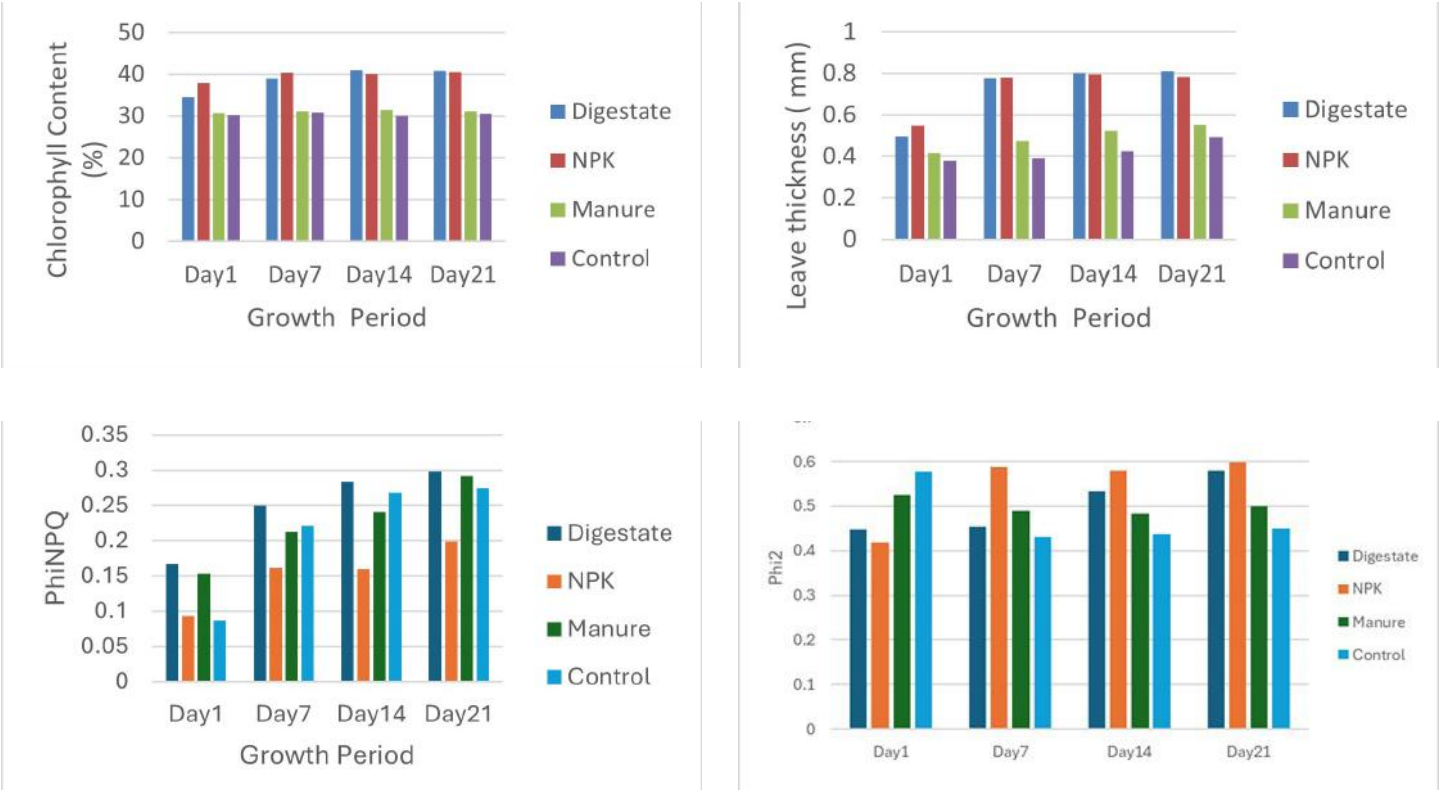

Figure 3: Physiological parameters of potato trials using Photosynq spectrophotometer

These findings highlight the importance of local agroecological conditions in treatment responsiveness.

Physiological Insights: Leaf Morphology and Photosynthesis

PhotosynQ data provided deeper insights into plant physiology. Bioslurry-treated plants exhibited the thickest leaves (0.81 mm by Day 21), which are associated with higher photosynthetic capacity due to increased mesophyll cell density. Chlorophyll content was also highest in bioslurry plots (40.94% by Day 14), indicating robust photosynthesis. Photosystem II energy partitioning metrics showed that bioslurry enhanced photochemical efficiency (ΦPSII) while maintaining balanced energy dissipation (ΦNPQ). These traits suggest that bioslurry-treated plants were more resilient under light stress and better equipped for biomass accumulation. Farmers observed greener leaves, stronger stems, and more vigorous growth in bioslurry plots.

Farmer Observations and Feedback

Farmers reported:

- Greener leaves and stronger stems

More uniform tuber development

- Easier soil workability post-harvest
- Interest in scaling bioslurry use across other crops

Practical Guidelines for Farmers

- **Start small:** Apply bioslurry on a test plot using watering cans or drip systems.
- **Ensure quality:** Use bioslurry from well-managed digesters to avoid pathogens and ensure nutrient consistency.
- **Combine wisely: if planning to** Pair bioslurry with compost or kraal manure, do so with care so to ensure balanced nutrients for crop requirement and soil health.
- **Monitor growth:** Use leaf colour charts to track plant health and adjust practices.

A Regenerative and Climate-Smart Path Forward for Potato Farmers

The North West potato trials demonstrates that bioslurry is far more than a waste product, it is a regenerative input with the power to transform smallholder farming systems. Across diverse sites and conditions, bioslurry consistently improved yields, enhanced tuber quality, and restored soil health. It supported better leaf development, stronger photosynthetic performance, and more marketable tuber sizes, all while reducing the need for costly synthetic fertilizers. For smallholder potato farmers, especially those facing rising input costs and declining soil fertility, bioslurry offers a practical, affordable, and sustainable alternative. Its ability to feed both the crop and the soil makes it uniquely suited to the challenges of climate-smart agriculture. Moreover, its alignment with circular economy principles, recycling farm waste into productive nutrients, adds value beyond the field.

However, bioslurry is not a one-size-fits-all solution. The trials revealed that site-specific conditions such as soil type, moisture availability, and management practices influence its effectiveness. Farmers are encouraged to start with small test plots, monitor plant responses, and adapt their application strategies accordingly. Looking ahead, broader adoption of bioslurry will require investment in farmer training, access to biogas systems, and supportive policies that recognize the value of organic inputs. Extension services and farmer organizations can play a key role in scaling this innovation, ensuring that bioslurry becomes part of a wider movement toward regenerative, resilient farming. In a time when agriculture must do more with less, bioslurry offers a hopeful path forward, one that is rooted in farmer innovation, scientific evidence, and the wisdom of working with nature. For South Africa's smallholder potato growers, the future may already be fermenting in the slurry pit. The study in still ongoing and presented in this article are preliminary results.

Acknowledgement

Authors would like to acknowledge the Department of Agriculture for funding this project, The Agricultural Research for availing resources during field trials, the team of Farmers Support Commercialisation and Enterprise Development at ARC-VIMP, finally the farmers of Mafikeng and Taung, NW, for participating in the project.

PROMOTION

Plough Through Summer Tasks: 5 Ways A Garden Tractor Can Lighten Your Load

Summer, with all its beauty and bounty, has arrived, ushering in peak growth season. Lawns thicken and spread, foliage fills out, and crops push into their key production phase, while weeds are never far behind. For homeowners, landscapers, and small-scale farmers, it can mean many hours spent mowing, hauling, digging, and spraying... unless you have the right tools for the job.

According to Lorna Ochiel, East Africa Representative, a garden tractor is one of the smartest investments you can make, as it dramatically cuts the time spent on essential maintenance tasks. “Time is the one thing you can’t get back. Whether you’re managing a large garden of an acre or more, a smallholding or small farm, saving hours every week isn’t just about convenience - it often translates directly into saving money too.”

She shares how a Husqvarna tractor turns summer's toughest tasks into quick and efficient jobs:

1. **Mow more in less time**
   Summer lawn growth can quickly get out of control, especially on larger properties. With powerful engines and wide cutting decks, garden tractors like the Husqvarna **TS 220TD** can mow large areas in a fraction of the time it would take with a walk-behind mower. For a smallholding or estate, this could mean completing a job in one morning instead of over two or three days - freeing up time for other priorities or reducing the need to hire someone else to do the job
   .
2. **Haul heavy loads efficiently**
   Moving compost, manure, soil, mulch, or debris by hand can consume days of labour. Unlike a ride-on mower, which is just for mowing lawns, a garden tractor can tow attachments such as trailers, spreaders, or other implements, making tasks like transporting materials quick and easy. For example, transporting several wheelbarrows of compost in one trip not only saves hours but also reduces fuel and labour costs. Over the course of a season, this efficiency adds up to real savings.

3. **Spray more effectively with less effort**
   Summer is also the season when pests are at their most active, and regular spraying can make the difference between a healthy crop and a disappointing harvest. By attaching a tow-behind sprayer, your tractor can cover large areas evenly and quickly. This means pests can be managed without extra labour or costly standalone equipment, saving time and money while protecting crops.

4. **One machine, multiple tasks**
   From collecting leaves and clearing debris to towing irrigation equipment or distributing feed, a single tractor can replace multiple pieces of equipment. The Husqvarna **TS 222TDF**, designed for larger properties and smallholdings, is particularly effective, making light work of time-consuming tasks.

"In a season that is both demanding and rewarding, whether you're a small-scale farmer or busy gardener, a Husqvarna garden tractor helps you get more done with less effort. By handling the work of several machines, it reduces the need for extra equipment, labour, and fuel," Ochiel concludes, "ultimately helping you to get the most value from your investment."

Discover how a Husqvarna garden tractor can lighten your workload at https://www.husqvarna.com/ke/garden-tractors/ or your nearest dealership.

About Husqvarna
Husqvarna, a brand within Husqvarna Group, is a market leader in innovative and high-quality products and services for shaping green spaces in parks, forests and gardens. Since 1689, Swedish-born Husqvarna has a strong focus on research and development and is a pioneer in robotic lawn mowers and chainsaws. Today, the product portfolio consists of the next generation of robotic mowers, riders, chainsaws and trimmers for professional as well as private use. Sustainable value creation, product innovation and digitalisation remain important for the journey ahead. Husqvarna products are sold in more than 100 countries. Husqvarna Group, which also includes Gardena and Husqvarna Construction, has 13,300 employees in 40 countries around the world and net sales in 2024 amounted to SEK 48,4 billion. Husqvarna Group is listed on Nasdaq Stockholm.

From Symptoms to Systems: PART 1

The Problem with Symptoms

Dr Ida Wilson
Independent Crop Production Consultant

Introduction to the Series From Symptoms to Systems

This eight part series, From Symptoms to Systems, explores why symptom based crop management so often unravels, and how systems thinking can transform agricultural decision making.

Across the series, Dr Wilson takes readers on a journey: from recognising the limits of reactive management and uncovering hidden constraints, to identifying patterns of failure, rethinking interventions, and ultimately farming systems rather than symptoms. Each article builds on the last, offering practical insights and a structured framework for more resilient, sustainable crop production.

This introduction marks the beginning of the series. Readers are invited to follow all eight parts as they appear in upcoming editions, and to engage with the ideas that challenge conventional approaches while opening new pathways for farming success.

Most crop problems are not caused by a single factor. Yet they are almost always diagnosed and treated as if they are. A leaf turns yellow and a nutrient deficiency is suspected. A lesion appears and a disease is named. A product is selected and applied. From the outside, this looks like control. It is not.

But what if the yellow leaf isn't about nutrients at all?

When Symptoms Mislead

In crop production, we are trained to observe, identify, and respond. Over time, this has shaped a way of thinking that assumes problems are discrete, identifiable, and correctable. A symptom appears, a cause is assigned, and an intervention follows. This approach has value. It creates structure and allows for action. It has supported decades of productivity gains through advances in fertilisation, crop protection, and plant

breeding. Yet it rests on an assumption that often goes unchallenged: that what we see is what is driving the system.

Crop systems do not behave this way. A nutrient deficiency may not originate from a lack of nutrients in the soil, but from root damage, waterlogging, or poor soil structure. A disease outbreak may not begin with the pathogen itself, but with environmental stress that predisposes the plant to infection. Poor crop performance is rarely the result of a single failure, but rather the outcome of multiple interacting pressures over time. A citrus orchard showing symptoms of zinc deficiency may, on analysis, have adequate zinc levels in the soil. The limitation lies not in supply, but in uptake. Compacted soil, poor root development, or prolonged wet conditions reduce root function. Foliar applications may temporarily improve leaf appearance, but the underlying constraint may remain. The symptom is treated. The system is not.

Inputs and Interventions: Control or Dependency?

Still, some interventions remain symptom based. A fungicide is applied because the disease is visible or anticipated. Fertiliser is added because a deficiency is suspected. An insecticide is used because damage has appeared. The underlying system that led to the problem remains largely unchanged. This way of thinking has shaped modern agriculture. Inputs are used to correct problems, and risk is managed through preventative action. Decisions are often made under uncertainty, where acting early is seen as safer than acting accurately. Entire fields and orchards are treated with agrochemicals to avoid the possibility of loss, even when the presence and extent of a problem is not clear.

Invisible Processes, Delayed Signals

Another persistent challenge in crop production is that the processes that matter are invisible. Roots are hidden beneath the soil surface, where their health status is difficult to assess. Microbial presence, diversity, and activity in soil unfold beyond the scope of direct observation. Even photosynthesis—arguably the most critical plant process in plant production—cannot be seen. Physiological stress develops long before symptoms appear, and disease infection may occur well in advance of detection, sometimes up to two weeks before visible signs appear. By the time a problem becomes apparent, the system is already out of balance, and the window for effective intervention is small.

Preventative Action and Its Risks

This delay drives behaviour in crop management today. If problems are only visible once they are well established, then preventative action becomes the default strategy. Inputs are applied in anticipation of risk rather than in response to confirmed conditions. Entire systems are managed to avoid uncertainty rather than to understand it. Yet, preventative actions without understanding the underlying reasons for the problems experienced do not necessarily eliminate risk. It redistributes it. It shifts the system toward increased dependence on external inputs, while leaving the underlying causes of instability unaddressed.

Recognising the system doesn't mean abandoning interventions—it means placing them in context.

Changing Environments, Shifting Systems

At the same time, the environment in which crops are produced is changing. Temperature patterns are shifting. Rainfall is becoming more variable. Extreme weather events are more frequent. These changes influence not only crop growth, but also the behaviour of pests, pathogens, and soil systems. The conditions under which current knowledge was developed are no longer stable. It may no longer be sufficient to manage the crop in the ways that has worked before. The system itself is evolving, and with it, the outcomes of management decisions.

The Disconnect Between Systems and Management

The result is a growing disconnect between how crop systems function and how they are managed. Problems persist despite increasing intervention. Efficiency declines as input use increases. Uncertainty remains, even as tools become more advanced. And yet, the underlying approach remains largely unchanged.

If there is a single reason why crop problems often do not make sense, it is this: we are trying to manage complex, dynamic systems as if they are simple, static problems.

In the next editions of AgriAbout, I present a series of articles, not about individual diseases, products, or practices, but about how we think. The series will explore why crop problems are so often misunderstood, why well-intended interventions fail, and why increasing effort does not always lead to better outcomes. More importantly, it presents a different way of approaching crop production—one that recognises the system, rather than reacting to its symptoms.

This series is not about discarding what we know, but about expanding how we think—so that interventions align with the systems they are meant to support.

Because until we understand the system, we will continue to treat the symptoms. And crops will continue not to make sense.

Read PART 2 (**Seeing the System**) in the next edition of AgriAbout

Essential Oils: Small-Scale Extraction Methods

Theresa Siebert: ARC-Natural Resources And Engineering

When you peel an orange, you become aware of a special aroma that is released by the fruit. This is the essential oil in the orange peel, and these are the compounds that give herbs, spices, fruits and flowers their flavour and perfume. Essential oils are found in the seeds, bark, leaves, roots, flowers, balsam, wood, and resin of plants.

There are 4 basic methods of essential oil distillation:

- Hydro distillation.
- Water-and-steam distillation.
- Steam distillation.
- Vacuum distillation.

Of these hydro distillation, and water-and-steam distillation are most used for the small-scale extraction of essential oils.

The choice of distillation method is dictated by:

- The sensitivity of the essential oil to the action of heat and water.
- The volatility of the essential oil that will be extracted.
- The water solubility of the essential oil that will be extracted.

Hydro Distillation

In the hydro distillation process the plant material is fully covered in water and then boiled to obtain the essential oil. A copper

still is fitted on a brick furnace. The still is then filled with plant material. The plant material is completely covered with water to the top. The condenser is placed in a water tank and connected to the still. The various joints are properly sealed. The essential oil vapour and the steam is collected and condensed in the copper container and the separated.

Hydro distillation produces oils of a lower quality and has some drawbacks:

- The plant material closest to the bottom wall of the still is in close contact with the furnace fire, which could cause the material to char and impart an undesirable odour, known as a burning note, to the essential oil.
- Oxygenated substances tend to partially dissolve in the water in the still and cannot be completely removed.
- Because the stills used for hydro distillation are small, it takes time to extract enough essential oil, which often leads to high grade oil being mixed with oil of a lower quality. This in turn reduces the grade of the final product.
- Hydro distillation is a slow process, requiring a long distillation time, which means it consumes a lot of firewood/fuel.

It is also important to note that the quality of the oil obtained through this method is directly related to the skill of the processor in:

- Managing the still.
- Selecting the raw plant material.
- Preparing the raw plant material.

Water-and-steam Distillation

The water-and-steam distillation method is an improvement on hydro distillation whereby a perforated grid if placed in the still just above the bottom. The main equipment used in water-and-steam is:

- The distillation still which is usually made from stainless steel.
- Condenser.
- Oil separator and receiver.
- Brick furnace.

During operation the still is fitted with a perforated grid and placed directly on the furnace. The furnace is fuelled with agro-waste and/or firewood. The plant material to be extracted in placed in the perforated grid; the still is the filled with water to below the grid. The still is then connected to the condenser with a vapour line and the distilled condensate oil and vapour mixture id separated in the oil separator.

Water-and-steam distillation is extremely popular due to the simple construction of the equipment, its low cost and easy operation.

Essential Oils Commonly used in South Africa

Common Name	Variety	Uses	Part of Plant Used
Geranium	*Pelargoniums*	High-grade perfumery products and in soaps, talcum powders and creams; for the flavouring of beverages	Green herbage
German Chamomile	*Matricaria recutita (Matricaria chamomilla)*	Tea; flavour in alcoholic beverages (liqueurs); cosmetics	Flowers
Lavender	*Lavebdula Grosso (Lavendula Herchum Blue) (Lavendula Mailette) (Mavedula No.9)*	Fragrance; medicine	Flowering tops
Lemon Balm	*Melissa officinialis*		Leaves & tops
Lemon grass	*Cymbopogon citrates*	Preparation of ionones; in less-expensive fragrance work; aerosol deodorants; odour masks	Green herbage
Oil roses	*Rosa*	High grade fragrance in cosmetics, toilet water & perfumes	Flowers
Peppermint	*Mentha piperita*	Flavouring applications in pharmaceutical industry; candies; confectionary	Green herbage
Roman Chamomile	*Anthemis nobilis*		Flowers
Rosemary	*Rosmarinus officinalis*	Liqueurs; medicinal wines	Leaves
Sage	*Salvia officinalis*		Leaves
Spearmint	*Mentha spicata*	Flavouring of toothpaste; candies	Green herbage
Sweet Marjoram	*Organum marjorana*	Flavoured spirits, liqueurs, vermouths	Leaves
Thyme	*Thymus vulgaris*	Disinfectants & antiseptics; in soaps; flavouring food products	Herbaceous tops
Yarrow	Achillea millefolium		Leaves & tops

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BREWING HYDROGEN:
Engineering Green Hydrogen from Brewery Wastewater

Sihle Thuesi
Chemical Engineering Graduate & Water-to-Energy Research Enthusiast
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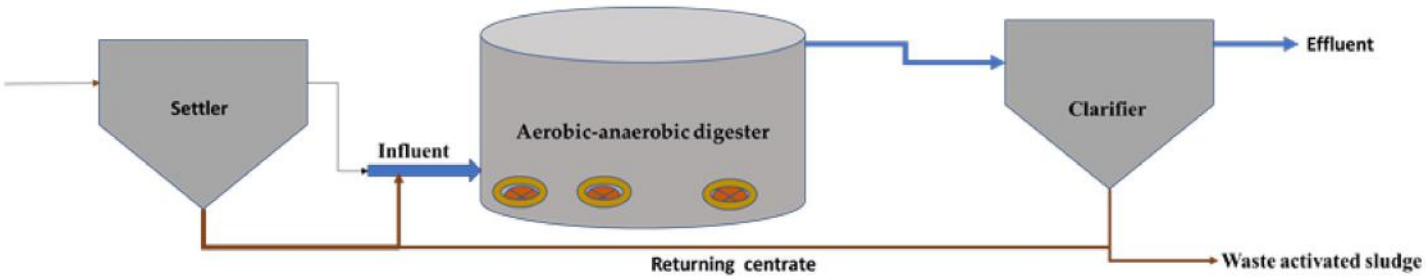
Dr Idan Chiyanzu (ARC-Natural Resources and Engineering)

Behind every glass of beer lies a hidden engineering challenge. While brewing is celebrated as both a craft and a major economic contributor, it is also one of the most water-intensive agro-processing industries. In a country like South Africa where water scarcity, aging municipal infrastructure, and persistent electricity shortages constrain industrial growth brewery wastewater is no longer just an environmental liability. It is a strategic resource waiting to be unlocked. This shift in perspective from waste management to resource recovery, forms the foundation of sustainable brewery engineering.

The Scale of the Challenge

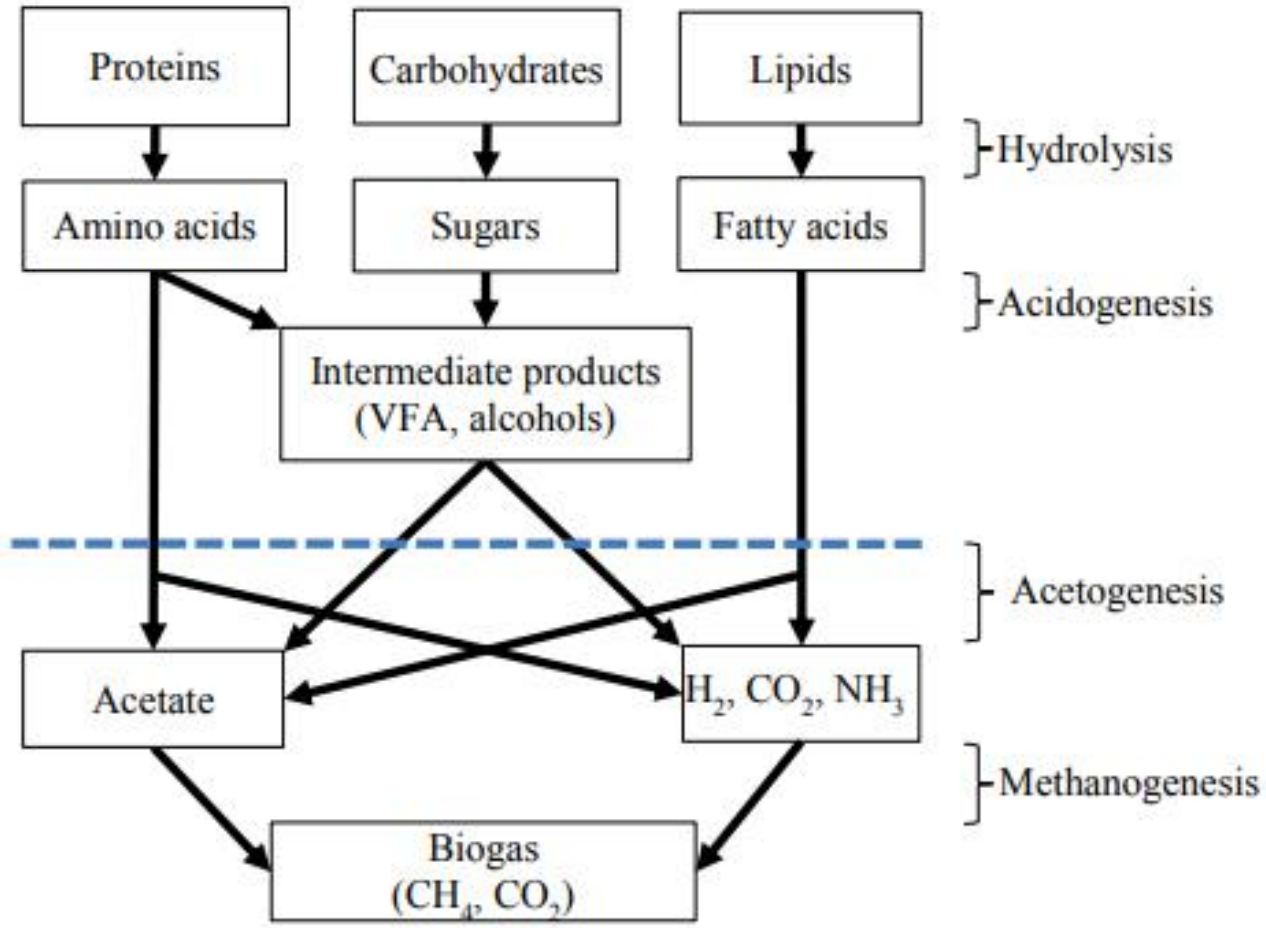
Beer production requires significant volumes of water. Industry data indicates that for every litre of beer produced, between 3 and 10 litres of wastewater are generated, with 3–5 litres typical for modern facilities. Considering the scale of commercial brewing operations, this translates into millions of cubic meters of wastewater annually.

If discharged without adequate treatment, this high-strength effluent can overwhelm municipal wastewater treatment works, increase operational costs, and negatively



Schematic representation of a local South African brewery wastewater treatment plant.

Source : https://www.mdpi.com/1634840



Schematic of anaerobic digestion pathways. Adapted from Pfeffer, Leiter & Worlund (1967); Parkin & Owen (1986); Batstone et al. (2002); Appels et al. (2008).
Source : https://open.uct.ac.za/items/b9cf8e72-9380-4a6f-a3db-47656197ebb3

impact receiving water bodies. Therefore, effective on-site treatment is not only an environmental responsibility but also a regulatory necessity.

Understanding Brewery Wastewater

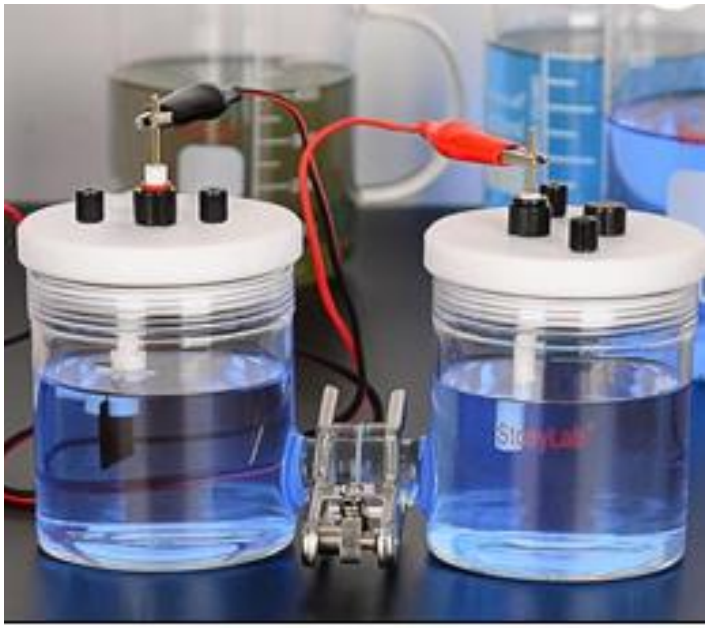
Brewery wastewater is characterized by a high organic load dominated by residual sugars, starch, yeast cells, and soluble solids. Chemical Oxygen Demand (COD) concentrations can range from several thousand to tens of thousands of milligrams per litre. Importantly, the wastewater is highly biodegradable, with typical BOD/COD ratios between 0.5 and 0.7 making it particularly suitable for biological treatment processes. However, variability presents challenges. Cleaning-in-place (CIP) operations cause fluctuations in pH, while nutrients such as nitrogen and phosphorus are often present in significant concentrations. These characteristics demand carefully designed treatment systems, but they also present a valuable opportunity: the recovery of energy from organic matter.

Conventional Treatment: Necessary but Under-Optimized

Industrial breweries typically operate on-site wastewater treatment plants comprising primary and secondary treatment stages, and occasionally tertiary polishing.

Primary treatment removes coarse solids, fats, oils, and grease through screening, grit removal, and equalization. Secondary treatment often aerobic activated sludge or biofilm systems—removes most biodegradable organic matter through controlled aeration and biomass growth, achieving substantial BOD reduction.

Tertiary treatment, where implemented, may include ultrafiltration, reverse osmosis, or advanced oxidation processes to produce



Batch test in gas endeavour

Laboratory -scale MEC batch reactors

high-quality effluent suitable for non-potable reuse. However, many facilities stop at secondary treatment, focusing primarily on compliance rather than resource recovery.

Anaerobic Digestion: From Waste to Biogas

Anaerobic digestion (AD) represents a mature and globally proven technology capable of converting organic matter into methane-rich biogas. In oxygen-free conditions, specialized microorganisms break down organic compounds through hydrolysis, acidogenesis, acetogenesis, and methanogenesis, ultimately producing biogas and stabilized sludge.
For breweries, this means that wastewater treatment can become an energy-generating process. The recovered biogas can be used for steam production, heating, or electricity generation, reducing reliance on grid power and fossil fuels while lowering greenhouse gas emissions key metrics in Environmental, Social, and Governance (ESG) reporting.

Technologies such as Upflow Anaerobic Sludge Blanket (UASB) and Expanded Granular Sludge Bed (EGSB) reactors are particularly well-suited for high-strength industrial effluents. In South Africa, adoption remains limited but promising. Facilities such as the Heineken Sedibeng Brewery and South African Breweries Alrode Brewery have integrated anaerobic digestion into their wastewater treatment systems, enabling biogas recovery while maintaining regulatory compliance.

Beyond Methane: The Rise of Green Hydrogen

Global decarbonization efforts and net-zero targets for 2050 are accelerating interest in alternative clean energy carriers, particularly green hydrogen. As industries transition from linear production models toward circular systems, wastewater is increasingly recognized as a feedstock for renewable hydrogen production.

Low-energy biological processes such as dark fermentation and microbial electrolysis cells (MECs) are gaining research attention for their ability to convert organic substrates including brewery wastewater into hydrogen.

Dark fermentation produces hydrogen during the acidogenic breakdown of organic matter under anaerobic conditions. MECs, meanwhile, enhance hydrogen yields by applying a small external voltage to drive electro-biochemical reactions. While these technologies are still at various stages of development and commercial readiness, they represent the next frontier in integrated wastewater to energy systems.

In future brewery configurations, wastewater treatment plants could simultaneously remove pollutants, generate methane for immediate energy needs, and produce hydrogen as a strategic clean fuel creating multi-product biorefineries embedded within industrial sites.

Research and Innovation in South Africa

South Africa is not merely observing this transition it is actively contributing to it. The Agricultural Research Council (ARC) operates a Sustainable Energy and Bioeconomy (SEBE) Laboratory at its Engineering Campus in Silverton, Pretoria. The facility investigates renewable energy and value-added bioproducts from diverse biomass resources, including agro-industrial wastewater.

The laboratory explores multiple conversion pathway anaerobic digestion, dark fermentation, microbial electrolysis, photo-fermentation, gasification, and pyrolysis alongside renewable fuel production such as bioethanol and biodiesel. Importantly, the unit also supports postgraduate research and capacity development in this critical skills area.

Current research initiatives include:

- Assessment of agro-industrial sector resource recovery potential using dark fermentation biorefineries (WRC-funded project).
- Integration of heterogeneous catalysts in anaerobic digestion for enhanced biogas yields from sugar industry waste.
- Design and simulation of integrated dark fermentation biorefineries using beverage wastewater.
- Investigation of biohydrogen production from wastewater via microbial electrolysis cells.

Such work demonstrates that wastewater valorisation is not theoretical it is being engineered, tested, and refined within South African laboratories.

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ARC Laboratory at Pretoria Silverton Campus

El Niño Looms:

South Africa's Farmers Brace for a Drier 2026–27 Season

South Africa's farmers may face a drier, more uncertain season as El Niño conditions strengthen, warns agricultural economist Wandile Sihlobo. In his recent AgriView podcast and accompanying Substack article, Sihlobo outlines how this global climate pattern could reshape rainfall, yields, and farm management decisions across the country.

What El Niño Means for South Africa

El Niño is a periodic warming of the central Pacific Ocean that disrupts global weather systems. For Southern Africa, it typically brings belowaverage rainfall, hotter temperatures, and increased drought risk. According to Sihlobo, the South African Weather Service, Australia's Bureau of Meteorology, and U.S. climate agencies all signal a strong likelihood of El Niño developing in the coming months.

The last major El Niño events in 2014–15 and 2015–16 triggered severe droughts, leading to livestock losses and reduced crop output.

Farmers remember those years as some of the toughest in recent memory.

Implications for Farmers

- **Crop production:** Maize, soybeans, and other summer crops could face moisture stress, especially in the Northwest, Free State, and Limpopo provinces.
- **Livestock:** Pasture shortages and water scarcity may pressure grazing systems, echoing previous drought impacts.
- **Input planning:** Farmers may need to consider early planting, droughttolerant varieties, and soilmoisture conservation techniques.
- **Financial resilience:** With input costs still high, risk management tools such as crop insurance and diversified income streams are vital.

Lessons from Past El Niño Events

The 2014–16 drought led to record maize imports and widespread livestock selloffs. Yet regional variability means not all areas suffer equally—coastal and southern regions sometimes receive nearnormal rainfall. Sihlobo emphasizes that timely monitoring and adaptive management can mitigate losses.

Outlook and Preparedness

While forecasts suggest a challenging season, El Niño intensity varies—some events are mild. Sihlobo urges farmers to stay informed through official weather updates, plan water use carefully and collaborate with local extension officers. The agricultural sector's resilience depends on datadriven decisions, soilhealth maintenance, and communitylevel preparedness.

Conclusion

This analysis underscores the importance of climatesmart agriculture and regenerative practices—central themes for South Africa's longterm sustainability. As the 2026–27 season approaches, farmers should view El Niño not only as a threat but as a prompt to strengthen stewardship, measurement, and adaptive planning.

Source: Wandile Sihlobo, *"El Niño Impact on South Africa's Agriculture,"* AgriView Substack, April 2026.

The Management and Troubleshooting of Nutrient Deficiency In Aquaponics Systems

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Aquaponics, a sustainable agricultural system, integrates hydroponics to aquaculture recirculation systems to create a symbiotic relationship between aquatic animals and plants. In this closed-loop system, fish waste and metabolic by-products nourish hydroponically cultivated plants while the plants purify water through nitrification, a bacterial-driven process converting ammonia to nitrate. In aquaponics, plants depend entirely on the nutrient balance created by fish waste, bacteria, and system inputs—so deficiencies show up quickly in plant leaves and growth patterns. Hydroponic plants are highly sensitive to changes in nutrient levels. If nutrient concentrations deviate significantly, visible signs of deficiency appear within a day. Thus, continuous monitoring becomes critical. In Aquaponics plants are a bit more forgiven, especially in media-beds, because the nutrient supply is more constant, more diverse and the microbes living on the media bring some additional benefits. Learning to “read” your plants is one of the most important skills. This article is a practical guide in spotting the most common nutrient deficiencies in aquaponics systems.

How do I know that my plants have a nutrient deficiency?
In aquaponics, you don't "guess" a nutrient deficiency—you confirm it using a combination of plant symptoms, system data, and patterns over time. Think of it like diagnosing a problem with both visual clues and measurements.

1. Read the Plant (Visual Diagnosis)
Plants show very specific signs depending on what they're lacking:
Key observation rules:
- Old leaves affected first → mobile nutrients (Nitrogen, Magnesium)
- New leaves affected first → immobile nutrients (Iron, Calcium)
- Edges of leaves damaged → often Potassium
- Veins stay green, rest turns yellow → classic Iron or Magnesium issue

Example:
- Yellow new leaves with green veins = Iron deficiency
- Yellow old leaves + slow growth = Nitrogen deficiency

2. Test Your Water (Critical Step)
Visual symptoms alone can be misleading, so you confirm with water tests:
Important parameters:
- pH
  - High pH (>7.2) → nutrients like iron get "locked out"
- Nitrate (NO_3^-)
  - Low nitrate → Nitrogen deficiency
- Ammonia/Nitrite
  - Should be 0 (if high, system is unstable—not a nutrient issue)

Example:
- Plants yellow + pH = 7.8 → likely iron unavailable, not absent

3. Look at your fish & feeding
Fish are the "fertilizer engine" of aquaponics:
- Too few fish or low feeding → fewer nutrients
- Poor-quality feed → missing minerals (like potassium, calcium)

If plants look weak and fish feeding is low → likely a nutrient deficiency

4. Age of your system, check
- New systems (0–6 weeks):
  - Quite common to see nitrogen deficiency.
  - Bacteria not fully established yet.
- Mature systems:
  - More likely to see iron, potassium, calcium deficiencies.

5. Look at the pattern (this is key)
Deficiencies are consistent and progressive, not random.

If you see….	It's likely….
Same issues spreading plant to plant	Nutrient deficiency
Random spots on one plant	Disease or pest
Sudden damage overnight	Pest or environmental stress

6. Rule out other causes first

Before concluding “nutrient deficiency,” eliminate:

- Pests (aphids, caterpillars)
- Disease
- Temperature stress
- Poor water flow to roots
- Light issues

Important: Nutrient deficiencies are usually slow and uniform, not sudden.

Simple 3-step diagnosis method

1. Look at where symptoms appear on the plant.
   - Old vs new leaves
2. Check your water.
   - pH + nitrate levels
3. Review your system.
   - Fish load, feeding, system age.

Real Example Case

You notice:

- New leaves are yellow with green veins.
- pH is 7.6

➢ Diagnosis: Iron deficiency (lockout due to high pH)

➢ Fix: Add chelated iron + lower pH slightly

Pro Tip

In aquaponics, many “deficiencies” are nutrient lockouts, not the absence of the minerals.

That means:

The nutrient is there—but plants cannot absorb it. The main cause is pH imbalance, but a few factors can trigger it.

What does a nutrient lockout mean?

The nutrients are present in the water, but plants cannot absorb them. So even though your system has the nutrients, the plants behave as if they’re deficient.

1. pH too high (most common)

- At high pH (above ~7.2–7.5):
  - Iron, manganese, and phosphorus become unavailable.
- This is common in aquaponics systems.

Example:

- Iron is in the water.
- But plants still turn yellow.
- Because high pH “locks” the iron

2. pH too low

- At very low pH (<6):
  - Calcium and magnesium uptake is reduced.
  - Can stress fish and bacteria too.

3. Nutrient imbalance

- Too much of one nutrient can block another.

Example:

- Excess potassium can interfere with calcium and magnesium uptake.

4. Poor root conditions

- Low oxygen in water
- Root rot
- Compacted media

Roots can’t absorb nutrients properly.

What it looks like?

➢ Lockout looks exactly like a deficiency, which is why it confuses beginners:

Symptom	Could be
Yellow new leaves	Iron deficiency or iron lockout
Burnt edges on leaves	Potassium issue or imbalance
Stunted growth	Multiple lockouts possible

How to tell It's a lockout (not a true deficiency):

Ask yourself:

- Is my pH outside 6.5–7.0? → likely lockout
- Am I feeding fish properly? → nutrients probably exist.
- Did symptoms appear suddenly after pH change? → lockout

Ideal range to prevent lockout:

- pH**:** 6.5 – 7.0 (sweet spot)
- Keeps:
  - Fish healthy
  - Bacteria active
  - Nutrients available

How to fix a nutrient lockout

If pH is too high:

- Slowly lower pH (don't shock fish)
- Use:
  - Phosphoric acid
  - Nitric acid (carefully)
- Add chelated iron (available even at higher pH)

If pH is too low:

- Raise pH using:
  - Calcium hydroxide
  - Potassium hydroxide

Improve root health:

- Increase aeration.
- Check water flow.
- Remove dead roots.

Simple analogy

Think of nutrients like food in a fridge:

- Deficiency = fridge is empty
- Lockout = fridge is full but locked

Plants are "hungry" either way—but for distinct reasons.

Important for your area (Cape Town)

- Water is often alkaline, so:
  - Iron lockout is very common.
  - Regular iron supplementation + pH control is key.

Common Nutrient Deficiencies in Aquaponics:

1. Nitrogen (N) deficiency

The deficiency of nitrogen leads to the development of some symptoms, which include the appearance of yellow to pale yellow-coloured leaves starting from the bottom of the plants. Nitrogen deficiency will lead to stunted growth of (leaves, fruits, and growth of plants) and reduces overall physical strength and good health of plants grown in aquaponic systems.

Symptoms:

- Older leaves turn pale green → yellow.
- Slow growth, small leaves
- Overall weak plants

Cause:

- Low fish stocking
- Immature system (not fully cycled)
- Insufficient feeding

How to fix:

- Increase fish feed slightly.
- Add more fish (carefully)
- Ensure proper biofiltration (bacteria established)

2. Iron (Fe) deficiency (very common)

Plants deficient in iron within an aquaponic system often exhibit distinctive symptoms that can aid in identifying the deficiency. One of the most prominent indicators of iron deficiency is interveinal chlorosis, where the tissue between the leaf veins turns yellow while the veins remain relatively green. This results from the inability of the plant to produce sufficient chlorophyll due to the reduced availability of iron. When iron

is deficient in the culture system, enzymatic activities are hindered, leading to stunted growth in plants. Shoot and root development may be compromised, resulting in smaller and weaker plants.

Symptoms:

- New leaves turn yellow, but veins stay green (interveinal chlorosis)
- Happens mostly on young growth.

Cause:

- Iron becomes unavailable at higher pH (>7)
- Not enough iron in system

How to fix:

- Add chelated iron (Fe-EDDHA or Fe-DTPA)
- Dose every 2–4 weeks.
- Keep pH around 6.5–7.0

3. Potassium (K) deficiency

One characteristic sign of the potassium deficiency is the appearance of yellowing or browning along the edges of older leaves. This symptom is called marginal chlorosis. Potassium deficiency is observed mainly in fruits and tubers as they need exceptionally high doses of potassium. The stems affected by the potassium deficiency can develop weak, brittle branches more prone to breaking or bending. Leaves and fruits grown with insufficient potassium resulted in poor growth, altered taste, and uneven colour development. Plants affected with potassium deficiency led to reduced flower and fruit production number and quality. The potassium-deficient plants in the aquaponic system were more susceptible to pest infestation, and eventually prone to developing diseases.

Symptoms:

- Yellowing and browning on leaf edges
- Leaf tips burn and curl.
- Weak flowering/fruiting

Cause:

- Fish feed often lacks enough potassium.

How to fix:

- Add potassium hydroxide (KOH) or potassium carbonate (K_2CO_3)
- Alternate with calcium additions to balance system.

4. Calcium (Ca) deficiency

The plants grown in the aquaponic system with calcium deficiency may exhibit leaf deformation i.e., the growth of leaves will be irregular and smaller than usual. Particularly in leaf vegetables with young leaves and shoot tips, brown or black necrotic spots may develop with calcium deficiency. This symptom is known as “tip burn”—a common symptom (blossom end rot) in fruiting plants like tomatoes and peppers. The bottom end of the fruit becomes sunken, darkened, and leathery due to insufficient calcium transport to the developing fruit.

Symptoms:

- New leaves are distorted or curled.
- Tip burn (especially in lettuce)
- Blossom end rot in tomatoes

Cause:

- Low calcium levels
- Inconsistent water supply to plants

How to fix:

- Add calcium hydroxide ($Ca(OH)_2$) also called slaked lime
- Maintain stable water flow.
- Balance with potassium dosing

5. Magnesium (Mg) deficiency

One of the most noticeable signs of magnesium deficiency is interveinal chlorosis, where the tissue between the veins of the leaves turns yellow while the veins remain green. This gives

the leaves a mottled appearance. Leaves affected by magnesium deficiency may exhibit curling or cupping, particularly at the leaf edges. The magnesium deficiency also shows necrotic leaf margins and stunted growth of overall plants.
Symptoms:
- Older leaves show yellowing between veins.
- Leaves may curl upward.

Cause:
- Low magnesium in water/feed

How to fix:
- Add Epsom salt (magnesium sulphate)
- Use sparingly to avoid imbalance.

6. Phosphorus (P) deficiency
Plants with a phosphate deficiency may exhibit slow or stunted growth. New growth may be significantly affected, resulting in smaller leaves and reduced plant size. Leafy vegetables, like lettuce, will develop a reddish to dark purple coloration on the undersides of the leaves.
The phosphorus deficiency leads to poor development of roots. Insufficient phosphate can delay flowering and fruiting plants.
Symptoms:
- Dark green or purplish leaves
- Stunted growth
- Poor root development

Cause:
- Low fish waste or cold water (reduces uptake)

How to fix:
- Increase feeding (carefully)
- Maintain proper water temperature.
- Ensure healthy bacteria colony.

7. Trace Nutrient Deficiencies (Zinc, Manganese, etc.)
Symptoms:
- General yellowing or mottled leaves
- Deformed new growth.

Cause:
- Lack of micronutrients in system

How to fix:
- Add aquaponics-safe trace mineral supplements.
- Use high-quality fish feed.

How to avoid or manage nutrient deficiencies:

Key Aquaponics Insight - Unlike soil gardening:
- You can't just add fertilizer freely.
- Everything must remain safe for fish, plants, and bacteria.

Ideal Water Parameters (for nutrient availability)
- pH: 6.5 – 7.0 (sweet spot)
- Ammonia/Nitrite: 0 ppm
- Nitrate: 20–150 ppm
- Temperature: Depends on fish (tilapia thrive ~22–28°C)

Quick Diagnosis Trick:

Where symptoms appear	The likely issue can be:
Old leaves first	Nitrogen, Magnesium
New leaves first	Iron, Calcium
Leaf edges burn	Potassium
Purple tint	Phosphorus

Tip for Your Location (South Africa / Cape Town):
- Local water is often slightly alkaline, so iron deficiency is quite common.
- If you are using municipal water, check for high pH and low minerals.
- Wind and temperature swings can also affect nutrient uptake.

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Editing grapevine DNA could boost resistance to disease and drought

A team of researchers from Stellenbosch University (SU) and the Agricultural Research Council have, for the first time, successfully edited the DNA of a woody crop plant in Africa by making precise changes to its genetic material. This is a major milestone for plant biotechnology on the continent.

Using CRISPR technology – a tool that enables scientists to cut and edit DNA at very specific points – the researchers "switched off" a single gene (*VvDMR6.1*) in grapevine plants. This gene is linked to how the plants respond to disease. The researchers say that this change made the plants less vulnerable to downy mildew, a major disease that affects vineyards around the world.

The findings of their study were published in **Plant Stress** recently.

According to the researchers, their study demonstrates how a single targeted genetic

change can influence multiple stress responses in plants.

"By editing a gene that makes grapevines more vulnerable to disease, we were able to reduce this vulnerability while also influencing how the plants respond to water shortages. Our research shows how modern gene or genome editing technology can be used to improve grapevines, so they are better able to cope with disease and droughts," says lead researcher Dr Manuela Campa from the Department of Genetics at SU.

"This represents a step toward integrating modern genome editing approaches into African crop improvement programmes, particularly for high-value horticultural crops such as grapevine."

Campa points out that in recent years, scientists have increasingly used genome editing techniques such as CRISPR technology to modify certain genes and increase plants' resistance to disease.

She notes that an unexpected finding of their study was the reaction of the modified plants to water shortages. "These plants responded better to dry conditions. They were able to conserve water more effectively, suggesting they may be better suited to the increasingly dry conditions expected due to climate change.

"This is an exciting step forward because it indicates that we can make precise changes to plants that improve more than one important trait at the same time."

With grapevines increasingly under pressure from both disease and changing environmental conditions, Campa notes that their study couldn't have come at a better time as both pressures are expected to intensify due to climate change.

"Viticulture (planting, managing and harvesting of grapes) faces significant challenges, as disease outbreaks increase after periods of environmental stress.

"Because grapevines are a high-value crop globally and are especially important to South Africa's agricultural sector, we must develop

Dr Manuela Campa with in vitro grapevine plants.

varieties that can tolerate multiple stresses simultaneously. This can help us to produce grapes sustainably as conditions become more challenging."

According to Campa, their findings highlight the potential of genome editing as a powerful tool to improve crops in Africa.

"While genome editing has been widely applied in model plants and several crops globally, its use in woody perennial species has remained limited because of their complex regeneration systems and long breeding cycles.

"This work demonstrates that advanced genome editing technologies can be successfully applied to perennial crops in Africa. It opens the door to new research aimed at developing more sustainable and climate-resilient crops."

Campa emphasises that further studies will be needed to evaluate the edited plants in real-world conditions.

ource:
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Spicy Tomato Chicken

Ina Paarman

This easy chicken dish comes together in the time it takes to cook the pasta. Flavourful and comforting – mild enough for the whole family.

Serves: 2 - 4

You Will Need:

2 T (30 ml) butter

4 large chicken breasts, sliced against the grain into bite size pieces

1 garlic clove, finely chopped

1 t (5 ml) smoked paprika (or regular paprika)

1 x sachet Ina Paarman's Spanish Tomato Flavour Bomb

1 x sachet Ina Paarman's Portuguese Peri-Peri Flavour Bomb

½ cup (125 ml) fresh cream

1 T (15 ml) fresh parsley, chopped

To Serve

pasta, cooked

Method:

Place a large, wide pan over high heat.

Foam the butter.

When the butter starts to sizzle, add the chicken pieces, and fry for a few minutes until about ¾ cooked.

Add the smoked paprika and Flavour Bombs, stirring well.

Add the cream and bring to a simmer.

Simmer for 5 minutes.

Serve hot over freshly cooked rice or pasta, sprinkled with chopped parsley.

Aubergine & Butterbean Curry

Ina Paarman

An appetising vegetarian choice. The beans add protein to balance the healthy flavourful meal.

Serves: 4 - 5

You Will Need:

3 T (45 ml) vegetable oil

2 large aubergines (about 500 g), cubed

2 t (10 ml) Ina Paarman's Seasoned Sea Salt

1 onion, chopped

1 tin butterbeans in brine, drained

1 x 250 g Ina Paarman's Butter Chicken Curry Cook-In Sauce

½ cup (125 ml) fresh cream

a handful fresh coriander leaves, to serve (optional)

Method:
Heat the oil in a large heavy-based frying pan.

Fry the aubergine cubes until dark brown, stirring often.

Remove the aubergine cubes from the pan.

Season them with Seasoned Sea Salt.

In the same frying pan, stir the onion until soft and translucent.

Add the Butter Chicken Curry Sauce and cream, and bring to a simmer.

Add the drained butterbeans.

Cook for 3 minutes.

Add the cooked aubergines.

Cook for another 5 minutes. (Do not stir too much.)

Scatter with coriander leaves (optional).

Serve hot with flatbreads, fluffy rice, and sambals of your choice.

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