TRADE & INDUSTRIAL POLICY STRATEGIES

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Mogale Maleka and Tumelo Pule: Using hydroponics to enhance food security

OVERVIEW

Climate change will have drastic impacts on South Africa's economy and society and the need to adapt is urgent. As the country embarks on a just transition to a low-carbon, climate-resilient and environmentally-sustainable economy, an opportunity exists to develop domestic small, green businesses. This case study forms part of a broader initiative on small business development in South Africa's climate change space. It presents the journey and experience of Mogale Maleka and Tumelo Pule, two South African engineers active in the climate change adaptation space.

FROM ECLECTIC ENGINEERS TO FASTIDIOUS FARMERS

Mogale Maleka and Tumelo Pule met while studying mechanical engineering at the University of Johannesburg (UJ), and together developed the idea of using hydroponic technology to foster efficient farming solutions for fresh produce.

Despite the stigma associated with farming by young people, who gravitate towards professional careers, the team embraced hydroponic farming as a career path while in their 20s. Hydroponic technology complements their engineering skills and is a unique application through which they can harness the technical knowledge gained during their tertiary education.

Before entering the space commercially, the team researched the field heavily, seeking to understand current developments in hydroponic technology and the outlook for the market. With increased urbanisation, land access issues, and water security concerns, the pair felt passionate about being in the field and this formed the basis on which AB Farms was built.

AB Farms is a small agri-tech business aimed at developing hydroponic farming solutions and providing fresh produce. Venturing into this market segment is a tall order, given the competitiveness of established fresh produce value chains.

Originally, the team focused solely on hydroponic farming. In pursuing this, they soon realised that increasing the footprint of the technology would require tailoring planting solutions to local contexts. The firm then added a second stream of work focusing on research and development of hydroponic models for farming in South Africa.

AB Farms as a business is split into two: on the one hand, it develops and tests hydroponic models, and on the other hand, it practices hydroponic farming.

HARNESSING HYDROPONICS

Hydroponic farming is an innovative and high-tech approach to farming without the need for soil as a growing medium. Water is circulated among plants in this system and only the water that is either absorbed by plants or evaporates is replaced. The system is more water efficient than traditional irrigation. Without soil in hydroponic farming, soil-based costs, such as tilling, de-weeding and pesticides, are limited. This can result in lower than traditional operating costs and a healthier produce with limited or no pesticides. Hydroponic farming is ideal for growing fruit and vegetables with small root space, such as lettuce, kale, mint, tomato, pepper, cucumber and strawberries.

AB Farms's innovative approach to farming attracted the attention of the public sector

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soon after the firm was started. In January 2017, the state-funded Westonaria Agri-Park in Western Gauteng was addressing issues with hydroponic vertical farming in the park. The park's managers wished to optimise the existing system for greater efficiency, as the park recurrently dealt with power and water cuts, with substantial negative impact on crop productivity.

AB Farms was selected as the ideal candidates to assist and has been working with the Agri-Park since late 2017 to make its systems more efficient. The Agri-Park then became the home of AB Farms, providing the business with some access to financing, as well access to farming land, discounted rent and common cleaning and security staff. Using a business incubation approach, the Agri-Park pools small-scale farmers and provides infrastructure for the farmers to undertake their agricultural activities as well as co-learn from each other.

As the result of challenges with the Agri-Park hydroponic system originally installed, the entrepreneurs had to adapt that system to suit the local context, so as to enhance its operability and economic viability. In developed countries, water pumps, for example, run continuously thanks to affordable and reliable electricity. This allows the ongoing mixing of nutrients and fertilisers, which is good for the plants. In South Africa, however, power cuts jeopardise the system. Due to such disruptions, plants end up not receiving adequate nutrients and water as the electrical pumps will not be running. This significant impairs crop growth and productivity.

Such negative impacts can be mitigated by employing other improvised solutions, like using generators to drive the pumps, which is costly and drives up operational costs. Hydroponic designs from international suppliers also tend to be high-tech and highly costly, which increases the costs of a business. In the local market, the extent to which these costs can be passed on to consumers is limited.

AB Farms is also developing a vertical bucket system that allows the plant to have access to a mineral solution continuously even though the irrigating system may be off due to power shortages, pump failure or any other reason.

The design essentially allows for plants to be irrigated periodically, as opposed to continuously, thus reducing the amount of energy required per kilogram produced. In addition, the design allows the mineral solution to flow through it in such a manner that allows for the natural aeration of the mineral solution.

WHAT IS HYDROPONICS?

Hydroponics is a method of growing plants without soil by using nutrient solutions in a water solvent. Roots can exclusively be exposed to the solution, or can be supported in a medium like perlite or gravel. Hydroponic farming allows for the maximisation of yields with minimal space and water requirements.

TILLING THE SOIL: CHALLENGES AND SUCCESS

The AB Farms journey so far has not been without its challenges and the duo has had a steep learning curve in developing the business. Despite these challenges, the business has stayed resilient and adapted.

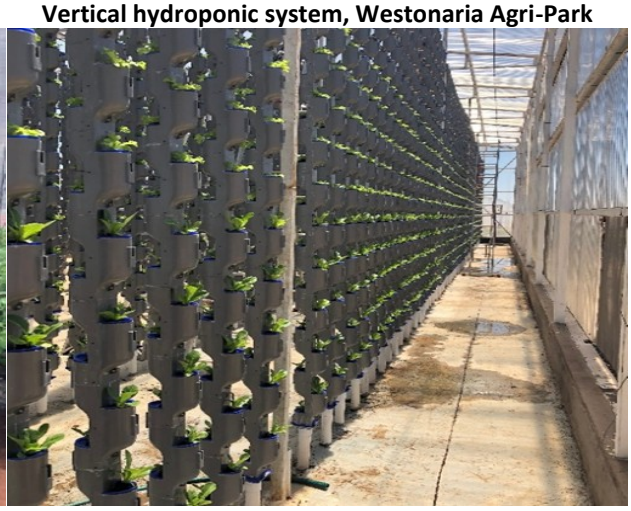
Having the right customer mix is vital for a business in ensuring adequate demand for its products. However, new and small businesses face difficulties in breaking into established value chains. Securing a supply contract for a small business is a milestone which helps it cement its place in the marketplace and expand. In the case of a small business bringing a new technology to the market, such a milestone also helps the technology gain a foothold in the market, assisting in technology diffusion. AB Farms initially began supplying fresh produce to the Johannesburg Fresh Produce Market through intermediary agents. This was an easy channel to get into initially. However, this supply channel was fraught with difficulty as products were sold on a consignment basis and AB Farms was paid only when produce was sold. Revenues were erratic and uncertain, threatening the business cash flows.

The business is moving away from the fresh market model to established and fixed supply contracts with private clients, large retailers, and other large consumers, such as hotels and restaurants.

Such private clients provide the advantage of better payment terms as well as certain and consistent revenue streams. While the firm is making strides by engaging with established packhouses, major retailers are still difficult to reach. Large consumers tend to contract with established and large farmers due to scale and quality requisites, squeezing out smaller players who are unable to meet these requirements. Entering the value chain is hard but necessary for a small business to grow and for the technology to proliferate. It is difficult for smaller players to produce at the scale that is required by large retailers, hence larger farms are much better positioned to supply these customers. Due to scale reasons, the larger

Vertical bucket system with the A-frame

Vertical hydroponic system, Westonaria Agri-Park



Source: AB Farms

farms can also sell their produce for a lower unit cost than smaller farms, allowing retailers to pass on these savings to their consumers or ensure higher margins.

Furthermore, large retailers are increasingly placing stringent quality and sustainability criteria in their procurement policies, requiring suppliers to engage in specific investments in their operations. For a small business to engage in such investments early on is difficult, due to financial resources being constrained. This leads to a chicken-and-egg scenario in which small businesses do not have sufficient resources to undertake these investments to access customers, but cannot accumulate the resources without large supply contracts.

Smaller farmers view the fresh produce market as a dichotomy – small farmers tend to supply to the fringes of the market, while the larger commercial farms provide the bulk to the established value chains. If lucky, a small farmer may obtain a contract to supply a given branch of a large retailer, e.g. a single Spar store.

Most small businesses face financial resource constraints. One of the biggest barriers is finance to acquire the necessary tools and machinery for their farming operations. This also applies to the lack of finance to develop a mould as well as the overall manufacturing of their innovative hydroponic system. The business is open to contracting a commercial loan from a bank but the lack of collateral is a problem. In addition, the interest rate to reflect this risk is prohibitive.

AB Farms has experienced success with accessing support from the National Tooling Initiative Programme (NTIP), which has also been a vital source of technological knowledge and manufacturing expertise. The UJ Process, Energy & Environment Technology Station (UJ PEETS) has also been an important source of funding to develop the prototype hydroponic model. The company still has to secure the funding to develop the tooling equipment. The Water Research Commission is also working with the business to improve the design of the prototype.

To start developing revenue streams, the business has initiated farming activity, such that loans taken may be paid back. AB Farms has yet to approach other funding institutions for finance and is developing a plan for this.

Entrepreneurs typically start off with a basic knowledge and have to rapidly learn new skills to expand their business. Mogale and Tumelo had deep technical expertise in engineering but were not farmers or manufacturers. Mentorship from a number of sources was important for the business, which met its first mentor by chance, when it was attempting to acquire farming land and the team spent a number of months with this mentor learning the appropriate farming practices.

The Agri-Park model also provides skills transfer through access to training and skilled farm managers. Having a farm manager to leverage off has assisted AB Farms to plant its crop cycles properly, increase yields and benefit from advice on pest control. The NTIP has also been an invaluable source of technological knowledge and manufacturing expertise.

Gaining access to intellectual property rights has also been difficult. Patents are expensive and funders generally want entrepreneurs to own patents to fund their innovation. Entrepreneurs often have to settle for a design patent, such that the product can be produced exclusively for a short period but eventually have to pay a substantial amount for full rights. AB Farms feels there should be supporting capacity or institutions to assist entrepreneurs to deal with patent issues and find ways to bring costs down.

HARVESTING THE CROPS: THE WAY FORWARD

Ever-optimistic, AB Farms is innovative and adaptive, having clear goals to grow and increase the footprint of sustainable farming. The first year of operation did not yield a profit and AB Farms expect that another year will be required to attend to technical optimisation before becoming profitable. Once it introduces its innovative, energy-efficient prototype bucket design at the farm, AB Farms plans to experiment with solar-powered pumps. Furthermore, the design can be optimised by incorporating natural fertiliser dosage control that releases only the necessary amount of fertiliser to plants. AB Farms also sees the hydroponic technology being combined with other sustainable production methods, such as organic fertilisers derived from fish farming (aquaponics). While organic fertiliser is a small market in South Africa, it is set grow substantially in future.

Funding institutions, such as the Department of Trade and Industry (the dti), the Industrial Development Corporation (IDC) and the Technology Innovation Agency (TIA), are perceived by the business as having a responsibility in specifically tailoring seed funding for entrepreneurs. AB Farms feels that it is important for there to be a structured funding and growth programme for entrepreneurs in general, and green economy businesses in particular. A structured pipeline or timeline by funders would see the business being guided through each stage of growth until it reaches a stage where it is completely self-sufficient. Having this pipeline would provide certainty to a business and make entrepreneurship and green economy businesses more attractive to the youth. This incentive will allow the country to harness the job creation potential from entrepreneurship along with environmental and food security.

Funders are also encouraged by the business to develop specialised expertise to evaluate innovative and green businesses, which take into account factors beyond just business plans and financial projections. The experience of AB Farms is that greater technical expertise on the part of funders would bridge the information asymmetry between the funders and entrepreneurs and foster a funding pipeline for green businesses. On the farming end, the business aims to break into established value chains by taking advantage of the space savings hydroponic farming provides. A large farming operation requires more than 10 hectares, but hydroponics combined with vertical farming can produce as much as 50 hectares worth of produce on a five-hectare plot, representing a disruptive game-changer in the industry. The scaling up of the farming activity will happen initially through the Agri-Park but the business wishes in time to secure its own land for larger operations.

Greenhouses at the Westonaria Agri-Park, Gauteng

Source: AB Farms

As part of technology diffusion, AB Farms aims to expand its business by providing training to farmers on hydroponic techniques. A franchise option is also being considered for novice farmers, in which a complete package would provide the technology, knowledge and mentoring to become a hydroponic farmer. Solutions will have a degree of flexibility and be tailored to the consumer. Ultimately, the business wishes to develop the technology and manufacturing side, once a mould is developed. An existing plastic manufacturer will be used to produce the hydroponic units and AB Farms has already sourced a distributor who is keen market the product. AB Farms is also interested in scaling up production for newer target markets such as hobbyists and office parks.

MAKING CONTACT

AB Farms is set to revolutionise the agricultural sector in South Africa, while placing waters security, energy efficiency and food security as paramount objectives. To help Mogale and Tumelo grow and develop their innovations – and revolutionise South Africa's agricultural space, get in touch with them at:

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This case study forms part of a broader initiative by TIPS with support and funding from the Government of Flanders. It is complemented by a main report, *Small Business Development in the Climate Change Adaptation Space in South Africa*, which summarises the research findings on the topic, as well as five other case studies on South African-based entrepreneurs active in the adaptation space. These are available on the TIPS website at www.tips.org.za.