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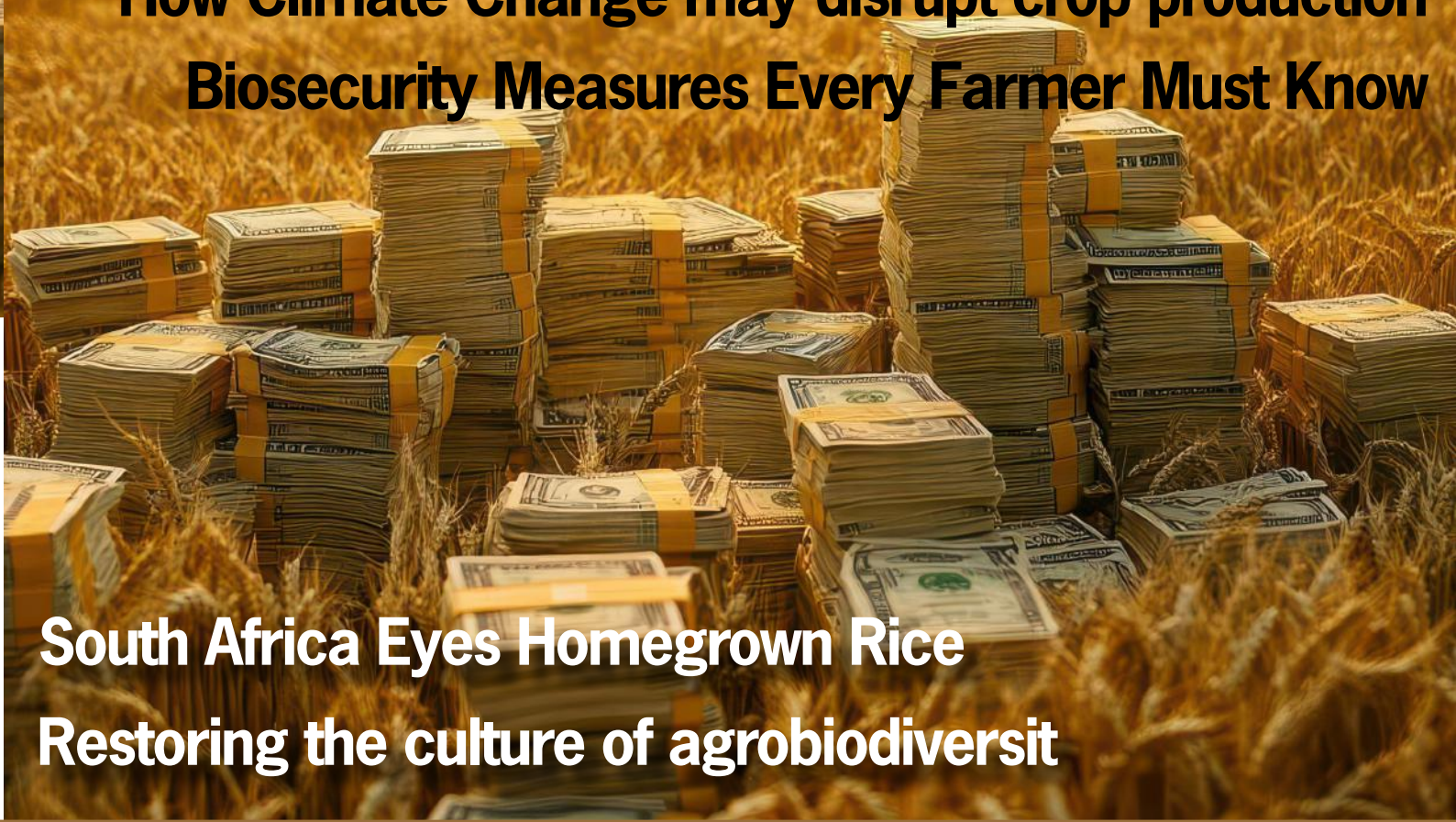
Agri-Finance and Risk Management

Turning Uncertainty into Opportunity

Farm Budgeting with Profit in Mind

How Climate Change may disrupt crop production

Biosecurity Measures Every Farmer Must Know



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Editorial

Agriculture has always been defined by risk - weather shifts, market volatility, and global disruptions that ripple through farms and food systems. Yet within this uncertainty lies opportunity. In this February 2026 edition of *Agriabout*, we focus on **Agri-Finance and Risk Management: tools and strategies to help farmers manage uncertainty and invest in growth.**

Our lead feature, *Agri-Finance and Risk Management: Turning Uncertainty into Opportunity*, explores how financial instruments, insurance, and innovative credit models can empower farmers to plan with confidence. Alongside it, *Farm Budgeting with Profit in Mind* offers practical guidance for structuring farm finances to ensure sustainability and profitability.

Risk management today is inseparable from climate realities. *How Climate Change May Disrupt Crop Production in South Africa* examines the challenges of shifting rainfall and rising temperatures, while *Safeguarding South Africa's Farms: Biosecurity Every Farmer Must Know* highlights essential practices to protect livestock and crops from disease threats.

Beyond these core articles, this edition brings a rich mix of exclusive features: *Climate Change is Disrupting Crop Production*, *Restoring the Culture of Biodiversity*, *How Tenure Insecurity Continues to Undermine Agriculture*, and *South Africa Eyes Homegrown Rice as ARC Expands Research Efforts*. Each piece reflects the interconnected challenges and opportunities shaping modern farming.

Together, these contributions underscore a simple truth: resilience in agriculture requires more than survival, it demands foresight, innovation, and collaboration. By equipping farmers with knowledge and strategies, we aim to help turn risk into a pathway for growth.

We invite you to explore this edition with curiosity and optimism. May it inspire new ideas, spark conversations, and strengthen your journey in agriculture.

Enjoy the read!

Chris

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Agri Finance and Risk Management in South Africa: Turning Uncertainty into Opportunity

Farming in South Africa has always been a balancing act. On one hand, we're blessed with fertile soils, diverse climates, and strong export markets for citrus, wine, and macadamias. On the other, farmers face droughts in the Western Cape, floods in KwaZuluNatal, volatile input costs, and global market swings.

In this article this article focuses on— **Agri Finance and Risk Management**. Let us talk through how South African farmers can manage uncertainty, access credit, and invest in growth. Think of this as a fireside chat: practical, conversational, and grounded in the realities of farming here at home.

Why Finance and Risk Management Matter
Every season begins with expenses before income. Seeds, fertilizer, fuel, labour - all upfront costs. Without affordable credit, farmers can't scale operations or adopt modern practices. At the same time, climate change and global market volatility make risk management more important than ever.

South Africa's agricultural sector contributes significantly to the economy and employs hundreds of thousands of people, but its success depends on resilience in the face of uncertainty.

Accessing Credit in South Africa
The Land Bank has long been the backbone of agricultural finance, offering loans to both emerging and commercial farmers. Despite recent challenges, it remains a critical institution.

Cooperatives also play a role, extending credit bundled with inputs like seed and fertilizer, a lifeline in rural provinces.
Meanwhile, digital banks such as TymeBank and Capitec are expanding access to affordable credit. Farmers can now open accounts, apply for loans, and manage finances via smartphone apps, a big step toward inclusion.

Risk Management Tools: Insurance and Diversification

Insurance uptake among farmers is low, mainly due to cost. Traditional indemnity insurance requires proof of loss and can be slow. But indexbased insurance pilots are emerging, especially in droughtprone provinces. These use rainfall or satellite data to trigger payouts, making them faster and more affordable.
Risk management also means tailoring strategies to local realities: drought in the Western Cape, flooding in KwaZuluNatal, frost in the Free State. Diversification is another powerful tool. Farmers are increasingly moving into agroprocessing - wine, dairy, citrus exports - or exploring agrotourism and renewable energy projects to spread risk.

Investing in Growth: Climate-Smart Finance

Growth today is not just about producing more; it's about producing smarter. Climatesmart agriculture (CSA) is gaining traction worldwide, and financing models are evolving to support it.

South Africa has seen green finance initiatives through the Agricultural Development Fund and the Industrial Development Corporation (IDC). Export infrastructure - cold storage and logistics - is also critical for citrus and wine farmers targeting global markets.

Blended finance, where concessional capital is combined with private investment, is helping farmers adopt practices like conservation tillage, renewable energy, and efficient irrigation.

Financial Literacy: The Foundation of Resilience

Financial literacy is often overlooked but is essential. Farmers who keep accurate records, budget carefully, and understand loan terms are better equipped to make smart decisions.

AgriSETA provides training in financial management and recordkeeping, while provincial departments and NGOs run workshops and offer templates. Think of financial literacy as the difference between surviving and thriving. It is not about becoming an accountant; it is about knowing where your money goes and how to make it work for you.

Technology and Data: The New Frontier

Digital tools are revolutionizing risk management. Satellite data and AI predict weather and crop yields with increasing accuracy. Market transparency apps provide realtime price information, reducing vulnerability to middlemen. Expense tracking tools help farmers monitor cash flow and plan investments.

Even something as simple as a WhatsApp group where farmers share local price updates can make a big difference.

Policy and Regulation: Creating an Enabling Environment

Governments play a critical role in shaping access to finance and risk tools. The Department of Agriculture, Land Reform and Rural Development (DALRRD) provides grants and subsidies for emerging farmers. Credit guarantees reduce lender risk and expand farmer access to loans. Trade agreements with the EU and BRICS partners directly affect farmer profitability.

Farmers should stay informed about these programs, and advocate for policies that support financial inclusion.

Closing Thoughts

South African farmers are no strangers to uncertainty. But risk does not have to mean fear. With digital credit, innovative insurance, climatesmart finance, and strong financial literacy, farmers can transform uncertainty into growth.

The future of agriculture here is not just about producing more food. It is about building resilience, sustainability, and prosperity - one smart financial decision at a time.

Farm Budgeting with Profit in Mind

Dr John F. MacRobert:
Crop Seed Specialist and Agronomist, Zamseed, Lusaka, Zambia.

Farming is a noble and vital occupation, providing nutrition to every person on the earth. While farming is a relentless and often difficult pursuit of food production in the context of variable climate, harsh economic realities and political uncertainties, it can nonetheless be one of the most satisfying and joy-filled vocations. And this especially so where you see nature blooming and the bank account flourishing. Farming without ecological regeneration or financial success or both is unpleasant and catastrophic. To counter this, farming must have a profit goal as much as it has ecological and productivity goals. Without profit, farms fail, inadequate food is produced, and people face food shortages. This article presents an approach that enables a farmer to plan for and work towards a profitable outcome.

There are two ways to plan for profit. The one is to budget expected sales and costs, and hope that the equation results in a profit. If not, then either budgeted sales are increased or costs are reduced or both. This is fine as far as it goes, but there is no clear target of what profit amount is being aimed at. Thus, the second and better way of planning for profit

is to begin by specifying the actual profit you want to achieve from your farming activities and then use that figure to define how to build up your business plan. This is really the ideal way of planning for profit because it gives a target to aim at that will define your sales goal and constrain your costs accordingly.

Profit for what?
When starting with profit, the question to be asked is, "What do you need the profit for?" Obviously, the first call on any profit made by a business is the government in the form of tax. This is unavoidable, but it can be managed effectively through wise accounting and understanding the tax laws. The ways to do this are beyond the scope of this article, but it is an area of business management that is very important to ensure that the company has as much disposable profit that is legally possible.

After-tax profit is therefore the key focus of a business. The net profit may be used in several ways, each specific to the business context, and a business plan needs to enumerate these. The following uses of net profit are possible:

Retaining cash as savings
While saving cash is often thought of as a wise investment of profit, so much depends on the interest rate it can earn relative to the inflationary pressure on the currency. Rarely is there a sufficient reason to save significant amounts of cash in a bank account for any lengthy period. As a general principle, an amount of cash now is worth more than in the future. Money devalues with time due to inflation, whatever the cause of inflation. Thus, only maintain a cash reserve for emergency expenses.

Investing the net profit back into the farm
Using profit to build the business makes sense if there are critical areas of the business that need investment either in terms of infrastructure or working capital, which will thereby reduce the need for borrowing and stimulate the business into growth. Therefore, as a farm manager, when planning for profit, consider the needs of the business for internal investments. There may be need to invest in immovable assets, such as land and buildings, or moveable assets like machinery and equipment that will make the business run more efficiently and be less reliant on third parties. There may also be need for new technologies, computer hardware and software for effective management of operations. A budget for these may be constructed, which then serves as a target for the profit needed in the company.

Paying off debt faster than required
If a business in indebted to third parties for capital items or working capital, it may be economic to reduce this dependency and eliminate interest payments. An analysis of the liabilities of the company relative to the costs of borrowing and inflation will be needed to determine if it is better to maintain the liabilities if they can be serviced as per agreements, or to pay some or all off faster.

Investing in alternative businesses
There may be opportunities outside the farm that are ancillary or separate from the core business. Ancillary businesses may be new farming enterprises, agro-processing businesses or input supply services that enable vertical or horizontal integration. Separate businesses could be anything that is attractive and potentially profitable to themselves. Investing in other businesses brings with it a whole range of new challenges and must be carefully reviewed and embarked on so that the core farming business is not disadvantaged.

Disbursing cash to shareholders
Any business is ultimately there for the shareholders' benefit. This is often the first call on profit, but shareholders may delay taking a dividend or take only a small dividend from the business in favour of investing into or outside the business.

Giving away cash
At the discretion of the shareholders, and according to their generosity, profit from a business may be disbursed to worthy causes. Following a review of the options for using profit, a business needs to put a monetary value to some or all of these (Table 1). This is not easy, but can be done, considering the scale of the business, past financial performance, market opportunities, production capacity and external economic environment. In the example, the total profit target is $150,000, but with the tax rate of 30 %, there is $105,000 available for use, of which $60,000 is to be re-invested in the farm, $30,000 distributed to shareholders and $15,000 will be given away. Apart from giving the company a profit target, this exercise also defines what can be spent on capital items.

Table 1: The various uses of profit with an example of amounts applied to each for a medium sized seed business aiming at a profit of USD150,000.

Use of Profit	Cash Value
Tax (30 %)	45,000
Cash Savings	0
Invest into business	60,000
Pay-off debt	0
Invest in new business	0
Shareholders dividends	30,000
Give away	15,000
Total	**150,000**

Profit Percentage

A profit percentage is the next critical factor to consider. The profit percentage is the proportion of total income that is profit. Thus, if income is $100,000 and the profit is $10,000, then the profit percentage is 10 %. For any given income level, the higher the profit percentage, the greater the monetary value of the profit (Figure 1). Thus, in the above example, where income is $100,000, if profit is 20 %, then the profit is $20,000.

A corollary to this is that if the monetary value of profit is constant across income levels, the profit percent decreases exponentially as income increases (Figure 2). This is because the profit percentage correlates directly to the scale of the income. Thus, if profit is $10,000, this is 10% if income is $100,000, but only 1 % if the income is $1,000,000.

Usually, as a rule of thumb in a farm business, the profit before-tax percentage should be between 25 and 35 % for the company to be thriving and growing. If we take a profit percentage of 30 %, then the total costs will be 70 % of income.

Components of Profit

Profit is Income minus Costs, but for developing a business plan, it is necessary to look at the components of profit (Figure 3). Firstly, Income is the product of the quantity of goods sold and the unit selling price. Secondly, on costs we can define several components. In a farm business, these are usually divided into Variable Costs and Overhead (or Operational) costs. The variable costs are those that are directly related to the enterprises on the farm, such as seed, labour, fertiliser, diesel, etc. These are termed "Variable Costs" as they vary in proportion to the units of production, such as land area or animal numbers. Sometimes they are referred to as "Direct Costs" because they are directly associated with the production of the saleable product.

The Gross Margin is the difference between the Income and the Variable Costs. As a proportion of Income, the rule of thumb is that the Gross Margin (GM) is 50 %, in which case 50 % of Income is spent on variable costs, leaving a margin of 50 % for operational costs and profit. As a guide, Overhead or Operational Costs should be about 25 % of total income. Thus, if the total variable costs are 50 % of Income, and Operational Costs are 25 % of Income, then the net profit before tax will be 25 %.

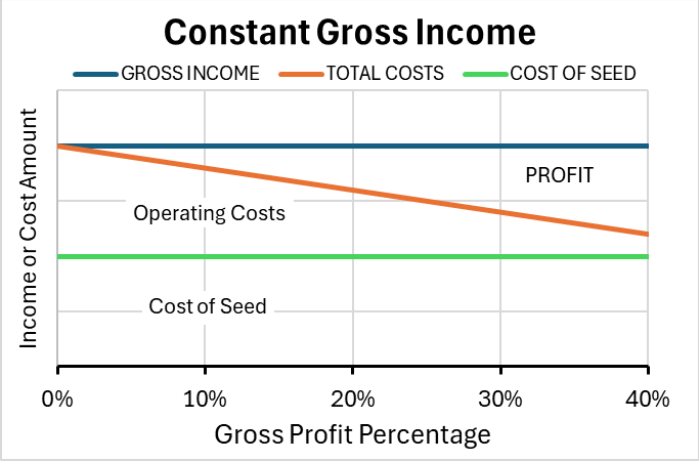


Figure 1: If income remains constant, the monetary amount of profit increases with the profit percentage, but total costs must decrease to achieve the profit value.

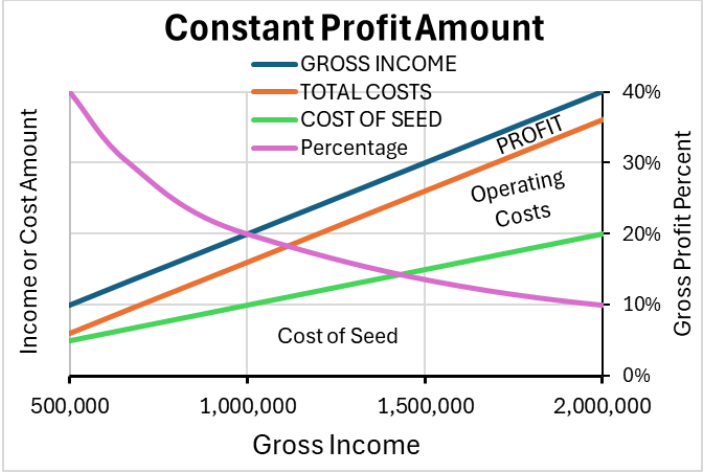


Figure 2: If the amount of profit remains constant as income increases, the profit percentage decreases exponentially.

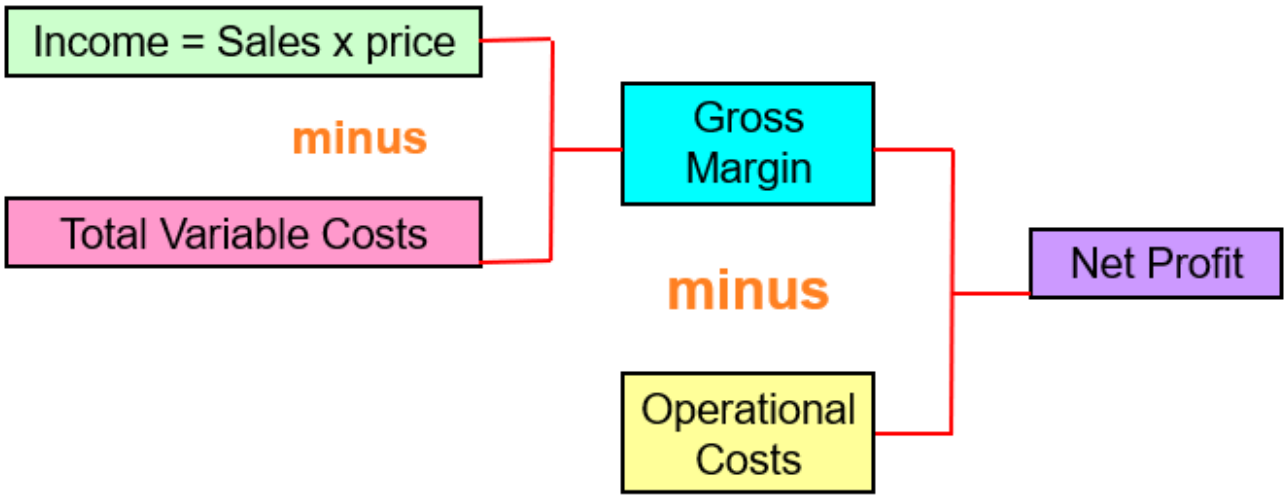
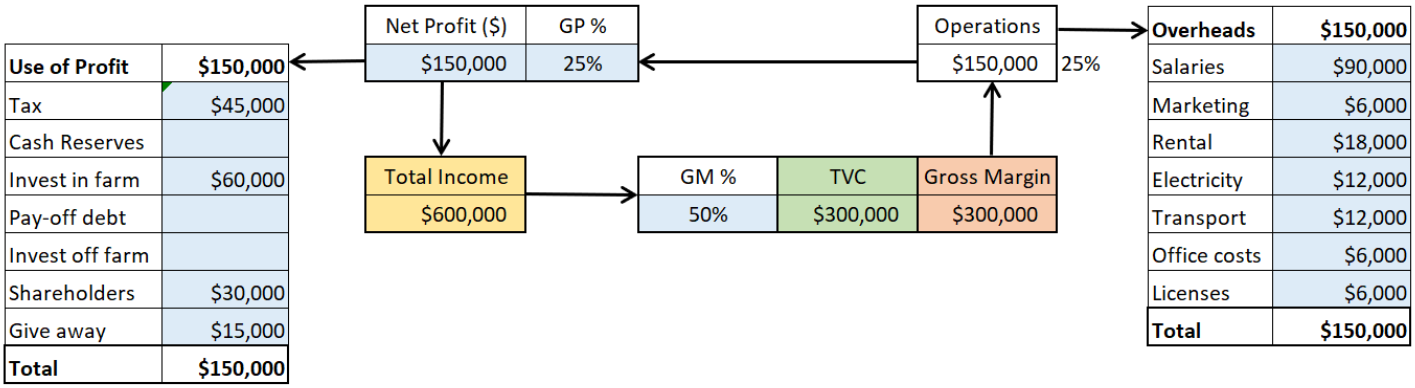


Figure 3: The components of profit in a farm business



Use of Profit	$150,000
Tax	$45,000
Cash Reserves	
Invest in farm	$60,000
Pay-off debt	
Invest off farm	
Shareholders	$30,000
Give away	$15,000
Total	**$150,000**

Net Profit ($)	GP %
$150,000	25%

Total Income
$600,000

GM %	TVC	Gross Margin
50%	$300,000	$300,000

Operations	
$150,000	25%

Overheads	$150,000
Salaries	$90,000
Marketing	$6,000
Rental	$18,000
Electricity	$12,000
Transport	$12,000
Office costs	$6,000
Licenses	$6,000
Total	**$150,000**

Figure 4: Example of a Profit First Budget Framework

The Operational Costs are made up of the Administration, Marketing, Electricity, Rent, etc. These costs comprise all those costs that are relatively fixed regardless of the scale of operation and are therefore sometimes referred to as fixed costs. A good term for these operational costs is "Wealth Generating Costs" because this presents the notion that these costs are only justified if they contribute in some way to wealth generation, because they enable the company to operate efficiently.

Building a Farm Business Plan Based on Profit Goal

Once the profit goal has been set based on the context of the business, the vision of the farmer and the opportunities and challenges of the farming environment, the business plan may be constructed. The profit goal, together with the expected profit percentage defines the gross income that must be achieved through sales. The next step is to estimate the desired gross margin, which will determine the maximum expenditure on enterprises and the maximum expenditure on operational costs. A simple outline of how this is constructed is given (Figure 4) and explained below.

Assuming a net profit before tax goal of $150,000 and a profit percentage of 25 %, the total income is $600,000. With this total income in mind, the enterprise(s) can be analysed to determine how that income will be achieved. For a crop farm, the simple formula is area x yield x price. Assuming a maize yield of 5 t/ha and a price of $300/t, then the area required is 400 ha. For an animal enterprise, this is a bit more complex, because the stock values and animal numbers will vary over time. The key is to establish how the total income will be achieved in terms of output and price.

Thereafter, the enterprises are analysed based on the expected Gross Margin. If the expected Gross Margin is 50 %, then the maximum expenditure on the enterprises (i.e., the total variable costs) is 50 % of the total income, i.e.,

$300,000. The next step is to drill down into the enterprise budgets based on the number of units that are required to earn the total income. Thus, in the above maize example, if 400 ha of crop is required to produce the required income, the maximum expenditure is $750/ha. From this, the line-item budget for inputs may be constructed.

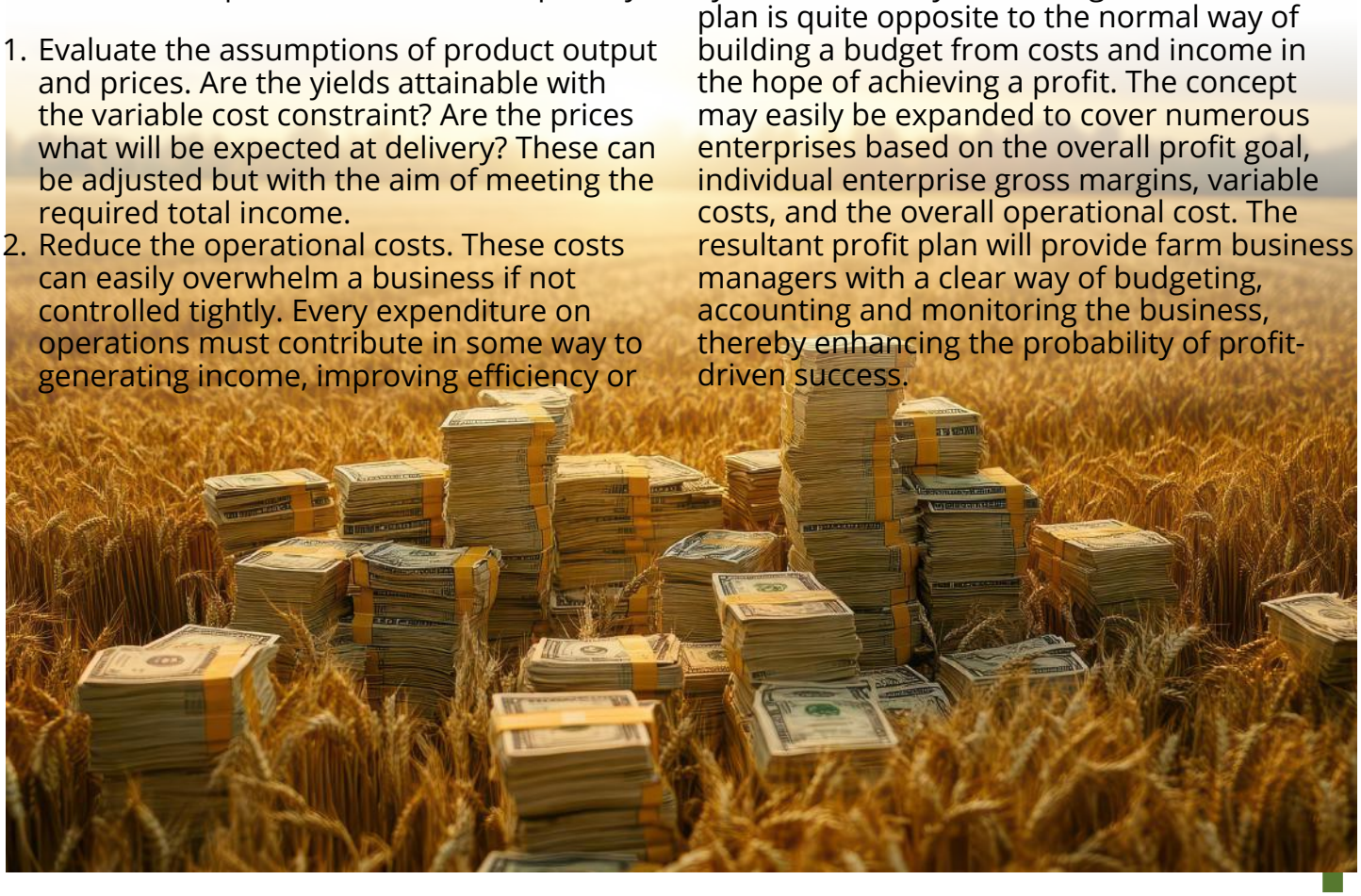
The last part of establishing the framework of the business plan is to budget the Operating Costs. The Gross Margin of $300,000 was calculated as 50 % of total income. This gross margin is apportioned between profit and operational costs. The gross profit is $150,000. Therefore, the maximum that can be spent on operational costs is $150,000. This can then be apportioned among the main operational expense categories. These are broad categories and would need to be subdivided into line items for better budgeting, accounting and control.

With this framework of a business plan, it is now possible to interrogate the output to evaluate the feasibility of the plan. The plan primarily depends on the sales quantity and the selling price because the profit goal determines the total income. If either the sales goal or selling price appear to be unreasonable for the business and market context, then the whole plan needs to be reviewed. The options are, in order of priority:

1. Evaluate the assumptions of product output and prices. Are the yields attainable with the variable cost constraint? Are the prices what will be expected at delivery? These can be adjusted but with the aim of meeting the required total income.
2. Reduce the operational costs. These costs can easily overwhelm a business if not controlled tightly. Every expenditure on operations must contribute in some way to generating income, improving efficiency or protecting the business from losses. Thus, every expenditure on operations must be justified in contributing to the business.
3. Reduce the variable costs. Savings in variable costs will contribute positively to the gross margin, provided these savings do not reduce quantity or quality of product. Improving efficiencies through good management is always possible.
4. Reduce the profit goal. This is the last and worst thing to do in a business. Without profit the business will degrade because the growth potential will be hindered. Further, if the profit percentage is less than the inflation rate, the business will degenerate sooner or later towards bankruptcy. However, if the profit goal is to be reduced, reduce the profit amount and not the profit percentage. Reducing the profit has the effect of reducing the total income required but also reduces what can be spent on total variable costs and operations.

Conclusion

Building a farm business plan with profit as the goal is an excellent way of setting limits on variable costs and operational costs, while also defining the production units required, yield target and ideal selling price. Defining these boundaries focusses attention on the key components of a business bringing objectivity and discipline to management systems. This way of building a business plan is quite opposite to the normal way of building a budget from costs and income in the hope of achieving a profit. The concept may easily be expanded to cover numerous enterprises based on the overall profit goal, individual enterprise gross margins, variable costs, and the overall operational cost. The resultant profit plan will provide farm business managers with a clear way of budgeting, accounting and monitoring the business, thereby enhancing the probability of profit-driven success.



How Climate Change may disrupt crop production in South Africa

Dr Ida Wilson

Climate change is no longer a distant or theoretical risk. Extreme climatic events such as wildfires, floods, droughts, heatwaves, and severe storms are already reshaping agricultural systems worldwide. Crop production, which is fundamentally dependent on relatively stable climatic conditions, is particularly vulnerable. In South Africa, mounting evidence shows that climate change is altering the baseline conditions under which crops are grown, managed, and protected.

What is climate change?

The Earth's geophysical systems, including the atmosphere and hydrosphere, operate within natural limits. Climate change refers to long-term, persistent shifts in these limits. One of the clearest indicators is the continuous breaking of historical temperature records across the globe. Maximum temperatures that were once considered extreme are now being exceeded with increasing regularity, even in historically cooler climates, like that of Europe.

In effect, the climate system has transitioned into a new state. Agricultural systems developed under historical climatic conditions are now required to function in an environment with fundamentally different temperature and rainfall dynamics. Moreover, historic scientific recommendations (pre-2000) become less valid, as crops respond to varied moisture inputs (under dryland conditions) and higher temperatures as driven by the changed climate.

Contributing factors

The primary driver of climate change is the long-term accumulation of greenhouse gases in the atmosphere, particularly carbon dioxide (CO_2). These gases trap solar radiation, leading to global warming. Rising temperatures disrupt atmospheric circulation patterns and ocean currents, which in turn alter rainfall distribution, increase the frequency of heatwaves, and intensify extreme weather events. Although greenhouse gas emissions are the dominant cause of warming specifically, other factors such as deforestation, land-use change, and ozone depletion also contribute to climatic instability.

Evidence that South Africa is warming

South Africa has already experienced measurable warming. Observational analyses consistently show widespread warming observed since the mid-20th century. Stronger warming was recorded over the western, northern, and central interior relative to coastal regions (IPCC, 2021; SAWS, 2019; CSIR, 2019) (**Table 1**).

Table 1: Summary of observed regional temperature warming across South Africa based on published observational analyses. Values represent approximate warming ranges reported since the mid-20th century, highlighting stronger warming over the interior relative to coastal regions.

Region	Reported warming since mid-20th century (°C)	Relative trend
Western & Northern Cape (interior)	≈ 1.5–2.0	Stronger warming
Central Interior (Free State / Northwest)	≈ 1.3–1.8	Stronger warming
Limpopo & Gauteng	≈ 1.2–1.7	Stronger warming
Southern & Southwestern Coast	≈ 0.8–1.2	Relatively lower warming
Eastern Seaboard	≈ 0.9–1.3	Relatively lower warming

Sources: IPCC (2021); SAWS (2019); CSIR (2019)

Climate projections for South Africa

Climate models consistently project that South Africa will become both warmer and drier overall. Average annual temperatures are expected to rise by approximately 2–5 °C over the coming decades (**Table 2**). Rainfall is projected to become increasingly variable, with more frequent and intense droughts interspersed with flooding events (IPCC, 2021; SAWS 2019; CSIR, 2019; NCCIS, no date). This increasing variability poses a significant challenge to crop production, as it reduces the predictability of growing seasons and complicates management decisions.

Table 2. Observed and projected climate trends in South Africa

Climate variable	Observed change	Projected trend
Mean annual temperature	Increase of up to ~1 °C in parts of SA	Additional increase of ~2–5 °C
Rainfall patterns	Increased variability	More erratic rainfall
Extreme events	More frequent heatwaves and droughts	Increased drought and flood frequency
Seasonal reliability	Reduced predictability	Further destabilisation

Sources: IPCC (2021); SAWS (2019); CSIR (2019); NCCIS (n.d.)

Climate change and crop production

Climate is a primary driver of plant growth and agricultural productivity. Temperature, water availability, and seasonal timing directly influence crop development, yield potential, and quality. As rainfall patterns shift and temperatures rise, crop responses become increasingly difficult to predict.

In South Africa, climate-related disruptions are already evident (**Table 3**). Rainfall during wheat harvesting has led to pre-harvest sprouting, reducing grain quality and market value. In addition, unusually strong winds have caused significant yield losses by dislodging grain from wheat ears. In some areas, losses of up to 30% in grain have been reported. Similarly, floods have severely hampered fruit yields in different parts of the country over the past five years.

Climate factor	Crop system affected	Observed impact
Rainfall during harvest	Wheat	Pre-harvest sprouting, reduced grain quality
Strong winds	Wheat (Western Cape)	Grain loss, yield reductions up to ~30%
Elevated temperatures	Multiple crops	Altered growth rates and phenology
Drought stress	Field and perennial crops	Reduced yield potential
Floods	Field and perennial crops	Reduced yields

Table 3. Examples of climate-driven disruptions to crop production in South Africa
Sources: SAWS (2019); CSIR (2019); NCCIS (n.d.); Engelbrecht *et al.* (2015); Wilson personal experience

Climate change and crop protection

Disease resistance

Crop resistance to pests and diseases is strongly influenced by environmental conditions. Resistance genes that are effective under one temperature regime may lose efficacy under another. For example, the wheat stem rust resistance gene *Sr6* is effective at approximately 18 °C but not at 27 °C. Similar temperature-dependent responses have been observed for leaf rust resistance in several wheat cultivars.

Drought stress further compromises plant resistance, meaning that resistance traits currently relied upon may become less reliable under future climate conditions.

Pests and diseases

Warmer climates can accelerate pest and pathogen life cycles, increase overwinter survival, and expand geographical ranges. Elevated temperatures may also reduce the efficacy of certain agrochemicals or increase the risk of resistance development. When pest or disease control fails, the cause is often attributed to product inefficacy. However, climate-driven changes in pest biology or host susceptibility may play a significant role and should be considered in diagnostic and management decisions (**Table 4**). Further impacts of climatic drivers are illustrated in **Figure 1**. Throughout the entire growth season, crops may be exposed to the unpredictability driven by climate change. Anything from the crop physiological responses being altered by prevailing conditions (e.g. lowered photosynthesis) to exposure to alternating stresses, of heatwaves followed later in the year by floods or hailstorms for instance. The bottom line is that the impact of climate change is widespread and affects the entire value and management chain in crop production with the uncertainty causing a rise in costs while concurrently lowering the quality and the yields of crops (**Figure 1**).

Table 4. Climate-driven risks to pest and disease management

Factor	Effect
Higher temperatures	Faster pest and pathogen generation times
Warmer winters	Increased overwinter survival
Heat stress in crops	Reduced effectiveness of genetic resistance
Temperature-sensitive resistance genes	Breakdown of resistance (e.g. *Sr6*)
Elevated temperatures	Reduced agrochemical efficacy

Sources: IPCC (2021); CSIR (2019); NCCIS (n.d.); Engelbrecht et al. (2015); Garrett et al. (2006)

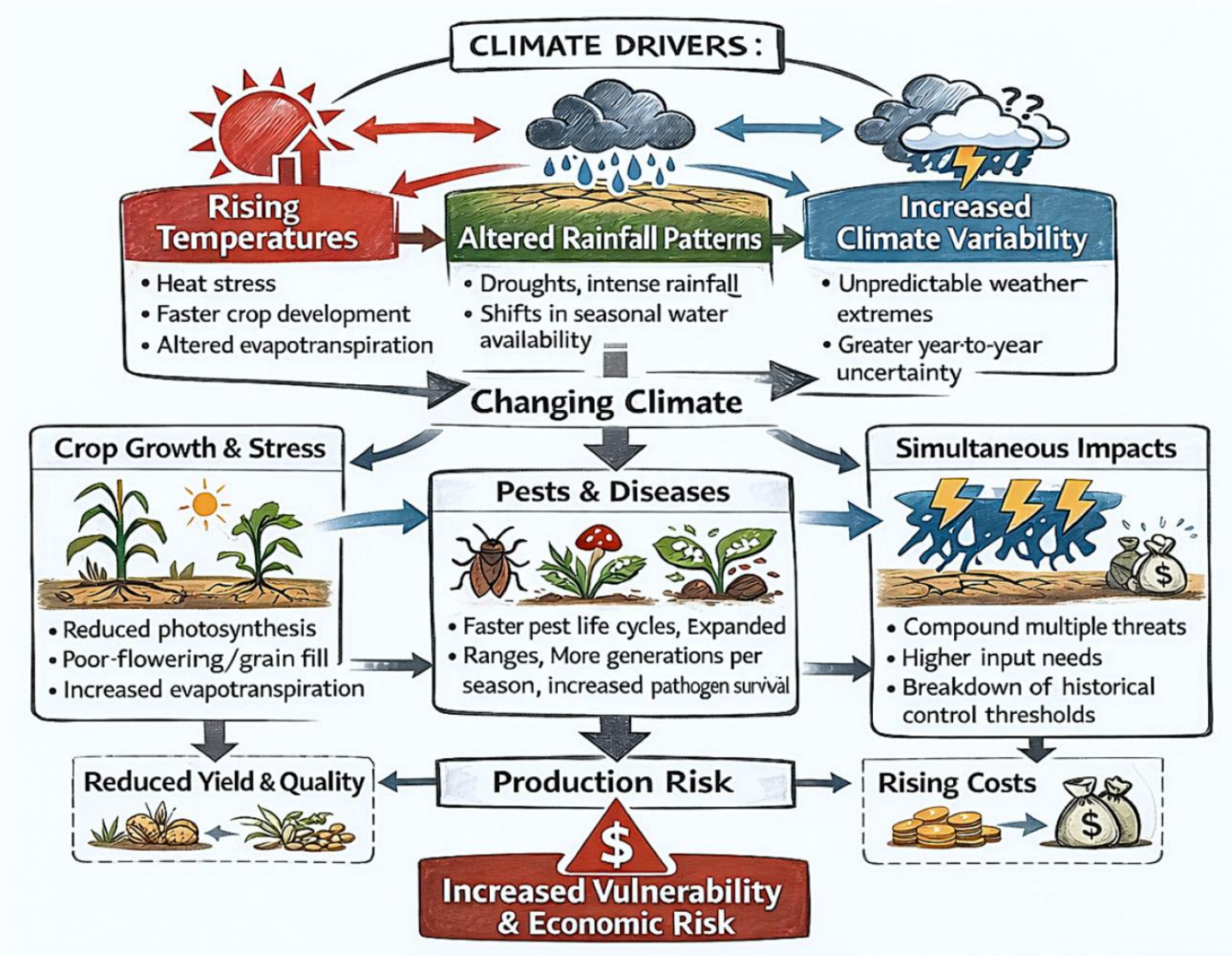


Figure 1. Climate change impacts on crop production systems (Collated from information as in Wang et al., 2022)

Preparing for the effects of climate change

Producers have always managed natural climate variability. Historically, this variability masked the gradual effects of climate change. Today, however, the increasing frequency and severity of climate-related disruptions make its influence unmistakable.

Climate change fundamentally alters the crop production environment. Crops are exposed to higher abiotic stress and increased biotic pressure from pests and diseases throughout the growing season. Strategic planning must therefore adapt.

Key adaptation strategies include:

- Adjusting planting dates to align with changing rainfall and temperature patterns
- Increasing crop diversification to reduce risk and limit the impact of pest and disease outbreaks.
- Selecting cultivars with improved tolerance to drought, heat, and salinity

Recognising and accounting for climate change is essential for sustaining crop productivity. Learning from recent seasons and integrating these lessons into future planning will be critical for building resilient production systems.

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Safeguarding South Africa's Farms:

Biosecurity Measures Every Farmer Must Know

Biosecurity is no longer a buzzword reserved for veterinarians and policymakers. For South African farmers, it has become a daily reality, shaping how livestock are raised, crops are managed, and produce is exported. With outbreaks of Foot-and-Mouth Disease (FMD), African Swine Fever, and Avian Influenza threatening livelihoods, biosecurity is the frontline defence for agriculture, food security, and trade.

The Legal Backbone of Biosecurity
South Africa's biosecurity framework is anchored in three key laws:

- **Animal Diseases Act (Act 35 of 1984):** Requires farmers to report outbreaks of notifiable diseases and empowers the state to enforce quarantines, vaccinations, and movement restrictions.
- **Meat Safety Act (Act 40 of 2000):** Ensures that abattoirs and meat processors meet hygiene standards, protecting consumers and export markets.
- **Agricultural Product Standards Act (Act 119 of 1990):** Governs quality and safety standards for agricultural products, including phytosanitary requirements for exports.

Together, these acts place responsibility on farmers to adopt preventive measures and cooperate with veterinary authorities.

On-Farm Biosecurity in Practice
Farmers are expected to implement **farm-specific biosecurity plans**. These typically include:

- **Quarantine and Movement Control:** New or returning animals must be isolated before joining herds. Movement permits are required during outbreaks.
- **Vaccination Programs:** DALRRD oversees vaccination campaigns against FMD and other diseases, though farmers continue to lobby for private access to vaccines to improve responsiveness.
- **Hygiene and Sanitation:** Vehicles, equipment, and visitors must be disinfected before entering farms.
- **Wildlife and Pest Control:** Measures to reduce contact between livestock and wildlife reservoirs of disease are critical, especially near game reserves.
- **Feed and Water Safety:** Farmers must ensure that feed is pathogen-free and water sources uncontaminated.

Sector-Specific Measures

- **Livestock & Poultry:** Poultry farms enforce strict visitor controls and sanitation to prevent Avian Influenza. Cattle and sheep farmers focus on FMD prevention, particularly in outbreak-prone provinces.
- **Piggeries:** Biosecurity is integrated with waste management and feed programs to reduce disease risks and improve profitability.

- **Crop Production:** Farmers adopt pest monitoring, invasive species control, and phytosanitary compliance to protect yields and maintain export eligibility.

Current Challenges
Despite strong legislation, implementation is uneven. Smaller farmers often struggle with the costs of disinfectants, fencing, and veterinary services. Outbreaks of FMD in Limpopo and KwaZulu-Natal have highlighted gaps in vaccine availability and enforcement capacity. Export markets remain sensitive to biosecurity lapses, with bans imposed when outbreaks occur.

Why Biosecurity Matters
Biosecurity is not just about protecting individual farms. It underpins **national food security, public health, and trade competitiveness**. South Africa's agricultural exports — from beef to maize — depend on international confidence in the country's disease control systems.

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Top 5 Biosecurity Practices Farmers Can Implement Immediately

Biosecurity does not have to be complicated or expensive. While legislation and veterinary directives set the framework, there are simple, practical steps every farmer can take today to protect their animals, crops, and livelihood.

1. Control Farm Access
Limit who enters your farm. Visitors, vehicles, and contractors can carry pathogens on clothing, boots, or equipment. Provide disinfectant footbaths and ensure vehicles are cleaned before entry.

2. Quarantine New Arrivals
Always isolate new or returning animals for at least 14 days before mixing them with the herd. This prevents introducing diseases that may not show symptoms immediately.

3. Maintain Hygiene Standards
Regularly disinfect equipment, pens, and feeding areas. Clean water troughs and ensure feed is stored securely to avoid contamination from rodents or wild birds.

4. Monitor and Report Diseases
Keep a close eye on livestock health. Early detection of unusual symptoms can prevent outbreaks. Report suspected cases of Foot-and-Mouth Disease, African Swine Fever, or Avian Influenza to veterinary authorities immediately.

5. Separate Wildlife and Livestock
Where possible, fence off areas to reduce contact between domestic animals and wildlife, which often act as reservoirs for diseases. This is especially important near game reserves.

Why It Matters
These five steps may seem small, but together they form a powerful shield against disease. In a country where outbreaks can shut down export markets overnight, biosecurity is not just about compliance, It is about survival. Farmers who adopt these practices protect their own businesses while contributing to national food security.

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Global market shifts challenge South Africa's agriculture's export stability

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The South African agricultural industry is interlinked to global markets. A substantial share of output is exported, while many inputs for farming are imported.

In recent decades, a stable global environment supported the sector's growth, even as it navigated domestic challenges at multiple points. The sector is now at a point where 2025 exports are likely to have crossed the $14bn mark for the first time, a significant achievement from the $2bn in exports recorded in the early 2000s.

The ease of access to agricultural inputs from other countries also helps South African agriculture improve its productivity and output. However, the world that powered the agricultural sector is changing.

If there is a central message we took from the World Economic Forum this past week, perhaps not so much from the formal speeches but from sideline conversations, it is that countries are looking for new ways to firm up partnerships and build new alliances.

There is pressure on institutions such as the World Trade Organisation — which has been pivotal in sustaining South Africa's agricultural trade success and that of other countries — to ensure global trade remains fair, open, and in line with the rules.

For South African farmers, growing global trade friction is a concern. This is not only in the US market, but also in markets closer to home. Within the Southern African Customs Union (SACU), South Africa continues to face barriers to vegetable exports to Botswana and Namibia. Also, within the BRICS grouping, there is limited focus on improving trade relations.

Elsewhere, the EU and Canada, among other key economies, are increasingly focused on opening new export markets and strengthening relations. The EU recently signed a trade deal with Mercosur, a grouping of South American countries comprising Argentina, Bolivia, Brazil, Paraguay and Uruguay.

Canada is expanding its trade relations with China, among others. Both countries are also looking to deepen their access to India.

India and China are BRICS members and are among the countries with significant potential to absorb South Africa's agricultural products. What remains missing within the BRICS grouping is a trade agreement.

Notably, as the BRICS grouping grows, with several new members added in recent years, reaching consensus on fundamental matters such as trade may become more challenging. Yet without a strong economic focus that bridges the gap between these countries and deepens engagement beyond high-level meetings, the long-term economic benefits of BRICS participation will remain minimal for SA.

Global realignment

In this new reality of global realignment and recognising that South Africa's agriculture and other industries thrive on trade, the country's leadership should focus on ensuring that new relations deliver tangible economic benefits.

The starting point should be to untangle SA from SACU. As things stand, apart from the trade barriers the SACU members often erect, it doesn't appear there is shared urgency or enthusiasm for establishing new trade relations. Thus, negotiating as a pack only stalls South Africa's growth ambitions.

South Africa must maintain a clear focus on BRICS, nudging the original member countries to prioritise trade and deepen trade with these countries. South Africa must speak out against the potential paralysis of BRICS, which risks becoming a forum for high-level engagement and geopolitical matters, with no clear economic benefit.

South Africa must also strengthen its domestic trade capacity and aggressively promote trade and economic diplomacy in several countries. This new reorientation must be based on the idea that the world is changing, and that South Africa cannot afford to be left behind.

Source:

Republished with kind permission of the author. Global market shifts challenge South Africa's agriculture's export stability, Jan 29, 2026

Local Seeds, Local Solutions: The Role of Household Seed Banking in South Africa

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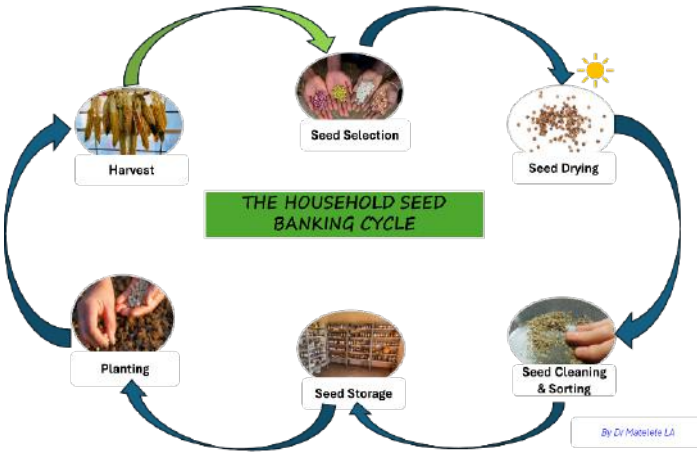
Across South Africa's diverse agricultural landscapes, the conservation of traditional crop varieties and locally adapted seeds has become a pressing concern. As climate change, market pressures, and the dominance of commercial hybrid seeds reshape farming systems, the genetic diversity of crops, an invaluable resource for resilience and food security, is steadily eroding. In response, innovative and community-driven strategies are emerging to safeguard these genetic resources for future generations. One such approach gaining renewed attention is household seed banking.

Household seed banking refers to the practice whereby individual farming households save, store, and maintain their own seeds from one planting season to the next. Unlike formal or community seed banks, which operate at organized institutional or collective levels, household seed banks are small-scale, informal, and embedded within the daily routines and traditional knowledge systems of rural families. They represent the most localized form of genetic resource management, often preserving landraces and farmer-selected varieties that are uniquely adapted to local soils, climates, and cultural preferences.

In South Africa, where smallholder farmers play a vital role in sustaining food production and agrobiodiversity, household seed banking serves as both a practical and cultural conservation strategy. It enables farmers to retain autonomy over their planting materials, reduce dependency on costly external seed sources, and ensure the continuity of indigenous varieties that might otherwise disappear. Moreover, household seed banks complement larger conservation initiatives such as community seed banks and national gene banks, bridging the gap between formal scientific conservation and traditional farming practices.



This article explores how household seed banking functions as a complementary conservation strategy in South Africa. It highlights the role of traditional knowledge, importance of household seed banking, complementarity with formal and community seed banks, and the challenges and opportunities associated with household seed banking. By recognizing the value of household-level efforts, South Africa can strengthen its broader agricultural resilience, promote seed sovereignty, and preserve its rich crop heritage in the face of ecological and socio-economic change.

"When farmers keep their own seed, they also keep control over their future."
- Kloppenburg (2010).

Why Household Seed Banking Matters

Household seed banking is rooted in traditional farming systems, where families select, dry, and store seeds from one season to the next. Beyond preserving seed for future planting, this practice sustains local crop varieties adapted to diverse microclimates, soil types, and cultural preferences.

In rural South African communities, especially in provinces such as Limpopo, Eastern Cape, Northern Cape, Free State, North West, Mpumalanga and KwaZulu-Natal, many smallholder farmers, mostly women, still rely on their own seed stocks for 60-70% of their needs. These farmers are the custodians of agricultural biodiversity, maintaining old landraces of maize, sorghum, cowpea, pumpkin, and millet that are no longer found in commercial seed systems. Household seed banking ensures that these varieties, often more drought-tolerant and pest-resistant, continue to thrive in the face of climatic unpredictability. Some of the household seed banks in KwaZulu Natal (e.g. *Sophiwe Dlamini's House hold Seed Bank in Pongola – conserving more than 13 difference landrace crops such as: sesame, groundnuts, cowpea, pumpkin, kidney bean, pearl millet, pigeon pea, calabash, maize, sorghum, mung bean, jugo bean, watermelon*) and Limpopo provinces are being supported by Non-Governmental Organizations (NGOs), such as Biowatch and Ukuvuna Urban Farming.

Complementing Formal and Community Seed Banks

South Africa's formal seed banks, like the National Plant Genetic Resources Centre (NPGRC) in Roodeplaat, play a critical role in long-term ex situ conservation. Similarly, community seed banks managed by farmer groups in Gumbu village (Limpopo Province), Jericho (North West Province) and Sterkspruit (Eastern Cape Province) with the assistance from both the National Department of Agriculture, Directorate Genetic Resources and the Provincial Departments of Agriculture, facilitate shared access and collective management of seed diversity at a local scale (Matelele et al., 2018).

However, household seed banks complement these systems by anchoring conservation directly in people's homes and everyday practices. They provide a decentralized safety net: if pests, theft, or natural disasters affect one household's seeds, neighbouring families

can easily restore lost varieties through local exchange networks. This interconnectedness strengthens **resilience and redundancy** within the broader conservation framework.

Empowering Farmers and Strengthening Food Sovereignty

Household seed banking is not only a conservation measure but also an act of **empowerment**. By maintaining control over their seeds, small-scale farmers reduce dependence on costly hybrid or genetically modified varieties that must be purchased each season. This autonomy enhances **food sovereignty**, allowing farmers to decide what to plant, when to plant, and how to manage their crops in line with local traditions and ecological knowledge.

Moreover, women often play a central role in seed selection and preservation. Their expertise in identifying desirable traits, taste, storage quality, cooking time, and pest tolerance, ensures that household seed banking supports both cultural heritage and nutritional diversity.

Challenges and Opportunities

Despite its value, household seed banking faces several challenges, however, these challenges also present opportunities, as indicated below:

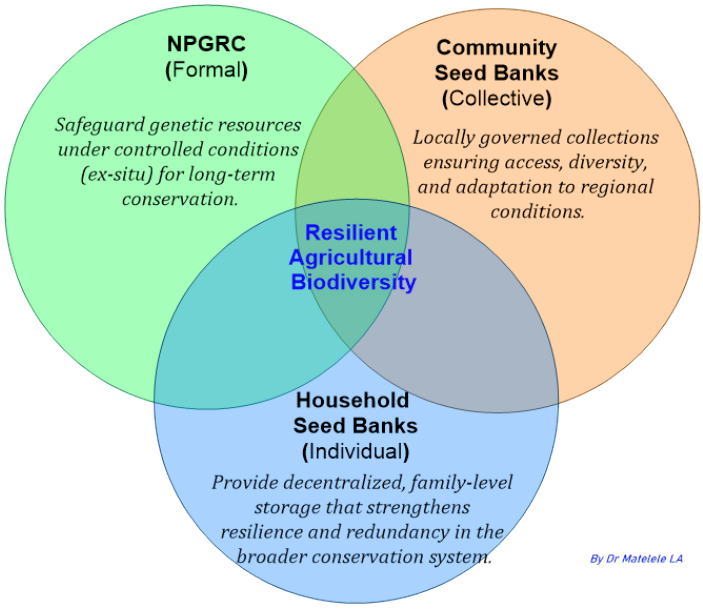
Challenges	Opportunities
Decline in traditional seed knowledge - due to modernization &migration	**Training on seed selection, drying, labelling, and airtight storage** – can improve seed viability and longevity
Poor storage conditions - leading to seed deterioration from humidity, pests or mould	**Youth engagement through "seed schools"** - through integrating household seed banking into school & community programs
Policy barriers favouring commercial seed systems over farmer-saved seed	**Partnerships with government agencies, NGOs and local cooperatives** – could also support households with materials like airtight containers, labelling tools, and record-keeping templates

A Path Toward Integrated Conservation

For South Africa to fully safeguard its agricultural biodiversity, **an integrated seed conservation system** is essential, one that connects national, community, and household seed banks in a mutually reinforcing network. Household seed banking contributes the grassroots depth needed to make this system truly resilient and sustainable.

In the era of climate uncertainty and food insecurity, each seed stored at home represents more than future harvests, it embodies **heritage, resilience, and hope**. Strengthening household seed banking ensures that the nation's agricultural future remains firmly in the hands of its people.

"Women in smallholder farming communities select seeds based on taste, cooking time, and storage life, preserving not only crops but culture" (by GRAIN and the Alliance for Food Sovereignty in Africa (AFSA) | 29 Oct 2018)



"Household seed banking is not just about storing seeds, it is about preserving heritage, empowering farmers, and securing South Africa's food future."
- Matelele, et al., 2018.

Final thoughts / Conclusion

Household seed banking is more than a storage technique: it is a practice of stewardship. In South Africa, as elsewhere, it links food security to culture, resilience to community ties, and biodiversity to everyday choices. *When households keep seed, they keep options*: options for flavour, for adaptation, for a future where farmers and communities remain the custodians of the seeds that feed them.

Household seed banking offers grassroots, low-cost, and culturally grounded approach to conservation. It strengthens resilience, supports climate adaptation, and keeps control in farmers' hands. As the country seeks sustainable agricultural solutions, recognizing and investing in household seed banking as a complementary conservation strategy will ensure that the *seeds of today become the harvests and heritage of tomorrow*. Each seed save is a story preserved.

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Restoring the culture of agrobiodiversity in communities

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South Africa's agroecological zones are classified based on localised climatic conditions, elevation, and landforms to assess agricultural suitability, with key zones including dry sub-humid, moist sub-humid, arid, and semi-arid zones. These zones provide and support distinct farming systems and the varying length of the growing period. The length of the growing period is the number of days in an annum suitable for crop growth, determined by sufficient seasonal rainfall, soil water content, and thermal degree days. These environmental factors are key to consider when selecting crops in a particular agricultural zone. Agrobiodiversity entails a variety of crops, livestock, wildlife, trees, microorganisms, and agrifood systems. It thrives on diversity that strengthens resilience, sustainability, and food security. It includes landraces, indigenous species, underutilised species, locally adapted livestock breeds, farming practices, and indigenous knowledge systems. This paper investigates the possibilities of restoring the culture of agrobiodiversity in the Free State and Mpumalanga selected communities through the reintroduction of landraces.

Genetic erosion of seed landraces

Genetic erosion of crop landraces in the South African communities is rife. Thus, referring to the traditional, locally adapted crop type and crop varieties. The main contributors to the erosion of seed landraces in communities include a plethora of factors, such as the adoption of high-yielding varieties, which resulted in a drastic decline in indigenous crops; incentives given to farmers to produce uniform crop cultivars for commercial markets, depicting diverse landraces as less profitable; mechanised monoculture drastically narrowing the genetic base; environmental degradation exacerbated by climate variability and change; loss of interest in agriculture to loss of indigenous knowledge which stemmed to the abandonment of ancient agrarian practices; and the high intensity of use of pesticides and insecticides leading to a loss of landraces and the interests to retain such seeds. Agricultural landrace genetic loss is estimated at above 90% of crop types, and their accessions have disappeared

According to the South African scholars, crop landrace diversity is under threat due

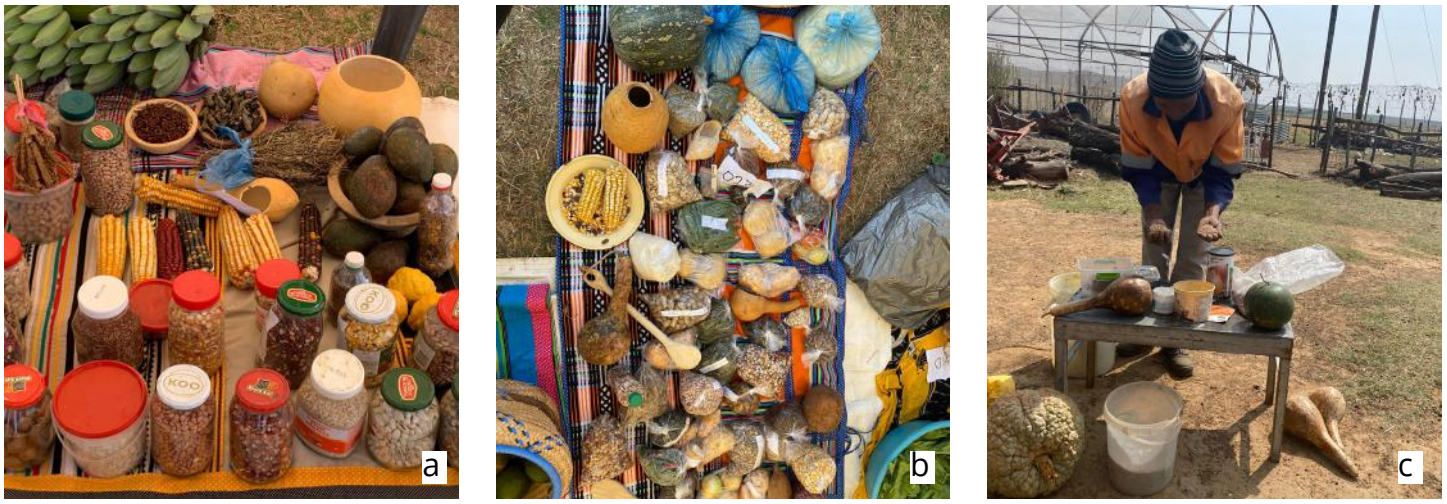
to the high adoption of commercialised cash crops, the changing climate, and the growing population. The numerical approximation of total agricultural landrace loss country-wide is limited, except for selected underutilised crops categorically, leafy vegetables, grains, legumes, tubers, and medicinal plants, highlighting that amongst smallholder farming systems, landrace genetic erosion is a critical issue. Examples of these crops include Amaranthus species, traditional maize accessions, pulses such as Bambara nuts and cowpeas, and local sweet potatoes and potatoes. The key findings on landrace loss from the South African perspective indicate that the drivers of genetic erosion resulted from the shift from landraces to modern cultivars, that underutilised crops are vulnerable since farmers opt for high-input crop types, and that the loss of indigenous knowledge on seed preservation and agricultural practices. Furthermore, environmental stressors contribute to the risk of genetic decline, and studies and observations confirm the valuable traits of drought pliability and heat tolerance. There is a critical need to conserve landrace seeds and systematically document associated indigenous knowledge, particularly as these landraces are currently cultivated on a limited, small-scale basis within certain communities. Without deliberate conservation and knowledge-preservation efforts, both the genetic diversity and the cultural practices underpinning these landraces remain highly vulnerable to erosion.

Household to community seed landraces

Landrace seed preservation in innate South African communities operates along a continuum from household custodianship to broader community-based systems.

At the household level, farmers maintain landrace seeds through producing, saving, selection, and exchange practices informed by indigenous knowledge and cultural traditions. These practices entail the annual gathering at the tribal authority compounds for the performance of seed exchange and blessing (Picture 1 a & b). These household-managed landraces form the foundation of community-based seed systems, where informal seed-sharing networks facilitate the circulation of genetic material and knowledge beyond individual families (Picture 1(c)). As these practices expand, they contribute to the emergence of community-based seed initiatives, such as community seed banks, which play a critical role in safeguarding landrace diversity, enhancing local seed access, and strengthening resilience to climate variability. However, without deliberate support and documentation, the transition from household to community landrace conservation remains fragile, placing both genetic resources and associated indigenous knowledge at risk of erosion. Landrace seed custodianship is the deliberate, intergenerational responsibility bestowed by smallholder farmers and communities to conserve, improve, and impart landrace seeds and local agricultural practices

Subsequently, the establishment of community-managed seed banks has gained increasing attention as a community-driven initiative for acknowledging, conserving, and promoting the utilisation of underutilised crops and agrobiodiversity. Nevertheless, the restoration of landrace seeds alone is inadequate. Without the revitalisation of farmers' localised knowledge, cultural practices, and local governance over seed



Picture 1. Landrace seed display during the seed and food fair and seed exchange networks

systems, these seeds cannot be sustainably maintained. This article, therefore, underscores the critical importance of restoring, preserving, and sustaining landrace seeds alongside indigenous knowledge systems and community-based seed governance to ensure their continued use and resilience within local farming systems.

Community Driven Agrobiodiversity Initiatives

The promotion of agrobiodiversity within communities plays a crucial role in restoring seed diversity and security. One of the most visible expressions of this is through community seed and food fairs, which are conducted annually in some South African rural communities. These events not only showcase the diversity of seeds conserved within communities but also facilitate the exchange of indigenous knowledge, cultural values, and belief systems associated with seed stewardship. Seed and food fairs provide an important social platform where communities collectively celebrate, transmit, and revitalise their agricultural heritage. Such community gatherings represent an integrated, living system in which crop diversity is actively maintained, adapted, and passed across generations. By recognising agrobiodiversity as a lived and dynamic practice, such community festivals reinforce resilient and adaptive local agricultural systems, enabling crop diversity to be sustained and disseminated from one generation to generations.

In achieving sustainable, localised agroecosystems, effective participatory approaches are imperative for the preservation of seed landraces, thereby supporting sustainable genetic resource conservation and the long-term viability of community seed banks. The approaches implemented include farmer-led seed selection and management, participatory plant breeding, participatory documentation of indigenous knowledge, and community-based seed governance, all which position farmers as active custodians of seed diversity rather than passive recipients. Through collective decision-making, knowledge co-production, and horizontal seed exchange, communities can maintain locally adapted landraces while revitalising cultural practices and strengthening informal seed networks. By integrating participatory approaches, community seed banks function as dynamic, living systems that support agrobiodiversity, resilience, and locally controlled seed systems.

The establishment of a localised community seed bank is established and governed through a locally developed constitution, collectively formulated and endorsed by community members to ensure transparency, collective responsibility, and communal ownership. The development of the constitution affords a common understanding as the constitution delineates rules and procedures for seed collection, access, storage, benefit-sharing, seed return, and decision-making, thereby institutionalising participatory seed governance. The six-cell analysis model participatory tool was used to determine the landrace seed status within local seed systems (Table 1, Pictures 2 & 3). It systemically analyses the typology of farmer groups maintaining landraces, the types of landraces available, underutilised, lost, and the wish list on crops that require reclamation and retention within communities. It further simplifies roles and responsibilities on the whole value-chain of seed production, crop type and cultivar selection, seed storage control, value-addition, benefit distribution, and consideration to social differentiation. Within communal seed banks, the six-cell analysis model provisions inclusive ownership, equitable benefit-sharing, and the design of interventions reflecting existing social dynamics.



Picture 2. Multiplication and adaptation sites for seed landraces in smallholder farmers

Table 1. The six-cell analysis model for seed landrace availability in South African communities

Categories	*Seed Availability Status*	*Source of Landrace Seeds*	*Strategic Action*
Common	Widely available: High seed security for staples	➢ The elderly in communities, ➢ National gene banks, ➢ Landrace seed organisations, ➢ Research Institutions, ➢ Smallholder farmers, and ➢ Other regions	Seed production for household consumption, for the local market, and to maintain purity
Niche	Available but limited: Mostly for household nutrition or other use		Knowledge of culinary and medicinal traits
Specialised	Locally available: Focused on culture preferences and agroclimatology zones		Linkage to value-added markets
Rare	Endangered: Landraces kept by farmers and available in certain areas		Priority for communal collection, seed recovery
Extinct	Unavailable: Landraces that are known about, heard of, or in distant gene banks		Seed scouting from national gene banks and other organisations promoting landraces
Wish list	Experimental: Introduced and/or migrated landraces		Participatory Variety Selection and establishment of multiplication and adaptation trials

The multiplication and adaptation trial site functions as a living laboratory where landrace seeds are grown, multiplied, and evaluated under local conditions. Organic farming principles guide all activities, avoiding synthetic inputs that could compromise seed quality or ecological balance. Farmers apply agro-ecological practices such as crop rotation, intercropping, composting, and natural pest management to strengthen soil health and maintain genetic integrity (Pictures 2 & 3). These practices allow seeds to adapt naturally to local environments, improving their resilience to climate stress, pests, and diseases. It is noteworthy to mention that the multiplication and adaptation trial sites are farmer-led, farm-maintained, and managed.

The project extends beyond crop cultivation, aiming to restore lost landrace seeds through participatory workshops, focus groups, key informants, seed showcases, and oral histories conveyed by elderly community members. Central to these activities was the guiding inquiry: *What has happened to landrace seeds that carry historical, cultural, high nutritional value, and sensory knowledge, yet have been forgotten?* Insights gathered indicate that the genetic erosion of agrobiodiversity is closely associated with the widespread adoption of commercial seed varieties and the related breakdown of intergenerational knowledge transfer. This has been the factual issue among cross-cultural and geological participants in Thaba Nchu and eMlondozi. The project adopts the agricultural school with the explicit objective of introducing learners to agricultural landrace crop types, seed management, and the importance of indigenous crops. The purpose is to engage younger generations in the conservation and stewardship of traditional crops, thereby addressing the discontinuity in knowledge transmission and promoting the sustained use and preservation of local genetic resources.

Interinstitutional and disciplinary collaborations amongst research and academic institutions, government agencies, and farming communities, landrace crops are preserved for living systems implanted within local agroecosystems, cultural practices, and food traditions. This collaborative approach strengthens community seed banks, facilitates intergenerational knowledge transfer, addresses genetic erosion driven by commercial seed systems, and enhances resilience, food sovereignty, and local control over seed systems

Policy

The strong collaborative efforts by the Department of Agriculture (DoA) and the Agricultural Research Council (ARC) have ensured the restoration and sustainable retention of crop-type landraces in their communities following the Food and Agriculture Organization (FAO) agrobiodiversity

Picture 3. Illustration of collected *landrace seeds displayed to the communities in the Free State*

principles. The implementation of these principles contributes to the sustainable use of plant genetic resources within local agroecosystems, with farmers recognised as key custodians of landrace diversity. The restoration of agrobiodiversity in communities allows for maintaining genetic diversity through on-farm and in situ conservation, which enhances resilience to climate variability and change, pests, and socio-economic shocks. Participatory approaches that integrate indigenous knowledge with scientific research, ensure equitable access to landrace seeds, and promote fair benefit-sharing are essential for strengthening local seed systems and sustaining agrobiodiversity.

Embedding agrobiodiversity in national frameworks and daily cultural practices is crucial for its lasting value. The recent ratification of the International Treaty on Plant Genetic Resources for Food and Agriculture by the DoA highlights a strong commitment to conserving and utilizing plant genetic diversity (DoA, 2025). This commitment recognizes community seed banks as key players, working alongside national departments, farmers, and research institutions.

When policy, research, and community practices align, they create a supportive environment for agrobiodiversity. For instance, seed-sharing rituals, seasonal fairs, farmer-led selection, and local markets can reinforce each other, fostering a vibrant agricultural ecosystem. In the Free State and Mpumalanga, the implementation of agrobiodiversity and communal seed banks is guided by the Plant Improvement Act 11 of 2016. This approach strengthens local agricultural practices and enhances the overall resilience and diversity of food systems in these regions.

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South Africa's Microbial Culture Collection:

A National Asset for Food Security and Sustainable Agriculture

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Manana Mamabolo:
Whitney Matli:
Economic Analysis Unit, ARC
Sinalo Mani:
GI Microbiology and Biotechnology Unit, ARC

South Africa's agricultural sector increasingly relies on scientific solutions for food security and livestock health. The GI Microbiology and Biotechnology Unit of the Agricultural Research Council's Animal Production (ARC - AP) in Irene , contributes significantly to those solutions. The Unit houses a unique collection of microorganisms with the potential to transform food production, livestock management, and environmental protection.

This in-house culture collection, managed by Dr. Mani and her team, is one of ARC's National Public Good Assets [NPGAs]. While it appears as freezers and cryo-tanks and shelves filled with labelled samples, these microorganisms are a vital scientific resource, supporting advancements in agriculture, health, and sustainability.

What makes up the Microbial Culture Collection?
The collection is a dynamic repository of beneficial microorganisms, including bacteria and fungi from plants and animals [gastrointestinal microbiology], supporting research in probiotics and biocontrol agents. Some cultures are over a century old [100 years], while others have been recently added through field sampling across South Africa. Each microorganism is isolated (either from animal waste or digestive system), identified as a potential probiotic, and preserved under strict conditions to maintain its unique genetic and functional traits.

Figure 1 is an example of a biobank, which is a repository for the short- and long-term storage of animal biological samples. Samples are kept at room temperature and conventionally frozen. The ARC gathers, processes, and banks tissue, skin, hair, and blood samples from various livestock species, with pertinent animal information recorded in a database. DNA samples from research and diagnostic services (parentage verification and forensics) are also stored.

"Probiotics are beneficial microorganisms naturally found in the gut of animals and humans. They offer a natural alternative to antibiotics, addressing one of the biggest global challenges, antimicrobial resistance." explains Dr Mani

Unlike commercial collections, this NPGA is a publicly funded national resource. It is accessible to researchers, postgraduate

Figure 1: Banked samples picture sourced *(ARC Irene) 2025 website*

students (MSc and PhD), interns and collaborators in South Africa and internationally. The collection supports postgraduate training, international partnerships, and the development of microbial innovations to reduce antibiotic use in animal farming.

Managing a Public Good

The ARC oversees and enforces stringent institutional procedures to safeguard intellectual property (IP). Previous examples, such as a patented strain that eventually passed into foreign hands, demonstrated the necessity of well-defined intellectual property arrangements and benefit-sharing methods in collaborative research. Existing agreements ensure that all new discoveries, including those made through transnational cooperation, are properly safeguarded. This institutional structure is consistent with South Africa's Intellectual Property Rights from Publicly Funded Research and Development Act (Act No.51 of 2008), which controls the ownership, administration, and commercialization of IP resulting from publicly funded research. Access to the collection can be obtained through official research partnerships with universities, research organizations, and businesses. This strategy ensures accountability while encouraging collaboration and creativity.

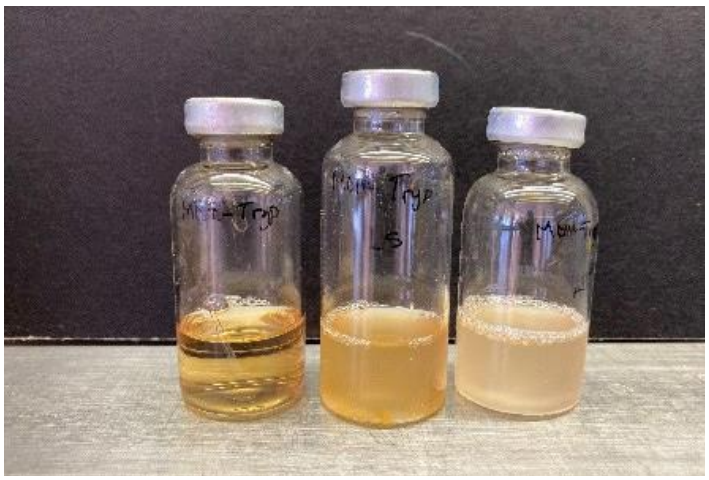
How Are These Microbes Used in Agriculture?

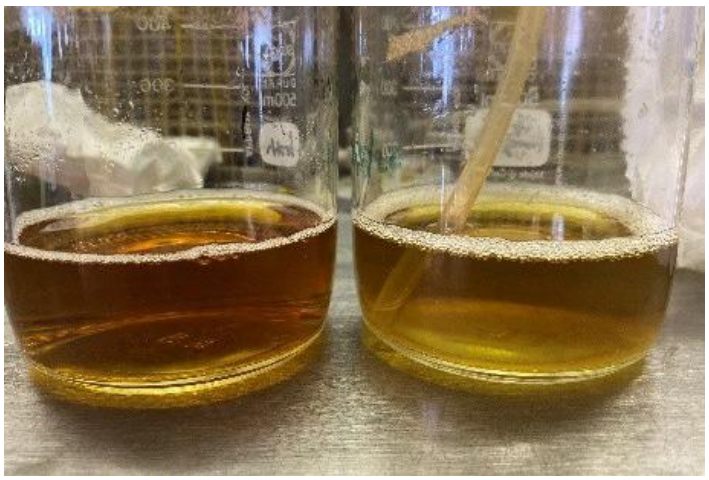
From the field to the Freezer

Researchers gather samples from livestock (cattle), small stock (sheep, goats), poultry and occasionally from plants. The samples are isolated, analysed for probiotic properties (bio controls – for plant microbes) and subsequently preserved in extremely cold freezers or tanks filled with liquid nitrogen to ensure their long-term safety. Each sample is meticulously documented with information such as animal type, its breed, origin and dietary habits.

The culture collection backs a broad array of research and innovation efforts**:**

- **Animal health:** Scientists create probiotic solutions as natural substitutes for antibiotics in livestock, aiding in the reduction of drug resistance and enhancement of animal well-being.
- **Crop protection:** Biocontrol microorganisms are evaluated against plant diseases (pathogen) like fungi and pests, offering eco-friendly alternatives that decrease dependence on chemical pesticides.
- **Training and education:** The institution provides advanced microbiological training for postgraduate students, interns, and postdoctoral researchers, preparing them for employment in biotechnology. It provides practical research experiences to MSc and PhD students who rely on it for their work. Several students have obtained





their degrees using specimens from the collection, contributing to the improvement of national capacities in microbiology, animal science, and biotechnology.
- **Industrial partnerships:** The Unit collaborates with local universities and global institutions to share data and knowledge, while advancing innovation and commercialisation. Notably, a collaboration with Queen's University Belfast, focuses on harnessing methane-reducing microbes for climate-smart livestock production. These partnerships have already yielded in patents and commercial products, such as a patented probiotic strain that still earns royalties from the US market.

Contributing to food security
Food security is more than just producing sufficient food but also guaranteeing it is safe, nutritious, and sustainably produced.

Beneficial microorganisms are essential in this matter:
- **Boosting productivity:** Probiotics boost productivity by improving feed efficiency and animal development, leading to higher yields and better meat and dairy quality.
- **Safeguarding crops:** Biocontrol agents safeguard crops from diseases, lowering losses and maintaining stable food supply networks.
- **Protecting environment:** Substituting chemical pesticides with biological pesticides reduce pollution and soil deterioration, promoting long-term sustainable agriculture.
- **Boosts resilience:** Microbial solutions improve animal and plant health, providing resilience against climate and disease shocks in food systems.

Challenges and the Road Ahead
Despite its scientific value, maintaining microbiological collections presents several obstacles. Power outages, limited storage space, and a lack of specialized maintenance personnel risk sample preservation. In 2022, for instance, several samples were damaged due to power outages and electricity load-shedding, highlighting the fragility of these essential research resources.

We came back from the December holidays in 2022 to find that one of our freezers had failed, we lost years of materials" recalls Dr Mani

To prevent future losses, Dr. Mani and her colleagues are relying increasingly on cryo-storage, which comprises of liquid nitrogen tanks that do not require electricity. Plans are underway to update and expand laboratory spaces, consolidate storage, and incorporate digital monitoring systems to ensure sample integrity.

Even though the asset receives project-specific funding from SANBI, and ARC internal budgets, its long-term viability is dependent on continual investment in equipment, cryo-storage facilities, and qualified personnel. Without continual investment, it becomes

challenging to maintain and enhance the asset's scientific and societal value.

Conclusion: A Living Asset for the Nation
South Africa's culture collections has positioned the country as a global biotechnology player, providing microbiological resources and knowledge that promote local innovation and worldwide collaboration.

Outsiders may regard the culture collections as nothing more than rows of freezers in a laboratory. Yet, within those vials is a thriving repository of potential solutions to antibiotic resistance, climate change, and sustainable agriculture. With mounting demands on South Africa's food systems, this asset exemplifies how science, as a public good, can efficiently meet societal needs. This powerful NPGA exemplifies the need for funding science as a public good. By reducing antibiotic dependency and teaching future scientists, the ARC's culture collection contributes to national goals of food security, innovation, and resilience.

The success of the Asset underscores an essential message: even the smallest organisms can create the largest impact in food security and agricultural sustainability.

Postharvest food waste crisis and solutions in SA

Reports indicate that over 63% of South African households experience varying levels of food insecurity. Yet, between 9 124 and 17 969 tonnes of fruits and vegetables, which is the equivalent of roughly 450 to 900 fully loaded large trucks, go to waste every year at the wholesale level — partly because of postharvest losses. Improved postharvest practices, infrastructure and policies are key to minimising this waste and enhancing food availability and food security.

This is according to food systems researcher Dr Ikechukwu Opara who recently obtained his doctorate in Food Science at Stellenbosch University.

As part of his study, Opara measured food waste at the biggest fresh produce market in South Africa, identified financial losses, and used machine learning models to predict waste. Opara says he focused on the later stages of the food value chain because they are often overlooked, resulting in an information gap in this area.

"The lack of comprehensive data on postharvest waste, particularly at critical points such as wholesale markets, makes it difficult to identify waste hotspots accurately and hinders the development of tailored interventions to reduce waste at specific stages of the food supply chain."

He monitored and evaluated the operational processes at the fresh produce market and conducted laboratory simulations of wholesale storage conditions, measuring the physiological attributes and shelf life and identify quality

issues of fresh produce before they are discarded at the market.

Noting that the issue of food waste at the wholesale level is complex and involves several factors, including infrastructural and operational challenges, Opara says his study identified a break in the cold chain as a significant challenge in the market.

“This often results from operational challenges that cause delays between the receipt of produce and its placement in optimal storage conditions. Additionally, the low availability of cold storage infrastructure, especially during summer, contributes to postharvest waste.

“Cold storage units and operations should be improved, especially during summer, to effectively cater for the volume of produce supplied to the market in that period. This is important since summer is when the highest amount of produce is supplied to the market, and when susceptibility to waste is high due to increased temperature.”

Opara adds that transportation conditions, both to and within the market, also led to waste.

“When fruit and vegetables are transported in unrefrigerated vehicles, they are subjected to unfavourable conditions such as inappropriate temperature and relative humidity levels, which accelerate processes like respiration and transpiration. This can result in weight loss and shrivelling. These issues diminish the physical appeal of the produce, which can lead to downgrading, and in extreme cases, this results in postharvest waste.”

According to Opara machine learning can help reduce food waste in practical, everyday operations at fresh produce markets. He explains:

“Temperature control systems can be improved with machine learning tools that automatically monitor conditions and alert supervisors and people working in the market when temperature and humidity levels deviate from the set range.

“Additionally, machine learning can be used to forecast demand and optimise the process of ordering, storing, using, and selling of products, especially in situations where this has been ineffective and contributing to food waste.

“Machine learning can also support dynamic pricing models. In this scenario, the system automatically tracks the supply date and shelf life of fresh produce, using that data to recommend prices that encourage quicker sales, thereby helping to minimise potential postharvest losses and waste.”

Opara says it is crucial to reduce postharvest losses and waste to combat food insecurity, malnutrition, obesity, diabetes, and other related health conditions.

A major economic consequence of postharvest losses and waste is the increased cost of food, adds Opara.

“Reduced availability of fruits and vegetables due to these postharvest losses and waste leads to higher prices. When low-income households must pay these elevated prices for fruits and vegetables, they are left with less money for other goods and services.

“This situation exacerbates poverty and traps households in cycles of debt and dependence on the government for social grants. It further widens the gap between the rich and the poor in one of the most unequal countries in the world. Considering these key points, addressing, and reducing postharvest losses and waste not only enhances food security but also alleviates negative economic impacts.”

Opara says he hopes his study will lay the groundwork for reducing postharvest losses and waste by using machine learning to generate insights that guide evidence-based interventions and strategies aimed at mitigating the negative effects of this issue.

One Country, Unequal Land: How Tenure Insecurity Continues to Undermine Agriculture and Wealth in South Africa

Mishal Trevor Morepje and Phumla Mayekiso,
ARC, Pretoria, South Africa

South Africa speaks about land as if it operates under a single, unified system. The country functions through parallel tenure regimes that determine who can invest, who can borrow, and who can build intergenerational wealth. The result is not only spatial inequality, but also agricultural inequality.

The core issue is simple yet profound: land does not mean the same thing everywhere. In some areas, it functions as a capital. In others, it functions only as a shelter or subsistence space. Until this structural divide is addressed, agricultural reform will remain incomplete.

According to the World Bank (2018) and national government assessments, secure property rights are strongly associated with investment, credit access, and productivity growth. Yet in South Africa, tenure security varies sharply across geography. The World Bank further states that approximately 17 million people, nearly one-third of the population, live in areas under customary tenure systems in former homeland regions. In these areas, legally enforceable ownership is often absent. This is not a marginal issue as it sits at the heart of rural development.

Urban Areas: Land as Capital

In formally serviced urban centres and established commercial farming regions, land is recognised through registered title deeds. These rights are enforceable, tradable, and mortgageable. Data from Statistics South Africa (2022) show that property ownership in metropolitan municipalities is significantly higher among households in historically advantaged areas. Secure land title enables:

- Access to bank loans
- Property insurance
- Use of land as collateral
- Intergenerational wealth transfer

In agricultural zones previously dominated by commercial farming, land can be leveraged for production finance. Financial institutions rely heavily on title security before issuing medium- or long-term agrarian loans. As a result, farmers in these areas can invest in irrigation systems, climate-smart technologies, and improved seed varieties.

Townships: Partial Security, Partial Opportunity

Townships present a more complex picture. While post-1994 housing programmes have delivered over 4 million subsidised houses, many beneficiaries still lack registered title deeds due to administrative backlogs, informal transfers, or deceased estates. The Department of Human Settlements (2022) has acknowledged significant title deed backlogs over the past decade. Without registered ownership:

- Properties cannot easily be used as collateral
- Insurance claims become complicated
- Informal transfers create legal uncertainty

For households engaged in backyard agriculture, small-scale poultry, or informal agro-processing, this uncertainty discourages investment in infrastructure such as boreholes, fencing, and storage facilities.

During a survey conducted by the Agricultural Research Council (ARC) on land reform, one farmer captured the concern in simple terms, explaining that without formal documentation proving land rights, investing in permanent structures feels too risky. That hesitation is not a sign of limited ambition. It is a practical response to uncertainty, especially when hard-earned savings could be lost if tenure arrangements shift or disputes arise.

Rural Homelands: Occupation Without Bankability

The sharpest tenure divide exists in former homeland areas, where land is administered mainly under customary systems. These systems retain strong social legitimacy and cultural value. However, the legal recognition of rights remains limited.

According to a GrainSA (December 2015 publication), communal land accounts for roughly 13 per cent of South Africa's land area but supports millions of rural residents.

Farmers in these regions often cultivate the same fields for generations, yet lack registered, bankable documentation. The implications for agriculture are profound:

- Limited access to formal credit
- Reduced investment in irrigation and mechanisation
- Low uptake of improved seed and fertiliser
- Difficulty entering formal value chains

The Food and Agriculture Organization (FAO, 2012) consistently highlights secure tenure as a foundation for agricultural productivity worldwide. Without it, long-term soil management and infrastructure investment decline.

In field engagements across rural communities, farmers often explain that investing in irrigation infrastructure feels too risky when land allocation rules are unclear or documentation remains informal. That uncertainty quietly influences decisions long before it shows up in productivity data, shaping how much farmers are willing to invest and how far ahead they are prepared to plan.

Agricultural Implications: Productivity Is Not Just About Inputs

Agricultural policy often focuses on inputs such as seed, fertiliser, and extension support. These are essential. Yet tenure security quietly

determines whether those inputs translate into sustained productivity. When land rights are unclear:

- Farmers prioritise short-term cropping over long-term soil health
- Investment in orchards or perennial crops declines
- Agro-processing partnerships hesitate to contract supply

Meanwhile, land held under secure tenure continues to appreciate, enabling owners to accumulate equity, refinance their assets, and expand their investments over time. Over time, the legal status of land becomes more decisive than the farmer's capability.

Policy Contradictions: Commercialisation Without Security

National development frameworks encourage the commercialisation of smallholders, rural agro-processing, and the integration of agribusiness. However, these ambitions assume stable, enforceable land rights.

This creates a structural contradiction. Farmers are expected to integrate into formal markets while operating on land that financial institutions do not recognise as collateral.

The National Treasury (2023) has repeatedly emphasised the importance of property rights for investment certainty. Yet policy implementation across communal and township contexts remains uneven.

Land reform debates often centre on redistribution. Redistribution matters deeply. But redistribution without secure, enforceable rights risks replicating uncertainty in new forms.

Practical Implications for Farmers and Agribusiness

For farmers:

- Secure tenure increases confidence to invest in irrigation and soil improvements
- Registered rights improve access to production loans
- Inheritable documentation supports generational continuity

For agribusiness:

- Clear land rights reduce supply risk
- Contract farming arrangements become more stable
- Value chain financing becomes viable

For rural communities:

- Property security strengthens local economies
- Asset appreciation supports household resilience
- Youth see agriculture as a viable long-term career

Land security is not merely a legal technicality. It shapes economic behaviour.

The Way Forward: From Access to Functionality

Strengthening tenure security does not require dismantling customary systems. It requires modernising legal instruments so that rights become enforceable, bankable, and inheritable while respecting local governance structures.

Policy priorities could include:

- Accelerating title deed registration in townships
- Developing legally recognised long-term use rights in communal areas
- Digitising land administration systems
- Integrating tenure reform with agricultural finance programmes

Clear transitional frameworks would allow financial institutions to design products tailored to communal tenure contexts rather than excluding them outright.

The land question facing South Africa has evolved. It is no longer solely about who has access. It is about whether land can function productively and sustainably across all geographies.

A country cannot pursue inclusive agricultural growth while operating under unequal tenure regimes. If tenure security becomes central to reform, agriculture in rural homelands, townships, and emerging farming areas could shift from survival mode to investment mode.

The fundamental transformation will not come from hectares transferred alone. It will come when every farmer, regardless of location, can farm with certainty.

Key Takeaways from the article

Why tenure security matters for agriculture and wealth in South Africa

- South Africa operates under fragmented land tenure systems rather than a unified framework.
- Around 17 million people live in communal tenure areas where land is often not bankable.
- Secure title deeds allow land to function as capital, enabling access to loans, insurance, and investment.
- Township title deed backlogs limit property owners' ability to fully participate in the formal economy.
- Farmers without legally enforceable rights are less likely to invest in irrigation, soil improvement, or long-term crops.
- Agricultural commercialisation policies risk failure if tenure insecurity is not addressed.
- Strengthening tenure security does not require dismantling customary systems but rather improving legal recognition and enforceability.

In summary, inclusive agricultural growth depends not only on redistributing land but also on ensuring that land rights are secure, enforceable, and economically functional across all regions.

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South Africa Eyes Homegrown Rice as ARC Expands Research Efforts

Anelisa Gusha: ARC

As South Africa continues to explore sustainable solutions for food security, the Agricultural Research Council (ARC) is turning its attention to an unexpected contender: rice.

The ARC-Small Grain has begun evaluating rice as part of its new crop research portfolio, with intensified efforts in recent years to establish and develop upland rice suited to local conditions.

Unlike traditional paddy rice, which requires large volumes of water, these cultivars are being tested for their ability to thrive in South Africa's diverse soils and increasingly water-scarce climate, potentially laying the foundation for a future domestic rice value chain.

At the heart of this initiative is ARC's Small Grain campus, where Professor Toi Tsilo and Timmy Baloyi, together with partners within the agricultural sector, academia and rice value chain who are hard at work in establishing the development and production of upland rice cultivars for adoption in South Africa.

strategically aimed at shaping the agricultural sector to provide more opportunities for economic growth within the rice value chain where farmers can participate.

The upland rice project in South Africa targets and participates with a wide range of stakeholders, including the Department of Science and Innovation (DSI), the Technology Innovation Agency (TIA), the Department of Agriculture, the National Agricultural Marketing Council (NAMC), Land Bank, Farmers, Farmer Associations, Universities, seed companies, mechanisation companies, , and current rice value chain industry stakeholders such as importers and regulators, as well as international rice organizations.

The positive impacts of this collaborative effort over the years are evident. The rice production has been proven feasible in South Africa, prospective adaptable rice accessions for production and development have been identified, and there are endless opportunities to address gaps within the rice value chain.

A wide range of rice accessions acquired from an international rice organisation were evaluated across multiple grain production

areas in South Africa for adaptation and a couple of accessions displayed great possibilities for adaptation and further improvement/development across South Africa's diverse soils and climate.

By focusing on the development of lowinput requirement, highyield crops, the ARC with its collaborators hope to establish profitable crop production alternatives to add to the annual crop production cycle and portfolio of South African farmers.

And as rice consumption continues to rise locally, producing more at home could significantly reduce the cost of imports.

Baloyi said this approach aligns with traditional crop production methods, ensuring farmers don't have to reinvent the wheel: "The South African grain production system is currently carried out under upland conditions where grain production relies on seasonal rainfall and irrigation in other areas; upland rice production will conform to the traditional grain production practices that farmers are currently deploying rather than reinventing the wheel."

He said the goal behind the multi-million project is making contributing to the needs driven research which outlines the importance of achieving self-subsistence in rice production as the country considering the growing demand of rice consumption within the country and to further mitigate any unforeseen political challenges the country may be faced with when having to import rice in the future.

"The response to South Africa's needs is in the development of climateresilient, lowinput requirement crops that are drought tolerant, high yielding and profitable to address the gap within the rice value chain and self-reliance on rice imports in a country that has a high demand for rice."

The rice adaptation and development strategy deployed is designed to work with limited rain and irrigation only during critical stages allowing rice to grow well even under varying weather conditions. "The project is structured in a way that it can identify and develop rice genotypes that can be produced with minimal rainfall and supplementary irrigation at critical growth stages…without the need for excessive irrigation," he said.

Upland rice also has significant commercial promise. "Rice production would be more profitable for the farmers compared to numerous crops. There would be established market opportunities for farmers,"

This fits neatly into existing farming cycles. "The planting window of rice would also assist multiple production of other crops within the farmer's production cycle per annum."

He underscores that the project was national importance. "Rice production would largely contribute to food security considering the growing demand for rice in South Africa."

Though interest is high, Baloyi stresses that government backing remains vital. "There is positive and substantial participation however, more attention and participation is still required from various spheres of government."

He said on its horizon is national rollout, which also depends on resources: "The project will be expanded nationally across all provinces; however, there are still more funds required, and support required from other government departments. There is an established rice task team which involves other industry stakeholders, universities, government departments, and other international partners involved."

Speaking to young scientists and agriculturists, Baloyi encouraged youngsters to be innovative. "They need to keep on looking for innovative ways to contribute to the agricultural global needs through applying plant breeding techniques. There are endless opportunities that could be created through plant breeding."

For the ARC, the upland rice project is beyond merely cropping science but it's about creating jobs, strengthening farmers against future challenges, and building real resilience in communities facing climate extremes. It's a practical, impactful step toward a food-secure South Africa.

Artificial insemination in indigenous and village chickens: A tool for improving rural poultry productivity

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Poultry farming is one of the most important agricultural enterprises for smallholder farmers in developing countries. Indigenous and village chickens play a vital role in rural livelihoods by providing meat, eggs, and income. However, despite their adaptability, disease resistance, and low maintenance requirements, they often exhibit low productivity compared to commercial breeds. Artificial insemination offers a practical and scientific approach to improving the genetic potential and reproductive efficiency of indigenous chickens without compromising their desirable traits such as hardiness and adaptability. Artificial insemination is a reproductive biotechnology technique in which semen collected from a male (rooster) is manually introduced into the reproductive tract of a female (hen) using specialized equipment. Unlike natural mating, artificial insemination allows controlled breeding and the efficient use of superior male genetics.

Advantages of artificial insemination in indigenous and village chickens

Farmers can use semen from high-quality, roosters without a need to own them. This enables the introduction of desirable traits such as faster growth rate, improved egg production, and disease resistance by crossing superior males with local hens. Artificial insemination allows for the controlled mating of individuals with desirable traits to improve specific genetic lines. It provides access to a wider genetic pool and can help reduce the risks of inbreeding. A single ejaculate from a rooster can be used to breed many hens, far more than natural mating. Artificial insemination can be more cost-effective than natural breeding, as it reduces the number of males a farm needs to own and manage. This technique prevents the spread of venereal diseases that are transmitted through natural mating. It removes the risk of injury to females and amongst males that can occur during natural breeding. It is a valuable tool for

Figure 1: (A) Selection of breeding chickens;

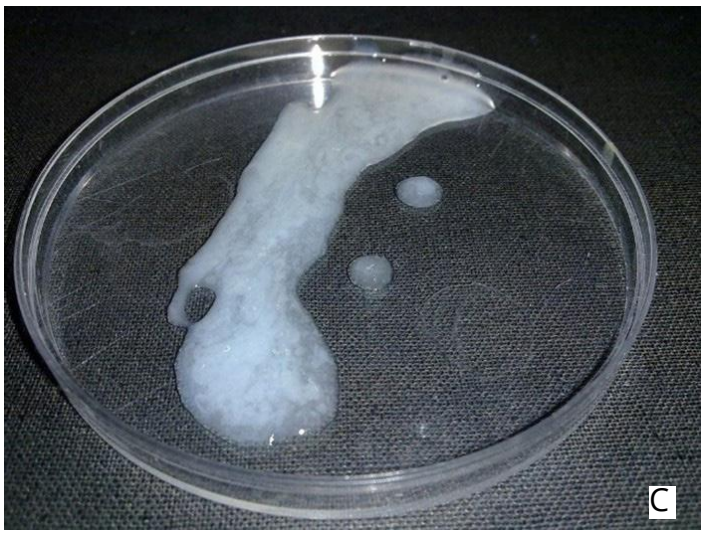
(B) Semen collection (adapted from https://share.google/images/ROTBsWLOXaaNsDEYk);

conservation programs, helping to preserve endangered avian species through controlled breeding. Thus, farmers and researchers can plan selective breeding programs, maintain records, and monitor performance more accurately.

Procedure for artificial insemination in indigenous and village chickens

It is important to choose healthy, mature males (8–12 months) with proven fertility, productive, and disease-free chickens (see figure 1: A). Semen is collected through the cloacal massage technique as shown in figure 1: B. Briefly, the first step is to gentle massage the lower abdomen and back to stimulates ejaculation. The semen should be collected into a clean, warm container or tube. For subjective visual evaluation of the quality of the sperm, after ejaculation semen should liquefy within 15–30 minutes (Figure 1: C-D). Once it liquefies, tilt the container slightly. If the semen flows smoothly (not thick or clumpy), sperm motility is more likely to be normal and if it stays thick, sperm motility is likely reduced because immobile sperm are often trapped in viscous fluid.

For thread test, touch the semen gently with a glass rod or clean stick and lift it up



(C) Flow observation of semen for liquification [(adapted from Esteves, S. C., & Agarwal, A. 2014);

(D) Post 15-30 minutes of liquification [(adapted from Esteves, S. C., & Agarwal, A. (2014)]

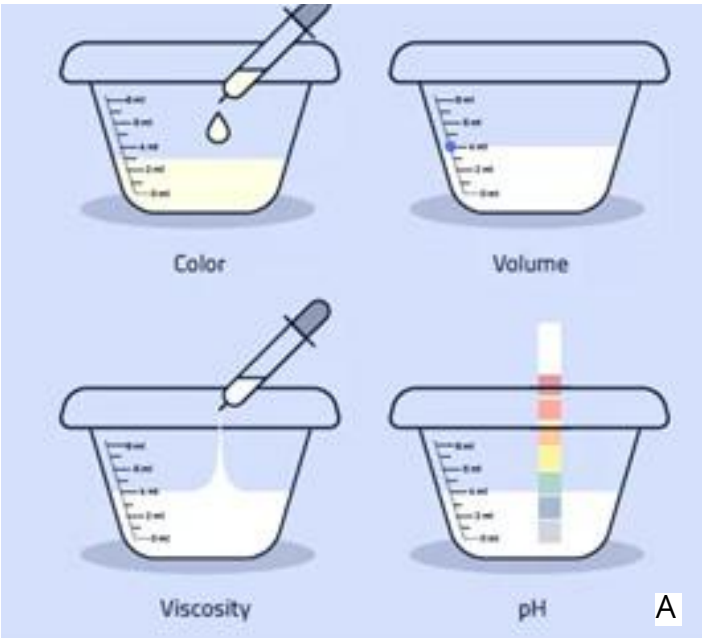


Figure 2: (A) Thread / viscosity test (adapted form https://www.exseedhealth.com/semen-analysis-what-is-measured/)

(B) Artificial insemination of hen

slowly (Figure 2: A). If a long thread (>2 cm) forms before breaking, it is too viscous (the thickness and resistance to flow of seminal fluid), and sperm motility is likely poor. A short thread or easy break (<1 cm) indicates normal consistency more likely normal sperm motility. To evaluate for the colour and health of the smell, normal semen should be whitish-grey and has a characteristic (chlorine-like) smell while yellowish, watery, or discoloured samples may indicate infection or poor sperm health (which often correlates with low sperm motility). The hen is gently restrained, and the cloaca is exposed by applying slight pressure to evert the oviduct, a small volume (0.02–0.05 ml) of semen is introduced using a pipette or syringe Figure 2: B). For consistent fertility, inseminate hens every 5–7 days.

Challenges in implementing artificial insemination in indigenous and village chickens

Small scale farmers lack training merely because they are unfamiliar with artificial insemination techniques, moreover, specialized materials like semen extenders and pipettes are not widely available in rural areas. Short semen storage time also play a role given that rooster sperm has limited viability, requiring fresh collection for each insemination. Since indigenous chickens can be more active and harder to restrain compared to commercial breeds, it is difficult to handle them.

Future prospects

With proper training and community-based breeding programs, artificial insemination can play a major role in improving the productivity of indigenous and village chicken populations. Integrating artificial insemination with other management practices such as improved feeding, housing, and disease control (vaccination) can significantly enhance the profitability of rural poultry enterprises. Research institutions and agricultural extension services have an important role in promoting artificial insemination awareness, providing training, and supporting small-scale farmers with resources and technical expertise.

Conclusion

Artificial insemination in indigenous and village chickens presents a promising avenue for enhancing productivity while preserving the valuable traits that make these chickens suitable for rural environments. With increased adoption, artificial insemination can contribute to food security, income generation, and sustainable poultry development in smallholder farming systems.

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Vegetable pickles for the home kitchen

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The preservation of food with salt and vinegar, either with or without the addition of spices, is commonly known as pickling. The salt solution and the vinegar that is used, must be sufficiently concentrated to prevent the development of micro-organisms as there must be enough liquid to cover the food.

There are three main classes of pickles:

- Sour pickles, which include mustard pickles.
- Sweet fruit or vegetable pickles.
- A large variety of pickles in which the food is finely chopped. Relishes are included in this class.

Products for pickling:
Vegetables and fruits for pickling should be young and fresh. If the raw product is green and slightly under-ripe, it produces firmer, crispier pickles than when ripe fruit or vegetables are used. Coarse salt may be used instead of fine salt, but it must be clean. Cider or malt vinegar gives a good flavour, but white vinegar produces a cleaner-looking pickle. White or brown sugar may be used. Spices should never be used in such large quantities that it conceals the original flavour of the fruit or vegetable being pickled.

Utensils:
All utensils used should be of earthenware, porcelain, or enamel lined. Saucepans should be wide and shallow to ensure even cooking. Only stainless steel, wooden or enamelled spoons should be used. The finished pickled product should be stored in glass containers with glass or enamelled lids. Never allow metal to come in contact with the pickles.

Pickling of vegetables:
In most cases both salt and vinegar are used in making pickles. After the primary preparation, such as cleaning the raw product and cutting it into suitable sizes, the vegetables/fruits are placed in brine (½kg salt to 4 litres of water), or packed in layers that are liberally sprinkled with salt. They should be left for 1-14 days or as indicated in the recipe being used. Some water will be drawn from the vegetables, making them firmer and enabling them to absorb spiced vinegar more easily. It will also prevent them from softening readily in the pickling mixture, and the salt prevents spoiling. The brine should be cool before it is poured over the vegetables/fruits, and the vegetables/fruits must always remain covered under the brine.

After brining (focusing now on vegetables), drain the vegetables well and treat them with spiced vinegar or as indicated in the recipes below.

The spices may be used whole or ground, depending on whether you want a clear or dark pickle. The spices may be tied in a small muslin bag and removed from the vinegar before it is poured over the vegetables.

Ripening:
Pickles should not be used before they are thoroughly ripened. The ripening process takes between 1-2 months after the product was bottled. The material becomes firm and translucent, and the colour of green vegetables turns from light green to a dark olive green. The change in colour should be the same for all the green vegetables.

Softening:
There are several reasons why the vegetables could go soft during storage. The brine or vinegar may be too weak – vinegar that is boiled too long, loses its strength. The storage place may be too warm. Or the vegetables are not covered completely in brine. Another

reason is that the vegetables themselves were cooked for too long.

RECIPES:
Spiced vinegar option 1:
(For mixed and other pickles)
3 litres vinegar
1 tablespoon clove stalks (without heads)
1 tablespoon whole allspice
½ tablespoon stick cinnamon
1 tablespoon mustard seed

Tie the spices in a muslin bag, add to the vinegar and bring to the boil. Remove from direct heat and allow to stand for 2 hours, then remove the spice bag.

Spiced vinegar option 2:
(For pickled onions)
2 litres vinegar
1 cup sugar
1 ½ tablespoons celery seed
1 ½ tablespoons mustard seed
½ cup grated horse radish
1 tablespoon salt
½ tablespoon whole allspice
1 tablespoon stick cinnamon

Tie the spices in a muslin bag, add to the vinegar and sugar, and bring to the boil. As soon as it starts boiling, remove from direct heat and leave to stand for 2 hours. Remove the spice bag.

Pickled onions:
Select small, white onions. Peel, cover with fresh water and let stand for 2 days. Change the water on the second day. Wash well and put into brine for 4 days. Remove from brine and drop into boiling water. Leave for 10 minutes, then put into cold water for 2 hours. Drain and pack into jars with a few small red chillies and peppercorns. Fill the jars with spiced vinegar until they overflow.

Pickled beans:
Put tender green beans in brine for 24 hours. Drain thoroughly, put into jars and pour hot spiced vinegar over.

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Chicken Wraps with Pesto Dressing

Ina Paarman

Chicken breasts are the ultimate versatile prep-ahead lunch box staple. Basted with one of our Flavour Bombs, they become a delicious filling for chicken wraps, along with a light yoghurt-based basil pesto spread.

Makes 6 - 8 lunchbox portions

You Will Need:

Pan-Fried Chicken Breasts

4 skinless and deboned chicken breasts

4 T (60 ml) olive or canola oil

2 x sachets Ina Paarman's Spanish Tomato Flavour Bombs (or Spicy Cajun Flavour Bombs)

Basil Pesto Spread

½ cup (125 ml) plain full cream yoghurt

4 T (60 ml) mayonnaise

3 T (45 ml) Ina Paarman's Basil Pesto

Assembled Wrap

6 large wraps (flour tortillas)

1 baby gem lettuce, shredded

pickled cucumber (homemade or store bought)

1 cup cheese, grated

Method:
On a cutting board, slice each chicken fillet open horizontally (butterflied) to create a thinner breast fillet surface.
Mix 2 T (30 ml) oil with the Flavour Bomb sachets and stir to mix.
Heat 2 T (30 ml) oil in a large, wide, heavy-based frying pan.
Fry the breasts briefly until golden and ¾ cooked, then spoon over the Flavour Bomb mixture and continue cooking until the meat is just done.
Remove the chicken from the heat and transfer it to a plate.
Use a rubber spatula to scrape the remaining sauce over the chicken.
Cool, then cut on the diagonal into strips.

Basil Pesto Spread:
Stir all the ingredients together in a small mixing bowl.

To Assemble:
Lightly toast each wrap in a dry pan (optional).
Spread the wraps generously with the Basil Spread, then top with lettuce, pickled cucumber, cheese, and the cooked chicken strips.
Roll up tightly.
Cover and refrigerate.
Cut the wraps in half on the diagonal to pack in lunchboxes.

Pasta Salad with Summer Vegetables

Ina Paarman

A wholesome pasta salad with a creamy yoghurt and herb dressing. Perfect as a pre-prepped lunchbox meal, or as a weekend braai side.

Makes 6 lunchbox portions

You Will Need:

2 cups (500 ml) small pasta shells (or orechiette), uncooked

2 T (30 ml) olive or canola oil

350 g baby marrows, sliced on the diagonal

2 t (10 ml) Ina Paarman's Vegetable Spice

1 red pepper, chopped

2 spring onions, sliced with green tops

1 wheel feta cheese, crumbled

Dressing

½ cup (125 ml) Ina Paarman's Creamy Herb Dressing

½ cup (125 ml) plain full cream yoghurt

1 x sachet Ina Paarman's Zesty Lemon Flavour Bomb

Method:

Cook the pasta for about 7 - 9 minutes until al dente (follow the pack instructions).

Drain in a colander and rinse briefly under running water, then transfer to a large mixing bowl and set aside.

Whilst cooking the pasta, heat the oil in a large, wide pan and stir-fry the baby marrows over high heat.

Cook until lightly browned, then season with Vegetable Spice and remove from the heat.

Toss the fried baby marrows into the cooked pasta, along with the red peppers, spring onion, and feta.

Mix all the dressing ingredients together and add.

Stir to mix well.

Cover and refrigerate until ready to serve.

Serve cold or at room temperature in a lunchbox.

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