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The business case for vertical farming in South Africa

Madima, Andani Eric

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The Business Case for Vertical Farming in South Africa

Andani Madima

462772

1.1.1 A business venture proposal submitted to the Faculty of Commerce, Law and Management, University of the Witwatersrand, in partial fulfilment of the requirements for the degree of Master of Business Administration

Johannesburg, [2018]

2 DECLARATION

I, Andani Eric Madima, declare that this business venture proposal project is my own work except as indicated in the references and acknowledgements. It is submitted in partial fulfilment of the requirements for the degree of Master of Business Administration in the Graduate School of Business Administration, University of the Witwatersrand, Johannesburg. It has not been submitted before for any degree or examination in this or any other university.



Andani Eric Madima

Signed at ……Sandton……

On the …22…… day of …February ····· 2019.

3 ACKNOWLEDGEMENTS

Foremost, I would like to thank my family and friends for the support and patience throughout my MBA journey.

I would also like to express my sincere gratitude to my supervisor, Mr Thabang Tsie, for his knowledge and guidance through this project.

4 SUPPLEMENTARY INFORMATION

Supervisor:	Mr Thabang Tsie
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5 EXECUTIVE SUMMARY

Food security means that there is a sufficient supply of and access to safe and nutritious food. As the population continues to grow, arable land diminishes due to soil erosion and degradation, and fuel prices rise, food security is threatened.

It is critical now more than ever that a new system of food production be developed if we are to sustain and improve our way of living and ensure that food security reduces vulnerability to famine. The vertical farming (VF) concept is one way to achieve this, and it is about maximising plant density to allow people in urban environments to access healthy, fresh produce all year round, that is free from harmful chemicals like herbicides and pesticides, and protected from bacteria like E. coli., listeria, and salmonella. Furthermore, VF produces up to 100 times more produce, uses 70-95% less water, and has cheaper operational costs than conventional farming methods.

Elysium (Pty) Ltd is a company that plans to revolutionise the way food is produced by bringing the farms directly to the consumer in the form of innovative buildings, called eHouses. The first eHouse will be established in Cape Town due to its high GDP per capita, the ensuing water crisis, and the extensive distances (as much as 1800km) travelled by producers to reach consumers.

A 2,560 m² warehouse has been selected to house production, where a controlled-environment agriculture (CEA) technology from the United States will be used to facilitate the production of microgreens, cucumbers, tomatoes, and lettuce. The CEA technology promises to produce up to 1200x the yield obtained from conventional farming methods.

The produce will be distributed through chain stores, the Cape Town Fresh Produce Market, and deliveries made directly to customers, through a 70%, 20%, 10% split, respectively. The chosen target market is persons of Social Economic Measure (SEM) 8-10 due to the numerous added benefits Elysium’s produce provides over competitors.

A total capital investment of R46.7m is required, with a Net Present Value (NPV) of R19.83m over a 10-year period. The break-even point is 5 years, with an Internal Rate of Return (IRR) of 28%, which is well above the Weighted Average Cost of Capital (WACC) of 12.29%.

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7 ABBREVIATIONS

CAGR	Compound Annual Growth Rate
CEA	Controlled-Environment Agriculture
CEO	Chief Executive Officer
EGGS	Environmental Green Growth System
GDP	Gross Domestic Product
GMO	Genetically Modified Organism
HID	High-Intensity Discharge
IRR	Internal Rate of Return
LED	Light Emitting Diode
LSM	Living Standards Measure
NPV	Net Present Value
PESTEL	Political, Environmental, Social Technological, Economical, and Legal
PHA	Philippi Horticultural Area
QC	Quality Control
R&D	Research and design
SA	South Africa
SEM	Socio-Economic Measure
VAT	Value Added Tax
VF	Vertical Farming
WACC	Weighted Average Cost of Capital
WTP	Willingness To Pay

8 DEFINITIONS

Soil degradation	The decline in soil condition caused by its improper use or poor management (The Government of North South Wales, 2017)
Soil erosion	The wearing-away of topsoil
Topsoil	The most fertile part of the soil which is only 5 to 8 centimetres thick (Parigiani & Spooner, 2015)
Arable land	Used or suitable for growing crops

1. INTRODUCTION

Food security means that there is a sufficient supply of and access to safe and nutritious food. As the population continues to grow, arable land diminishes due to soil erosion and degradation, and fuel prices rise, food security is being threatened.

According to The United Nations, the global population will grow to 9 billion people by 2050, and 70 percent will live in urban areas (Al-Chalabi, 2015). This means that food must be transported over long distances and is hence spoilt or only has 20 to 30% of its nutritional value remaining by the time it reaches the consumer (Hoppe, 2016). This further means that food prices are affected by rising transportation costs. The poor are most affected by price hikes as they generally spend more than 50% of their budget on food (Kroll, Carpenter, & Wyman, 2010).

Soil is a crucial resource because it sustains all our agricultural and livestock food production. In the last 150 years alone, 50% of the world's topsoil has been lost due to soil erosion and degradation, and an estimated 60 years of topsoil is left in the world. The biggest contributor to soil erosion is surface water runoff. Soil erosion, in general, is hard to reverse because it takes at least 500 years to form only 2.5cm of soil. In Africa, 65% of arable land is already damaged and in South Africa (SA), 40% of all cropland is affected by soil degradation (Parigiani & Spooner, 2015). This is alarming since only 12% of land in SA is fertile for crop production (Goldblatt, n.d). Figure 1 below shows the contributors of soil degradation in Africa.

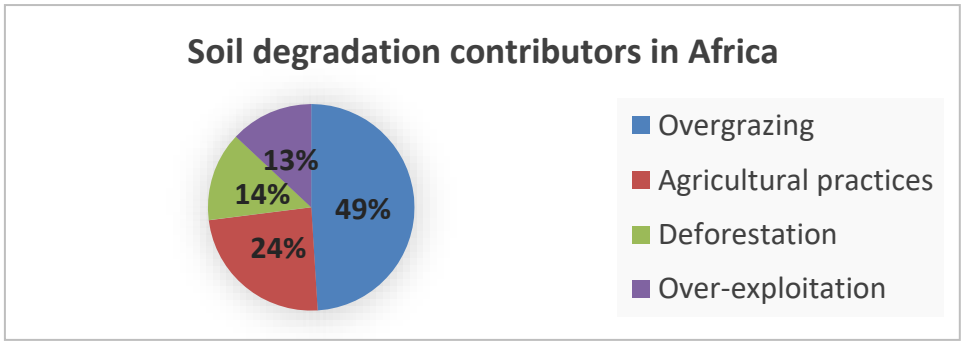

Figure 1: Soil degradation contributors

Source: (International Soil Reference and Information Centre, n.d.)

Most of the food products in the stores these days are genetically modified, doused in chemicals and are either dead by the time they arrive at the consumer or there are few to no nutrients left when consumed (Hoppe, 2016). Consumers are becoming more aware of this trend resulting in a strong shift around the world towards being more health-conscious. They are even willing to pay a premium for products which are prepared in a healthier way.

According to the 2015 Logistics Barometer conducted for the past decade by Stellenbosch University's department of logistics, of the nearly 80 million tons of agricultural goods transported within SA in 2014, the average travelling distance was 420km (domestic goods), 538km (exported) and 583km (imported) (Uys, 2015). In the United States, food travels 2,400 km on average from farm to consumer (Al-Kodmany, 2018). By contrast, locally sourced food travels an average of just 72 km (DeWeerdt, 2018)

With all the issues mentioned above, it is critical now more than ever that a new system of food production be developed if we are to sustain and improve our way of living and ensure that food security addresses people's vulnerability to famine. An increasingly popular solution that has recently emerged, is to take food production from the rural farm areas directly to the consumer in urban areas, thus minimising food transportation and storage costs. This solution is termed VF.

1.1 THE CONCEPT OF VERTICAL FARMING

VF is a way of producing food in vertically stacked layers (trays or racks) which uses CEA technology, thus taking up very little ground area. These high-tech farms are built inside buildings in urban areas and grow vegetables either hydroponically or aeroponically. These are both soilless methods of growing plants using mineral nutrient solutions either in water (hydroponics) or in an air/mist environment (aeroponics) (Hoppe, 2016).

The VF concept is about maximising plant density to allow people in urban environments to access healthy, fresh produce all year round that are free from harmful chemicals like herbicides and pesticides (Hoppe, 2016). VF is not meant to replace the current agricultural system, but rather to supplement it.

Some of the advantages and limitations of VF are listed below.

1.1.1 Advantages

- VF can produce up to 100 times the volume of conventional farming (Sarkar & Majumder, 2015);
- VF uses between 70 - 95% less water than used in conventional farming (Sarkar & Majumder, 2015);
- VF does not use herbicides or pesticides as growing takes place in a closed environment;
- The purchasing and operational costs of the hydroponic systems are much cheaper than the heavy machinery used in conventional farming making food production cheap and food easily affordable. In some cases, profitability of over 30% has been demonstrated even after deducting full amortisation of capital equipment over a 10-year period (Sarkar & Majumder, 2015);
- While human and animal waste can contaminate crops grown on conventional farms, food grown in indoor farms can be monitored constantly and kept protected from bacteria like E. coli, listeria, and salmonella;
- There is less spoilage as produce is not stored and transported over long distances;
- VF eliminates the dependency on fossil fuels as transportation and heavy machinery for ploughing, planting and harvesting are made obsolete;
- VF can be built in any environment, including the desert. This makes it possible to implement VF in poverty-ridden areas with minimal resources;
- VF is able to produce crops all year round as food production is independent of weather conditions. Therefore, crops can be grown out-of-season;
- VF provides for protection of crops from disasters such as droughts, floods, wildfires, hailstorms; and
- VF is relatively immune to the effects of global climate change.

1.1.2 Limitations

- VF is not practical nor suitable for growing commodity crops like corn and fruit-bearing trees in a building. It is more suitable for growing microgreens and leafy greens (Hoppe, 2016);
- Leafy greens require less light energy. Growing fleshy fruits like tomatoes, potatoes and especially grains like wheat or corn require a lot more light-energy and it would not be feasible to grow these indoors (Hoppe, 2016). However, there are some the existing VF projects where these crops are being successfully grown using CEA technology;
- VF requires substantial start-up capital for infrastructure, equipment and operations;
- Heating, cooling and lighting costs can erode profit margins below those of traditional outdoor farming (Hervey, 2016); and
- The crops VF is best suited for, such as arugula and chives, are a small portion of the average family's grocery list (Hervey, 2016);

1.2 Elysium (Pty) Ltd

Elysium (Pty) Ltd is a company that plans to revolutionise the way we produce our food by bringing the farms directly to the consumer in the form of innovative buildings, called eHouses. Each eHouse will be part of a network of other eHouses which will be strategically placed in urban regions to provide an abundance of food thus sustaining the entire population within that region. To achieve these goals, the principle of VF will be employed within each eHouse, which creates an artificial environment highly suited for the optimum growth of plants and vegetation.

2. LITERATURE REVIEW

This section looks at the VF market in terms of size and industry forecasts of growth of the market in the near future, followed by practical examples of VF companies and projects which are currently running around the world, and the key outcomes or learnings which can be taken from such projects.

2.1 GLOBAL VERTICAL FARMING MARKET

The global VF market is expected to reach US$3.88 billion by 2020, at a compounded annual growth rate (CAGR) of 30.7% between 2015 and 2020 (ReportsnReports, 2016). It is said that this will surpass US$13 billion by 2024 (Globe Newswire, 2017). This includes everything from equipment to technology.

In terms of mechanisms, hydroponics will continue to be the dominant technology by 2024; however, aeroponics is set to see rapid growth due to lower water usage compared to hydroponics. In terms of applications, warehouses, shipping containers and parking areas will account for more than 70% share of the market by 2024 due to their smaller footprint and ease of integration into existing infrastructure. In terms of product, leafy greens such as lettuce and other herbs dominate the indoor production market and will continue to do so. Tilapia fish dominates the aquatic species segment of the market, and raising crab and fish in vertically stacked layers is becoming more popular (Globe Newswire, 2017).

2.2 EXISTING PROJECTS AND KEY OUTCOMES

The idea is not to “reinvent the wheel” but rather to learn from existing initiatives and research on VF, with the goal of adapting them to the South African environment. Substantial amounts of money have already been invested in Research and Design (R&D), and this approach will save costs in this respect. There are a number of parties around the world which are commercially growing produce using VF. In this section, these initiatives are looked at (summarised in Table 1), with a focus on the key outcomes which can be utilised in the development of this business venture.

Table 1 Summary of major VF projects globally

	Growing method	Product	Area (sq-m)	Annual Yield (t)
CAN-SA	Aquaponics	Lettuce (possibly strawberries, broccoli)	800	130
Aerofarms	Aeroponics	Kale, arugula and other microgreens	6,400 (6m high)	907
FarmedHere	Aquaponics	Basil and microgreens	8,400 (6m high)	453
Green Sense Farms	Hydroponics	Basil and microgreens	2,800 (7.6m high)	680
Spread	Hydroponics	lettuce	3,000	2,358
Mirai	Hydroponics	Lettuce	2,300	1,089
Vertical Harvest	Hydroponics	Tomatoes	1,300	45
Metropolis Farms	Hydroponics	Strawberries, carrots, tomatoes and peppers	1,300	907

2.2.1 South Africa

There are two important cases in SA with regards to VF. The first is Clean Air Nurseries SA (CAN-SA), which has designed and developed an advanced water-use system called EGGS (Environmental Green Growth System). The operation is shown in Figure 19 of APPENDIX A. This system utilises 2,000litres of water in a four-week production period to produce up to 600kg of lettuce. The standard commercial model is 8,600 sq-ft. in size and it is able to produce 130t annually (almost 27 times more than traditional farming). The purchase price is between R7 million and R8 million. The EGGS works optimally with leafy crops such as lettuce, but can also be adapted to work with strawberries and broccoli (Uys, 2016)

The second is a dissertation by a University of Pretoria architecture Masters student, Calayde Davey, who won the Next Generation award in the Africa Middle East Regional Holcim Awards 2011, for developing an architectural model for vertical hydroponic agriculture for Pretoria on the existing industrial heritage site of the Old Pretoria West Power Station. Some key differentiators of this design are that it capitalises on the existing infrastructure in the Power Station and innovatively

proposes the use of bamboo to form the majority of the structural skeleton and convert it to a multi-storey application (Earthworks, 2011).

2.2.2 Aerofarms (in New Jersey)

With investment capital of $30 million, AeroFarms converted an old steel mill in Newark into a commercial vertical farm (Hervey, 2016) with a footprint of 69,000 sq-ft. David Rosenberg, chief executive and co-founder of AeroFarms says, “On average, we’re growing in 16 days what otherwise takes 30 days in a field – using 95 percent less water, about 50 percent less fertilizers, zero pesticides, herbicides and fungicides.” They grow up to two million pounds of kale, arugula and other greens annually and plan on opening 25 more farms by the end of the decade (Scheer & Moss, 2015)

They are supplying local supermarkets and restaurants; and are looking to expand their technology to SA, having even hosted a conference in the country recently. The operation is shown in Figure 20 of APPENDIX A.

2.2.3 FarmedHere (in Chicago, Illinois)

FarmedHere has been growing lettuce, kale, basil, arugula, and mint in an old 20-ft. high, 90,000 sq-ft. warehouse since 2011. It plans to expand to 150,000 square feet by the end of the year, according to Trends Magazine (2016). They are producing basil and microgreens on the equivalent of 4 acres of traditionally farmed land using aquaponics (similar to hydroponics but the water used is rich in nutrients from 8,000 tilapia fish which live in nine 800-gallon tanks) (Kurzius, 2014). FarmedHere reuses 97 percent of its water and uses no herbicides or pesticides (Scheer & Moss, 2015). It distributes its organic vegetables to nearly 100 stores around Chicago (Kurzius, 2014). FarmedHere’s operation is shown in Figure 21 of Appendix A.

2.2.4 Green Sense Farms (off Lake Michigan, Indiana)

Green Sense grows microgreens and basil in a 30,000-sq-ft. warehouse using hydroponics, supplying them with nutrient-rich water and specialised light-emitting

diodes (LEDs) in 25 ft. high racks. They can harvest microgreens, baby greens, and lettuce every 12, 30, and 35 days, respectively. Conventional farmers can only get up to two rotations a season (Gray, 2015).

Green Sense Farms has signed a contract to build 20 vertical farms in China. Countries “with a short natural growing season, long distances between growers and customers, and where water and pollution inhibit production are the natural markets for such systems” (Gray, 2015, p. 34). Due to a shortage of skilled indoor growers, Green Sense will partner with the local Ivy Tech Community College in a new $3m, 21,000 sq-ft. vertical farm training centre (Gray, 2015).

According to FoodManufacturing.com (2016), lighting costs represent between one-quarter and one-third of all operational costs for vertical farmers. One promising approach is to replace fluorescent lights with blinking LEDs that emit short bursts of light that allow plants to absorb more photons in a shorter amount of time. EcoWatch.com notes that General Electric partnered with Mirai in developing LEDs that reduce power consumption by 40 percent and increase harvest yields by 50 percent (Trends Magazine, 2016).

2.2.5 Noteworthy Mentions

Spread (in Japan) grows 21,000 heads of lettuce per day at its 32,000 sq-ft. vertical farm and uses a small staff of human workers to plant and harvest the lettuce, which is sold in 2,000 Japanese supermarkets. (Trends Magazine, 2016)

Mirai (in Japan) is a 25,000-square-foot vertical farm called Mirai, in Tagajo, is producing 10,000 heads of lettuce daily. The yield per square foot is said to be 100 times more than traditional agricultural methods. (Trends Magazine, 2016)

Vertical Harvest (in Jackson Hole, Wyoming) has a three-story vertical farm with a footprint of 13,500 sq-ft. They hydroponically grow up to 100,000 pounds of tomatoes, herbs and greens annually.

Using its own designed lights, rainwater recapture and solar power system, Metropolis Farms (in Philadelphia), produces 2 million pounds of strawberries, carrots, tomatoes

and peppers in its 14000 sq-ft. vertical farm, without using any water or electricity from the grid. “Metropolis Farms’ technology is patented and plans to partner with people to offer its technology on a royalty basis, making the system available to everyone for under $1 million. The IRR is over 100 percent, so you will get your money back,” CEO, Griffin notes (Hoppe, 2016, p.9)

Urban Crops (in Belgium) has developed an automated and climate-controlled growing room in a standard 40 ft. shipping container. It is equipped with the company’s tailor-made fixtures, which is climate-controlled via an app. They are currently talking to retailers and restaurants about introducing these containers on to their sites.

3. EXTERNAL MARKET

This section looks at various industry and competitive factors, which are all outside of Elysium's control. However, by understanding these factors, we can react better to them.

3.1 INDUSTRY ANALYSIS

PESTEL analysis (Thompson & Martin, 2010) is a method of assessing a business's environment and its possible impact on the performance of a company. It is a fundamental tool for business strategy and planning. Table 2 shows the key considerations in the agricultural industry as well as the urban farming market.

Some key observations from the analysis are that:

- Importing and exporting may become uneconomical if the recent trade war (in the United States) escalates. This will negatively impact Elysium's business as the CEA technology will be imported from the USA. An alternative solution is to source the system locally. However, this will not have the same yield and overall effectiveness;
- The recent increase in Value Added Tax (VAT) will impact all SA citizens and reduce their disposable income. This will have an impact on people's willingness to purchase premium products. However, the effects will be less severe on the higher Social Economic Measure (SEM) groups as they are not as price-sensitive. The SEM, also previously known as Living Standards Measure (LSM), is a marketing and research tool used to classify standard of living and disposable income of the population in SA (Truter, 2007). It divides the population into 10 SEM groups, with SEM 8-10 group, who earn the most money, consume the most media and enjoy the best standard of living.;
- The combination of increased health-consciousness and the recent Listeriosis outbreak (in 2017) presents a significant opportunity for VF as the focus is on a non-harmful way of food production. Again, this point needs to be well communicated to the consumer in order to drive adoption;

- The emergence of new technology is also a good opportunity for VF as it is at the centre of these advances. It is important to note that more and more technologies are being developed, and due to the high investment required, switching or catching up with trends becomes difficult. However, there are other advancements, such as growing techniques which need to be followed closely and can be easily incorporated into the existing make-up of the company;
- With the recent Listeriosis outbreak, stricter laws might be introduced to prevent similar occurrences, and this will need to be monitored closely in order to adhere to any of the changes; and
- The environmental factors present an opportunity for VFs as they overcome all of these challenges by using a growing method that uses as little as 5% of the water used by conventional farming, utilising solar energy to power the entire food production chain, and localising food production. Consequently, transportation and the associated costs are significantly reduced.

Table 2 PESTEL analysis

Category	Political	Economic	Social	Technological	Legal	Environment
Possible factors	• Recent trade tariff war activity in the USA.	• Recent VAT increase. • Strengthening of the Rand.	• Shift. towards health consciousness and the way food is produced • Recent Listeriosis outbreak	• Emergence of innovative technologies affecting the production • Automation of processes and artificial intelligence.	• FCD Act, 1972 standards. • Stricter laws might be implemented due to recent Listeriosis outbreak.	• Recent water crisis in Cape Town resulting in restrictions on water usage. • Recent drought experienced in SA • Load shedding in SA (recently stabilized) • CO2 emission restrictions and fines
Business impact	• Possible trade barriers to protect domestic suppliers	• Producers' unit costs will increase. • Consumers will have less disposable income to spend. • Exporter profits will decrease	• Producers have to stop the use of harmful production chemicals and methods. These may be more costly.	• In order to remain competitive, have to closely watch and adapt to trends.	• Government approval must be obtained for the release of a product on the market.	• Negative impact on crop production • Reduce energy and water intensity of production
Timeframe	• 0-12 months	• 6-12 months (possibly longer)	• Ongoing	• Ongoing	• 6-12 months	• Ongoing
Type of impact	• Negative	• Negative	• Negative	• Positive	• Unknown	• Negative
Rate of impact	• Unchanged	• Stable	• Increasing	• Increasing	• Unchanged	• Increasing
Importance	• Important	• Important	• Average	• Important	• Important	• Critical

3.2 COMPETITIVE ENVIRONMENT

In order to correctly identify who Elysium's competitors are, it is important to first understand what Elysium's value proposition is and identify any players who are currently satisfying that need. The major value being offered is the non-toxic and energy/water-efficient manner in which the food is grown.

The most appropriate tool to analyse the competitive landscape is Porter's Five Forces. It describes five forces (rivalry, new entrants, substitutes, supplier power, and buyer power) that determine the competitive intensity and, therefore, the attractiveness of an industry (Porter, 1979).

3.2.1 Threat of Rivalry

According to the analysis, the threat of rivalry is considered **medium.**

Rivalry in Johannesburg is very strong, as there are a number of notable urban farmers, shown in Table 3 (excluding conventional farms).

Table 3 Rivals in Johannesburg

Jozi Food Farmer (CBD),	Urban Harvest (installs home gardens)
Urbangrown (Midrand),	Big City Farms (Midrand)
Urban Fresh (Alexandra)	Dew Crisp (Lanseria)
Ukuvuna Urban Farming (Midrand)	Rosaly farm
Siyakhana Garden (Kensington)	IT&C Tunnels (Gauteng)
Greenzone (Alberton)	

There are numerous online vegetable deliverers (but not growers) in Johannesburg, such as Farm Fresh Online, Freshly Grown, The Green Grocery, Ferreira Fresh, and Wensleydale. There is also a drive for rooftop and home gardens around the city which are increasing in popularity. The City of Johannesburg has been encouraging households receiving food parcels in deprived wards to establish their own food gardens, and since then more than 36,000 homestead gardens, 200 communal and one pilot rooftop garden have been established across the city (Madwantsi, 2016). Madwantsie (2016) states that the city is planning to roll out over 100 rooftop gardens and use abandoned spaces to grow produce for the city.

Rooftop and personal gardens are not as popular in the Western Cape. However, there are a number of suppliers of hydroponic systems and technology related to indoor farming. Western Cape is less competitive than Johannesburg, as shown in Table 4. However, these are either small-scale outdoor farms/gardens, conventional farms, or online grocers who source produce from other farmers. One key advantage they have is that most farms are relatively close to the urban population.

Considering all the rivals mentioned in Table 4, there is significant room for a large-scale VF which is completely independent of the natural environment and able to supply fresh, healthy, local produce effectively and reliably. A point of concern is the large number of fresh produce delivery companies (online grocers); however, the advantages of the Elysium production method can be leveraged to overcome this rivalry. This will come at a significant cost for marketing, conversion and a robust customer retention strategy.

Table 4: Urban Farmers in Western Cape

	Type	Strength	Weakness/Threat
• Green Guerillas	Animal and tunnel vegetable farming	• 35km from the city centre	• Heavily diversified food production • Conventional farm disadvantages
• Abalimi Bezekhaya	Conventional small-scale community farm	• Strong community development (training, supplies and support for urban poor) • 31km from the city centre	• Suspended deliveries due to drought impact on production
• Dew Crisp	Hydroponic and Conventional farming	• Reduction in risk by utilising both growing methods	• Conventional farm disadvantages • 81km from the city centre
• The Philippi Horticultural Area (PHA); and • Naturally Organic	Conventional farms of various vegetable types	• Aquifer provides water to the farmlands • 22.5km drive from the city centre • PHA supplies 80% of Cape Town's vegetables • Some farms are organic	• Threat of losing a third of land from Silica mining company and property developer • Conventional farm disadvantages.
• Rooftop gardens • Personal gardens • Rebel Earth Permaculture	Hydroponic, and conventional small-scale gardens	• In close proximity to the consumer	• Not isolated from the natural environment • Small-scale production • Requires physical input
• Polkdraai Farm, • Mooiberge Strawberry Farm, • Helderberg Farm, • Mountain Breeze Farm Stall	Strawberry picking farms	• 22.5km to 50km from City Centre	• Conventional farm disadvantages.
• Lankgele, and • Hoopenberg	Blueberry tunnel farms	• 35km from City Centre •	• Conventional farm disadvantages.

	Type	Strength	Weakness/Threat
• Haygrove Heaven	Raspberries and strawberry conventional farm	• Along the Garden route	• Hemel-en-Aarde Valley, near Hermanus 121km from the city centre • Conventional farm disadvantages.
• Think Organic • Wild Organic Foods • Oranjezicht City Farm • Dig It Fresh • Mother City Living • Harvest of Hope • Christiana's whole food • Ethical Co-op • Organic Zone • Organic by Nature • Just Box It	Online ordering and door-step delivery of a wide selection of vegetables	• Wide selection of vegetables (due to sourcing from various suppliers)	• Dependency on farmers (suppliers) • Operates like a grocery store, just online hence quality impacted

3.2.2 The Threat of New Entrants

The threat of new entrants is considered **low.**

One of the deterring factors to entry in the large-scale VF is that it requires substantial capital and operational costs. This is mainly due to:

- The high property cost of urban buildings compared to traditional farming land;
- The cost of the specialised CEA technology which is significantly more than the heavy machinery and simple irrigation systems required in conventional farming;
- There are provisions which are required to isolate, sterilise and control the growing environment; and
- The specialised labour workforce required to ensure that growing is done effectively and efficiently. This will require consistent training and assessment with regular consultation with experts and suppliers of the growing technology.

Another entry deterring factor is the fact that the equipment is sourced from the USA, and this produces yields which local systems are not able to offer.

3.2.3 Threat of Substitutes

The threat of substitute products is **high.**

Although Elysium's product offers many benefits which other products cannot, the success of Elysium's product is largely dependent on how much people value these benefits and how well these benefits are communicated. This leads to two key success factors for Elysium:

1. Marketing will play a major role in ensuring that the value proposition is clearly articulated and understood by the target consumer, to entice them to choose Elysium's product.
2. The product needs to meet customer expectations in terms of being tastier, fresher, and more reliable than other products. This will be done by:
    - Ensuring strict quality control measures are in place;
    - Conducting regular training for workers and obtaining regular feedback;

- Conducting proper maintenance, cleaning and inspections of equipment; and
- Regularly benchmarking Elysium's product against its competitors by performing quality, taste and other tests. (see measures discussed in section 6, on page 54)

3.2.4 Bargaining Power of Buyers

The bargaining power of buyers is **medium.**

In Section 4.3, it can be seen that Elysium's target market is made up of chain stores, fresh produce markets, and direct-to-consumer through deliveries. Table 5 below gives an overview of the bargaining power of each target market based on specific considerations.

Table 5 Summary of bargaining power of buyers

	Chain stores	Fresh Produce Markets	Direct-to-consumer
Cost of switching	High	Low	Low
Backward integration	Low	Low	Medium
Number of producers	Low	Low	Low
Price sensitivity	Medium	High	Low
Differentiation	Low	Low	Low
Purchasing volumes	High	High	Low
Substitutes	High	High	High
Reliance	High	Medium	Low

- Cost of switching – For direct-to-costumers and the fresh produce markets, the cost of switching from another product to Elysium's is low. Most purchasing happens on a once-off basis, and for those that are under subscription, there are generally no cancellation fees or penalties. The customers, however, who have paid for deliveries in advance will be difficult to convert within the subscription period. However, it will be important to understand these clients, make regular follow-ups, or offer them special deals. It will be equally important for us to ensure as far as possible that switching costs for Elysium's clients are high in order to

improve retention. This can only be done by having attractive subscription conditions and maximising product/service satisfaction.

Chain stores usually enter into year-long contracts with suppliers; therefore, switching is difficult or costly. In all likelihood, we would have to wait until contracts expire, but it is important that we engage the chain stores well in advance of this happening in order to build the relationship, effectively communicate Elysium's value proposition and negotiate favourable conditions.

- Backward integration – The direct consumer can easily backward integrate and begin to produce Elysium's product themselves (rooftop or home gardens). It is important that we are able to consistently produce a better product than they can through superior expertise, convenience, and continuously broadening Elysium's product variety. The chain stores and fresh produce markets are unlikely to backward integrate as this goes against their core business; however, considering the competitiveness of the retail market, they may start exploring backward integration to improve profitability. Chain stores have also been known to enter into empowerment partnerships with producers for skills development and enrichment purposes.

- Number of producers – Within Elysium's target (SEM 8-10) group, there are few buyers. However, there are also very few urban growers who offer the benefits that Elysium's product does.

- Price sensitivity – The buyer in the SEM 8-10 target is also less price-sensitive and values quality more. Fresh produce markets are relatively well-known for bargain hunting due to the wide range of consumers they serve. The premium chain stores which are being targeted value quality of the product but due to their size and brand strength, increasing profit margins is high on their priority list and requires as competitive a price as possible from their suppliers.

- Differentiation – The product is clearly differentiated in the benefits and value it has over its substitutes. As mentioned above, it is important that these benefits are well communicated and maintained.

- Purchasing volumes – Chain stores and fresh produce markets purchase in high volumes, while direct consumers purchase in low volumes. This gives the chain stores and fresh produce markets high bargaining power to negotiate prices and other favourable conditions.

- Substitutes – As discussed in the previous section, the threat of substitutes is high and hence bargaining power is also high.

- Reliance – The chain stores make up 70% of Elysium's sale volumes. This makes us greatly reliant on them and gives them high bargaining power to negotiate prices and other favourable conditions.

3.2.5 Bargaining Power of Suppliers

The bargaining power of suppliers is **medium.**

Table 6 below gives an overview of the bargaining power of each supplier based on specific considerations. Consumables are the nutrients, seeds and other supplies. The CEA technology refers to the physical equipment and technology used for food production.

Table 6 Summary of bargaining power of buyers

	Consumables	**CEA technology**
Cost of switching	Medium	High
Number of suppliers	Low	High
Differentiation	Low	High
Substitutes	Low	High
Reliance	High	High
Industry importance	Low	Low
Forward integration	Low	Medium

- Cost of switching – Consumables are generally made on a just-in-time basis as there is no shortage of supplies or suppliers. However, a contract would be beneficial in order to obtain favourable unit prices from the supplier. The CEA technology requires a large capital outlay and lifespan of over 10 years, hence once committed to a system it is difficult to switch to another system. However, if it

is possible to enter into a rental agreement of the system, this would reduce this risk.

- Number of suppliers – There are a number of suppliers of consumables. The type of CEA technology being utilised is very specialised (and has numerous patents) and offers highly competitive benefits compared to similar systems. Hence, the number of suppliers able to meet the same standards are few. This also makes the system highly differentiated, hard to substitute, and increases Elysium's reliance on it and the supplier for continuous support.

- Differentiation – Not much advancement has been achieved in the agricultural consumables space (relative to other areas). Therefore, the products are neither highly differentiated nor irreplaceable.

- Substitutes – For both suppliers, their products are an important part of Elysium's business and hence there is a high reliance on the suppliers.

- Reliance and Industry Importance – For both suppliers, the agricultural industry forms a major part of their business and is thus very important. This reduces their bargaining power as there is a limited number of producers they can sell to.

- Forward integration – Due to the high capital cost of our business, forward integration is not easy for the consumable suppliers. It is, however, easier for the system suppliers as they own the intellectual property and have the production expertise. This risk is reduced due to the fact that they have invested considerable resources (in terms of time, in fact, several years) in developing the system to its current level, and this has resulted in a system sales-driven business model through third-party producers.

4. BUSINESS MODEL

In this section, the marketing mix (Isoraite, 2016) tool is used to describe the combination of factors that we can control in order to influence consumers to purchase Elysium's products. All the factors considered form the basis for determining the target market of the product.

4.1 PRODUCT

Due to the CEA technology utilised in the eHouse, some of the key features of the produce is that it is:

- Healthier, due to it not using herbicides, pesticides or other harmful fertilisers or chemicals as growing is performed in a closed environment. It is also protected from bacteria like E. coli. E. coli, listeria, and salmonella, whereas conventional farming is prone to contamination from human and animal waste.

- Fresher and better tasting, because produce is not stored and travels a much shorter distance. Therefore, there is less spoilage and loss of flavour. After harvest, produce keeps breathing and burns carbohydrates for energy while losing water to the surrounding environment, thus losing some of its characteristic aroma, taste, texture and colour. Similarly, the water loss changes the mouthfeel and decreases the crispiness (Banerjee, 2014). It is estimated that, by the time food gets to the consumer, it only has 20 to 30 percent of its nutritional value remaining (Hoppe, 2016).

- Readily available, because the food is independent of weather conditions, it can be produced all year round, and consumers can, therefore, enjoy fresh, healthy, great-tasting produce even out-of-season.

- Predictable price, because crops are protected from catastrophes such as droughts, floods, wildfires, hailstorms and supply is thus not compromised (which affects price).

- Locally grown, near the consumer engendering a sense of security and familiarity with the produce and the prices charged, and the fact that it is environmentally

friendly: it is completely solar-powered, and uses between 5% and 25% of water normally used in conventional farming.

- Quick and reliable, as growers can harvest and propagate within days whereas normal farming methods would take many weeks to produce a full-grown plant.

Premium quality in produce is directly related to the state of maturity or decomposition of the produce at consumption. Elysium's produce can thus be considered a premium quality product based on the features mentioned above. This forms part of the producer's brand and can be leveraged to drive demand.

According to Michael (2017), "consumers have lost trust in the conventional ways of growing food and labels like organic are a poor and increasingly confusing substitute for true transparent farmer-consumer relationship. This type of trust and transparency is only truly available with local options." (p. 1). Therefore, the product will not be purposefully produced in an organic way to obtain the organic certification.

4.1.1 Product (Crop) Decision Criteria

In order to determine the crop to be produced, a decision matrix was designed with 5 key criteria. This method was selected in order to mitigate the risk of making a decision based on a single factor, but rather to consider the combination of a number of key factors which influence the appropriateness of the crop in the South African context. The results are shown below in

Table 7, with microgreens, tomatoes, cucumbers and lettuce coming out on top. It is ideal to have a mix of multiple crops in order to minimise the risk of any single market being saturated.

Table 7 Product (crop) decision matrix

Options	Perishability	VF popularity	Yield	Input requirements	Market	Total
Lettuce	1	3	1.3	1.3	0.2	6.9
Microgreens	3	3	3	3	-	12.0
Peppers	2	1	1.4	1.6	0.5	6.5
Legumes	2	1	0.3	1.8	1.1	6.1
Cucumbers	2	1	2.2	2	0.2	7.3
Beets	2	1	0.2	1.8	0.3	5.2
Tomatoes	2	2	1.5	1.5	3.0	10.1
Strawberry	2	2	0.3	2	0.5	6.8
Carrots	2	1	0.3	1.8	0.5	5.6
Cabbage	1	1	0.3	1.8	0.4	4.5

Below is the logic for each rating in

Table 7.

Criteria 1: Perishability – This is the food's likeliness to decay or die, and speaks to the food's shelf life. High perishability means the food has a limited shelf as it decays faster. The maximum storage time after harvest at optimal conditions for leafy greens (lettuce and cabbage) is 2 weeks; for strawberries, cucumbers, carrots, beets, tomatoes it is 1 week and for microgreens less than 1 week (Hedin, 2015).

According to Hedin (2015), the only way an urban farm can create a tangible value superior to that of a regional producer is when the good is highly perishable. Hence, we are seeking a crop which is highly perishable, and the higher the perishability, the higher the rating which is allocated.

Criteria 2: VF popularity – Because the idea is not to reinvent the wheel when it comes to VF but to learn from the local and global players to see what crops have been successfully produced using VF methods. Table 1 used as a basis for the allocation, with a rating of 1 given to crops which do not feature at all, 2 given to crops which feature less than 3 times, and 3 given to crops which feature 3 times and more.

Criterion 3: Yield – This criterion simply looks at the expected yield that can be expected from each crop relative to traditional farming methods (see Table 8). The average VF yield is used as an indicator of the potential yield of each crop. The rating is based on the fraction of each yield compared to the highest crop yield (in this case microgreens at 63kg/sq-m).

Table 8 Estimated annual crop yield by farming method

Options	Traditional Farm Yield (kg/sq-m)	Source 1 VF Yield (kg/sq-m)	Source 2 VF Yield (kg/sq-m)	Average VF Yield (kg/sq-m)
Lettuce	2.5	3.7	51.6	27.7
Microgreens	3.15	63	-	63
Peppers	3	13.3	46.9	30.1
Legumes	1.35	-	5.7	5.7
Cucumbers	3	30	60.4	45.2
Beets	1	-	3.3	3.3
Tomatoes	4.5	15.5	49.5	32.5
Strawberry	3	6.9	-	6.9
Carrots	3	5.8	-	5.8
Cabbage	5	6.7	-	6.7

Average	**2.9**	**9.1**	**24.2**	**28.4**
Reference	(Sarkar & Majumder, 2015)	(Sarkar & Majumder, 2015)	(Kurzius, 2014)	

Criteria 4: Market – Input requirements speak to the amount of energy and resources which would be required to grow the crop. Average values were used where a range was given from the source. The biggest cost in VF relative to other parameters is light intensity, and this was used as the determining factor. The rating is based on the fraction of each light intensity as compared to the lowest light intensity (in this case microgreens at 65Wm^2).

Table 9 Controlling parameters (Sarkar & Majumder, 2015)

Options	**Temperature (°C)**	**Relative humidity (%)**	**Light Intensity (Wm^2)**	**Ph**
Lettuce	21	72	150	7.8
Microgreens	21	50	65	6.25
Peppers	22	75	120	7
Legumes	20	70	-	6.25
Cucumbers	28	77.5	100	5.5
Beets	19	-	-	6.1
Tomatoes	21	67.5	127	5.8
Strawberry	28	60	100	5.25
Carrots	16	65	-	5.5
Cabbage	13	90	-	6.1
Average	**21.2**	**69.7**	**110.3**	**6.2**

Criterion 5: Market – This speaks to the lucrativeness of each crop market, and is based on both the segment size and the shortage within that segment (the quantity which is imported into SA). The rating is based on the fraction of each total market value compared to the highest crop total market value (in this case, tomatoes).

Table 10 South African Market information per crop

Options	**Market size (Million-Rand)**	**AAG (Million-Rand)**	**Market size (Million-Rand) (2018)**	**Import (Million-Rand)**
Lettuce	185 (2015)[1]	12[1]	222	0.134[1]
Microgreens		-		-
Peppers	450 (2016)[2]	-	450	-

[1] (Department of Agriculture, Forestry & Fisheries, 2016a)
[2] (Absa, 2017)

Legumes	850 (2015)[3]	58[3]	1025	0.067[3]
Cucumbers	120 (2011)[4]	9[4]	182	0[4]
Beets	190 (2015) [5]	14[5]	233	1.5[5]
Tomatoes	2,300 (2015)[6]	167[6]	2,800	11.1[6]
Strawberry	385 (2018)[7 8]	-	385	62[7 9]
Carrots	420 (2015)[10]	26[10]	498	1.9[10]
Cabbage	2,800 (2014)[11]	20[11]	360	0.670[11]

4.1.2 Crop Decision

Based on the decision matrix, the four crops which are best suited to the South African context are microgreens, tomatoes, cucumbers and lettuce. Despite the different temperatures required by the different crops for optimum growth, the CEA technology overcomes this as discussed in section 5.3.

4.2 PRICE

Porter's Generic Strategy is introduced here as it speaks to the different strategies a business can apply to achieve a competitive advantage over its competitors, namely, value differentiation or cost differentiation. Value differentiation increases the customers' willingness to pay (WTP), while cost differentiation increases the gross profit (Revenue – COGS) of the company (see Figure 2) (Chen, 2017).

In Elysium's case, a hybrid strategy is also possible due both to value (see the previous section) being added to the existing product offering, and the lower unit cost. In the latter, Sarkar and Majumder (2015) state that purchasing and operational costs of the hydroponic systems are much lower than the heavy machinery used in conventional farming and in some cases, have improved profitability by 30%.

[3] (Deparatment of Agriculture, Forestry & Fisheries, 2016b)
[4] (Department of Agriculture, Forestry & Fisheries, 2011)
[5] (Department of Agriculture, Forestry & Fisheries, 2016c)
[6] (Department of Agriculture, Forestry & Fisheries, 2016d)
[7] (J.P. Human, 2018)
[8] (Municipality, eThekwini, 2017)
[9] (ITC Trade Map, 2013)
[10] (Department of Agriculture, Forestry & Fisheries, 2016e)
[11] (Department of Agriculture, Forestry & Fisheries, 2015)

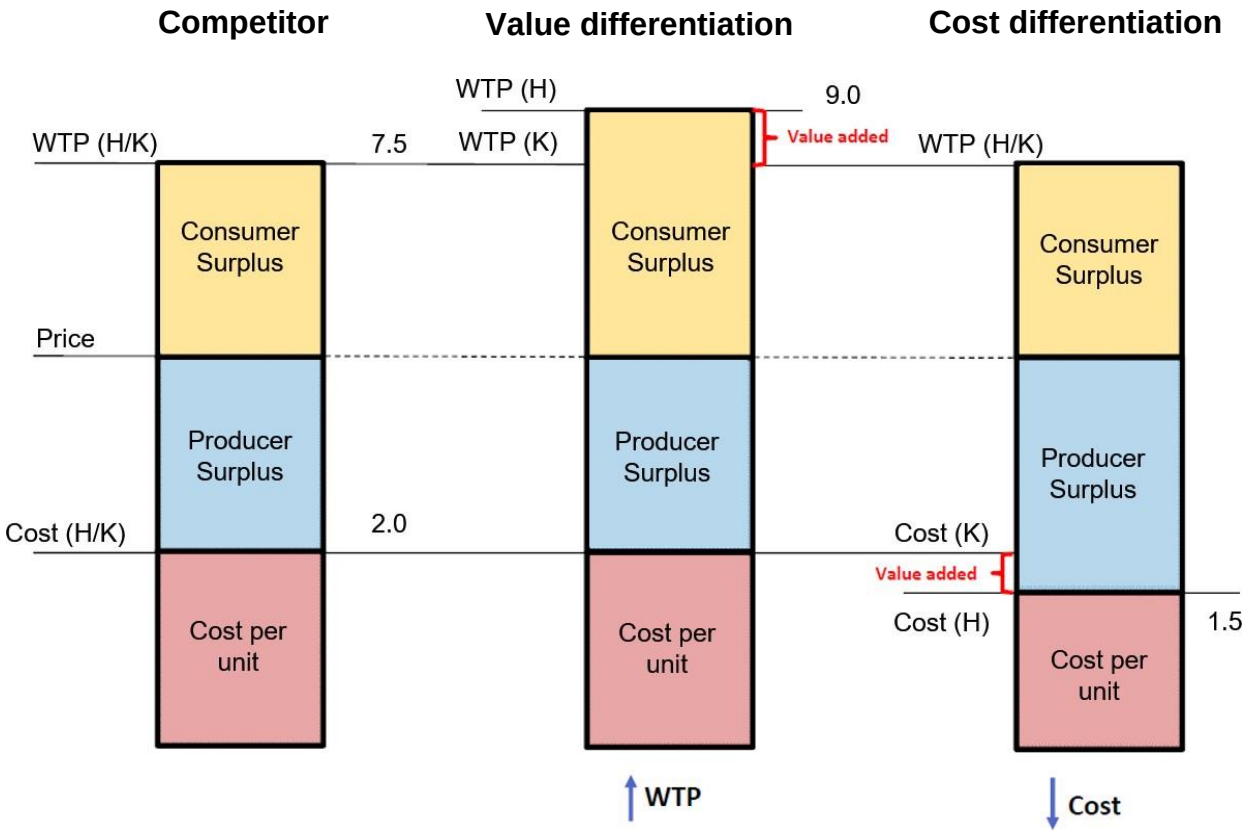

Figure 2 Strategies for gaining competitive advantage (Chen, 2017)

Consumers are becoming more health-conscious, and they are even willing to pay a premium for products which are prepared in a healthier way. According to Michael (2017), urban farmers need to avoid competing with conventional growers on price. He further states that today's consumers have even been shown to spend more for the increased benefits of quality, transparency, and peace of mind, and the product should be priced accordingly.

When the consumers' WTP increases based on added benefits, there are two ways of taking advantage of this:

1. Charging a higher price - this will achieve higher margins than competitors, but there is the risk of getting a smaller market share.
2. Charging a lower price – this has the opposite effect to that mentioned above.

According to Hedin (2015), large-scale urban farmers are dependent on their customer's willingness to pay for quality, and a good business model must be able to provide the customer with superior value, to capture this value for the innovator or

implementer and be hard to copy or imitate. We have thus chosen to charge a price which is higher than that charged by conventional farmers.

To efficiently penetrate the premium produce market, Elysium's produce will be priced equally to other premium producers (retailers), namely: Woolworths, Pick 'n Pay, and Food Lover's Market. The Woolworths' prices are shown below in Table 11. This is the pricing that will be used by Elysium.

Table 11 Woolworth's pricing for selected crops

Outlet	Basil (R/kg)	Baby Tomatoes (R/kg)	Mini Cucumbers (R/kg)	Lettuce (R/kg)
Woolworths	262.38[12]	58.32[13]	48.54[14]	51.69[15]

It is crucial to understand the recent shopping trends and behaviours with regard to price awareness. A study conducted shows that 88% of consumers feel that food prices are rising in SA, and in response to this, 44% said they now only buy essentials, the remainder either buy in bulk to get lower prices or buy less in total. Regardless of this, 73% still buy name brands because they trust them (Marklives, 2016). This shows that loyalty and trust play a major role in the grocery market.

4.3 PLACE

To determine how the product will be accessed by the customer, we need to first understand the existing agricultural value chain. **Error! Reference source not found.** below shows the agriculture value chain and the key players in the entire process.

[12] (Woolworths Food SA, 2018a)
[13] (Woolworths Food SA, 2018b)
[14] (Woolworths Food SA, 2018c)
[15] (Woolworths Food SA, 2018d)

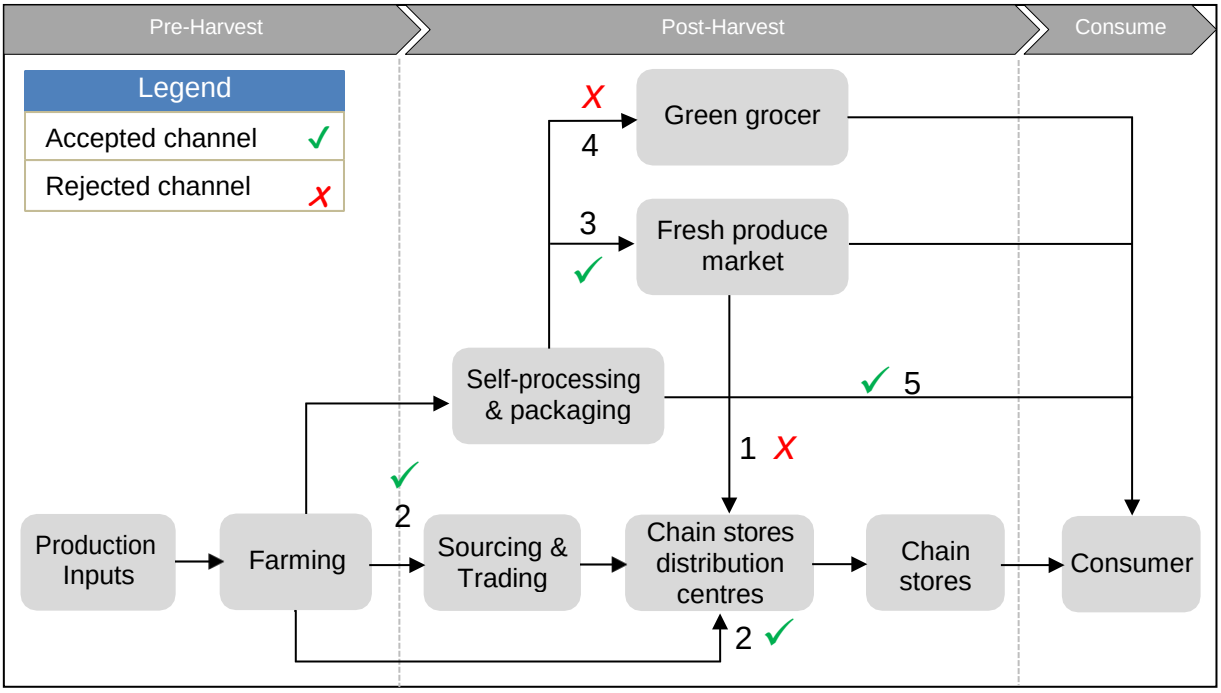

Figure 3 Agriculture value chain

There are channels presented in which a producer can reach the consumer:

1. Processing and/or packaging the produce ourselves and selling it to chain stores. Chain stores like Woolworths, Pick 'n Pay, and Food Lover's Market buy vegetables from a farmer with a proven ability to deliver fresh, high quality produce throughout the season and tend to negotiate contracts year. Some stores require that the produce is kept in a cold room on the farm and transported in a refrigerated truck. The farmer may also be required to pre-package and label his produce according to the store's specifications. (NAMC, 2016) Some stores are willing to collect the produce directly from the farmer.

   This channel is **rejected** as it will require substantial processing, packaging and marketing to drive sales. It is also prone to high levels of competition, and retailers themselves have their own products for which they want to drive sales.

2. Selling the produce to the chain stores either directly or through a trader. The chain store will generally have a distribution centre, where it processes and packages the produce (in its own branding) before distributing it to the various stores in that

vicinity. The chain store market is enormous as the majority of people purchase through this channel since it is conveniently located and easily accessible.

This channel is **selected** as it removes the burden of having to process, package, and market the product. And it removes the element of competing against the retailer's home brands. It leverages off the already existing capabilities of chain stores and allows Elysium to focus on its core competency – farming.

3. Processing and/or packaging the produce ourselves and selling it in any of the 16 national fresh produce markets countrywide. They serve retailers, shopkeepers, street traders, restaurateurs, housewives and exporters. The Cape Town Market connects over 5,500 producers to over 8,000 buyers across SA. These markets usually encourage farmers to use agents – people who sell produce on behalf of the farmer. Agents usually charge a 7.5% levy, and the Market charges a 5% commission. Produce is required to be packed in bags or crates (Cape Town Market, 2018).

   This channel is **selected**, although in small quantities due to its highly competitive nature. It is ideal as it is a single point of delivery and packaging is simple (crate or bag). Thus, it requires little effort. This channel will be good for selling high volumes quickly but will not be the main focus of the business.

4. Processing and/or packaging the produce ourselves and selling it to greengrocers. Greengrocers generally buy produce in bulk and add value by re-packing it into smaller bags. They may enter into contracts with farmers to supply specific produce.

   This channel is **rejected** as greengrocers are price-sensitive and would require direct delivery to their stores. This large effort would not be worth the expected returns. The greengrocers still have the option of purchasing Elysium's produce through the fresh market.

5. Processing and/or packaging the produce ourselves and selling it directly to the consumer. This can be done through online ordering (once-off or subscriptions)

and receiving a scheduled delivery which is picked fresh from the eHouse. This option requires targeted marketing in order to entice the consumer.

This channel is **selected** and will be pursued in small quantities, purely to explore the future potential of selling a self-packaged brand in chain stores. This will also allow us to build Elysium's reputation and obtain feedback from the customer, which can later be leveraged to sell Elysium's own brand in retail outlets. Consumers still mainly purchase fresh produce through the normal retail channel, as it conveniently stocks a larger variety of produce, which will not be available in Elysium's farm.

Based on the various channels available as described above, the three channels shown in Figure 4 have been selected. As mentioned above, the most lucrative and less demanding channel is supplying chain stores (retailers) via their distribution centres. In this way, the retailers process, package, and sell the produce as their own product. The chain stores usually enter into a fixed term contract, and thus sales are guaranteed within that period. This is, therefore, Elysium's primary channel and will make up 70% of volume sales.

Elysium's secondary channel is the fresh produce market, due to its simplicity. However, it will only make up 20% of Elysium's volume sales as it is more price-sensitive than retail, since people are looking to buy in bulk at a discounted price. It will also be difficult to track the destination of the produce and the brand thereof.

Elysium's tertiary channel is selling directly to consumers. As mentioned above, this makes up a small percentage of the volumes, as it is meant to serve mainly as a marketing tool to test and build the strength of the brand amongst customers.

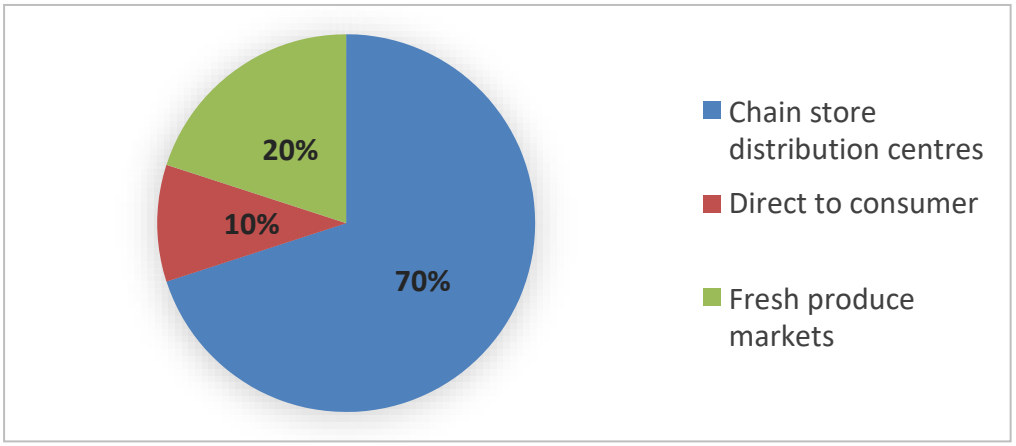

Figure 4 Elysium's Distribution Channels

As the first large-scale VF in SA, we will have the first-mover advantage, and this can initially be leveraged to obtain buy-in from chain stores. However, there is an inherent risk in relying on this channel for a prolonged period as competitors are tempted to and/or enter the market. In this case, the bargaining power of the chain stores increases.

The 10% direct-to-consumer strategy, acts as a contingency plan, as we can gauge the consumer's response to Elysium's self-packaged product. If the response is positive, this can later be leveraged to sell Elysium's own brand in chain stores and minimise the risk of being pushed aside by new entrants. It is important to continuously evaluate this strategy, as continuing with chain stores as Elysium's primary distribution channel may be the most effective strategy.

The motivation for the chain stores purchasing their produce from Elysium instead of other farmers is that it will be cheaper as it is local. Approximately 8% of the shelf costs of food in SA is from transportation alone (Sullivan, 2016). This cost is significantly reduced by localisation (up to 3.9% lower than the national average) and can be used as an advantage to negotiate a favourable deal with Elysium's target market.

4.3.1 City

Cape Town has been selected as the location for the eHouse for the reasons provided below.

Firstly, considering Elysium's target group SEM 8-10 (discussed in section 4.5), as shown in Figure 5 below, 42% of them lived in Gauteng, followed by Western Cape at 20.9%. This makes these two areas the most attractive for a VF.

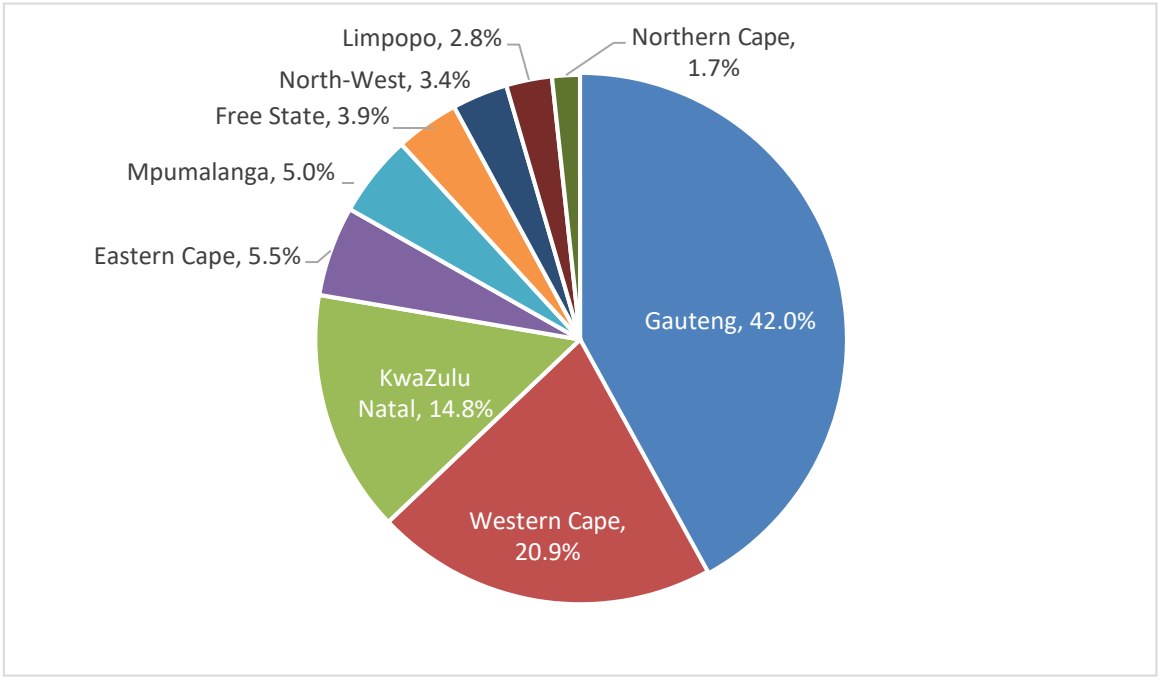

Figure 5 SEM 8-10 by province (Reid, 2018)

Secondly, although Cape Town does not have the largest GDP per capita in SA (second largest after Johannesburg), there are factors covered in the industry and competitor analysis (section 3) that make it attractive for the establishment of the VF.

And lastly, considering the produce selected, ZZ2, which is the largest tomato producer in the southern hemisphere, must transport its produce approximately 1,800km to Cape Town from its farms in Limpopo.

Elysium's warehouse (see section 5.2) is 21km from Pick 'n Pay's distribution centre, 8km from Woolworth's distribution centre, and 25km from Food Lover's Market Headquarters.

4.4 PROMOTION

4.4.1 The Branding

The Elysium brand communicates the key benefits of Elysium's product offering, namely: healthier, tastier, and trustworthy (local) produce. As shown in Figure 6 below, this is clearly articulated in the tagline and it is immediately clear what the Elysium brand stands for and values.



Figure 6 Elysium branding (Tailor Brands, 2018)

4.4.2 Building Brand Awareness

In order to build the awareness of the Elysium brand, we will ensure that it is visible to the public and the consumer. The method which will be utilised is branding the packaging within which the produce is sold to customers. This can be done on crates and paper bags (which are environmentally friendly), and will ensure that the customer is left with the image of Elysium as they receive their freshly delivered produce. The delivery vehicles will also be branded as this will expose the general public to the Elysium brand.



Figure 7 Branded packaging (Tailor Brands, 2018)

The second method is branding the employees' uniforms, both for client-facing and non-client-facing employees. The sales staff will be regularly interacting with clients and customers, and the uniform will immediately establish a professional business image that attracts and helps retain clients, as well as help brand and differentiate Elysium in the market.

Work uniforms promote a sense of team spirit and a sense of belonging, and help instil a sense of pride and responsibility and can convert employees into "brand ambassadors" outside of the actual workplace. This, in turn, can improve worker productivity.



Figure 8 Work uniforms (Tailor Brands, 2018)

4.4.3 Public Relations and Engagements

Elysium will be the first large-scale vertical farm in SA. The advanced nature of the technology utilised and the unique skill required to operate the eHouse is something that can be leveraged among the public. This, coupled with the benefits that eHouse brings with it, will be of keen interest to the media, particularly, news broadcasters, investigative journalism TV (e.g. Carte Blanche), and agricultural publications (e.g., Farmer's Weekly).

In addition to this, the eHouse can be used to promote social responsibility, by inviting the public to visit the farm and learn about the processes and technology used on the farm. Skills development is very important in SA, and trainee programmes will be in place to train and teach the general public about eHouse, which can then be passed on through the local community.

4.4.4 Online Media Presence

In today's rapid development in computing technology and increased internet usage, it is imperative to have a strong online presence to build and maintain a competitive advantage. In SA, 52% of the population utilises the internet, and 27% make use of social media (of which 87% do so through mobile) (Qwerty Digital, 2017). People love mobile apps, and it is estimated that 85% of all mobile usage is spent in mobile apps (Tech Crunch, 2015).

For these reasons, it is essential that Elysium has a strong digital presence via:

1. Website and Mobile application.

   People are moving away from web content consumption through laptops and desktops, which has seen a 16% drop between 2016 and 2017. E-commerce is also becoming increasingly popular as people become more confident in the security systems in place to ensure safe transactions. Almost 31% of SA's population make purchases via E-commerce totalling R27.6b (Qwerty Digital, 2017). For these reasons, Elysium will create a website and mobile application which is both desktop and mobile friendly.

- **A registration and log in feature** – This is good for information-gathering and data such as consumer demographics, preferences, location etc. The data can be used to better understand Elysium's target market, and identify possible new target markets;
- **Product pages** – Product information and benefits can be viewed. People can also get a virtual tour of the eHouse (via video), and learn about the technology and processes used in the eHouse. People can also request training or site-visits online;
- **Engagement** – Consumer feedback is key to the Elysium's success and this platform can be used to promote consumer engagement, harvest complaints and et ideas for possible product improvements;
- **E-commerce** – Consumers will be able to purchase produce online and have it delivered to their doorstep; and
- **Newsletter signup –** A monthly newsletter will be sent out with information regarding the status of production at the eHouse, and the eHouse market in general. This is done to drive awareness and interest and ensure that customers stay engaged with the product and the production mechanism.



Figure 9 Elysium Website and Mobile App (Tailor Brands, 2018)

2. Paid advertising and social media integration
    - To unleash the full potential of the online market, Elysium's website and app must be brought to the customer with successful online marketing. By fully

optimising strategies for organic and paid acquisition, we are sure to achieve streamlined source of steady conversions for Elysium's product;

- Paid installations are installations that are driven by active promotions, especially in an advertising campaign or through an incentivised network, where users are prompted to install an app in exchange for some virtual incentive. User acquisition feeds organic app installations. For every paid installation, apps get an average of 1.5 additional organic installations at minimum but this can go as high as 17x (Koetsier, 2017); and

- Social media is a power tool to reach consumers. Some 27% of the South African population uses social media (Qwerty Digital, 2017), and Figure 10 shows the platforms most widely used. This platform will be utilised, by order of popularity, to drive awareness about the brand through various content such as general posts, blog posts and stories, videos, and sharing general information about the eHouse market and cooking recipes.

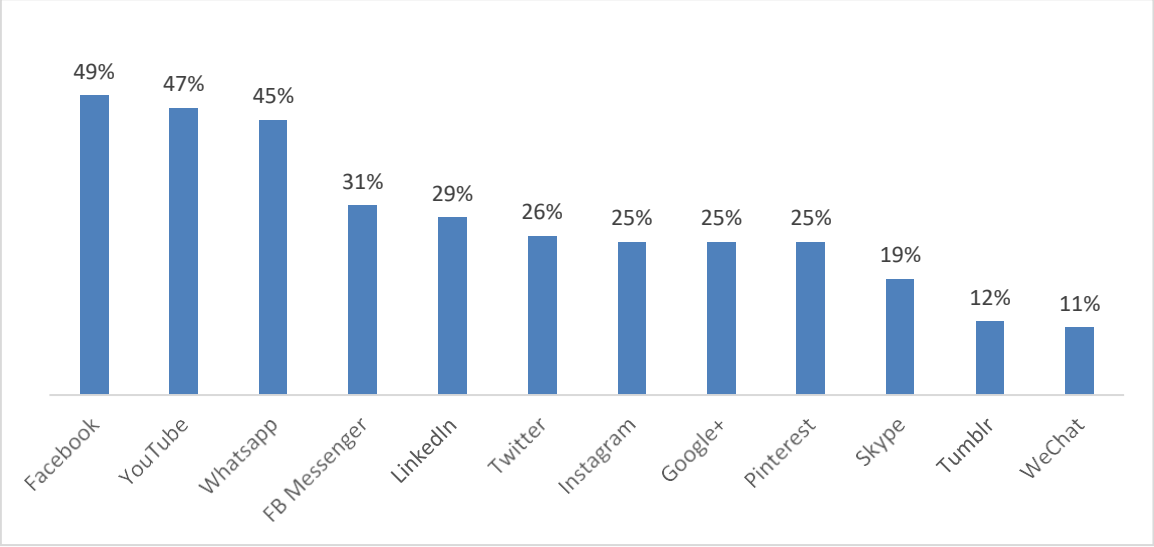

Figure 10 SA's social media consumption by platform (2016-2017) (Qwerty Digital, 2017)



Figure 11 Elysium's social media presence (Tailor Brands, 2018)

It is preferable to outsource the management of Elysium's online presence as there are companies which specialise in building brand awareness in the online space. They offer the following on a monthly retainer, all inclusive:

- Multiple social media profiles;
- Multiple posts per platform per week (including imagery);
- Basic profile management;
- Content and keyword research;
- SEO post optimisation;
- Basic reporting & recommendations;
- Reputation management; and
- Ad campaign management.

4.5 TARGET MARKET

The aspects of the marketing mix described in the previous sections all influence the decision regarding the target market.

Table 12 below is a summary of the target market per distribution channel. As discussed previously, the chain store selected serves the higher SEM market and is in line with the Elysium’s premium brand.

Table 12 Summary of Elysium's target market

Distribution channel	Target market
Chain Stores	• Woolworths • Pick 'n Pay • Food Lover's Market
Traders	• Fresh to Go • Famous Fresh • RSA group
Fresh produce markets	• Cape Town Market
Direct to customer	Primary: • Men, and women, white and black, aged 25-50, SEM 8-10 Secondary: • Men, and women, white and black, aged 50-56, SEM 8-10

In terms of the direct customer, it is important to know the demographics of the target market, including gender, age and SEM group. This will not only help in guiding the marketing effort but also in understanding the customer better to predict their behaviour more accurately.

With regard to gender, men and women have different purchasing behaviours. In 1993, women did 76% of all grocery shopping whereas in 2003 women accounted for only 60% of all grocery shopping (Prinsloo, 2016). A recent global study, however, shows that this has fallen further to 51%, although women still spend $2.73 more per trip. Women spend more time per trip while men normally have a list and stick to it. Men are also less price-sensitive and are more likely to spend online, whereas women tend to seek out deals in-store, occasionally buying items they do not immediately need if they are offered at a good price (MacDonald, 2017).

Since Elysium's product is a premium product, it falls within the high SEM group (8-10). SEM 8-10 constitutes 19.3% of the total population (7.6million people) and Figure 12 below shows its group characteristics according to the dominant age and gender group in SA. The age group 25-49 makes up 51.4% of the SEM group, and these can be grouped as a primary target since they fall closer to a similar interest group. The age group 50-64 will be targeted as a secondary target. (Reid, 2018)

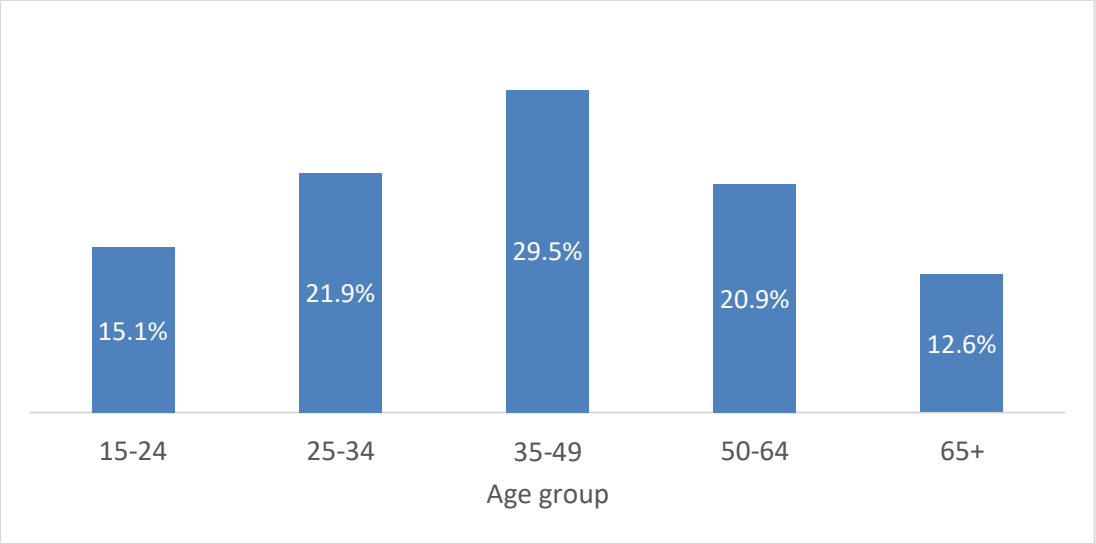

Figure 12 SEM 8-10 by age group (Reid, 2018)

As shown in Figure 13, white people make up a majority of the SEM 8-10 group, followed closely by black people. Other key characteristics of this group are that 56.7% of them are working full-time, the majority of them have formal education, and they are concerned about social issues such as crime and the environment (Reid, 2018).

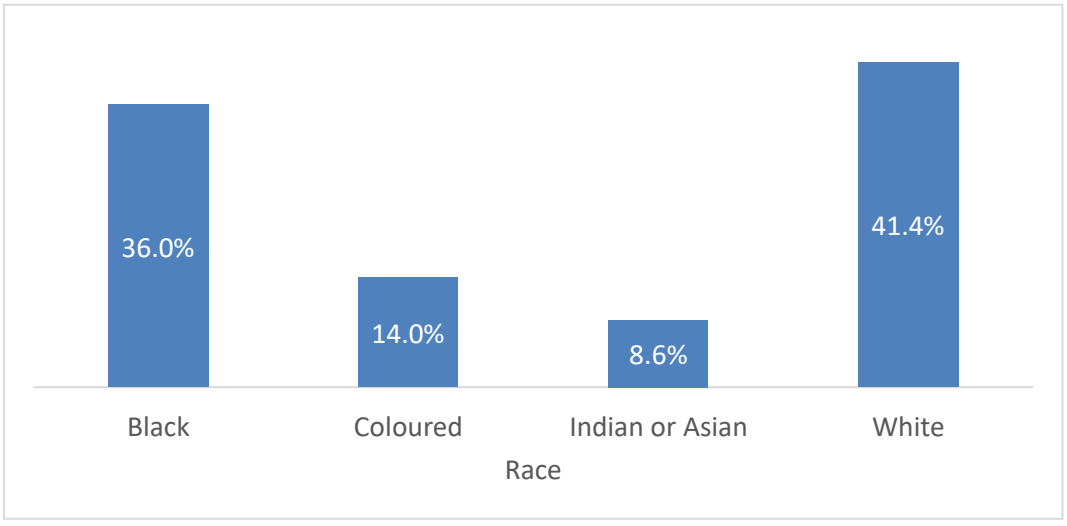

Figure 13 SEM 8-10 by race (Reid, 2018)

5. OPERATIONS/PRODUCTION

This section provides detail information on all aspects relating to Elysium's production.

5.1 PRODUCTION SCALE

Elysium had to make a decision with regard to its scale of production, either small-scale production or large-scale production.

Table 13 Production scale criteria (Hedin, 2015)

Production Scale	Definition	Dependencies
Small-scale	Sell through farmer's markets or restaurants rather than retail, or grow a wide range of products to manage subscription programmes with variety and freshness.	Not a sustainable business model without capturing other created values through additional revenue or decreased cost
Large-scale	Sell fewer products, often specialised on one or two ranges of products, through retail, and sometimes to restaurants.	This is a business model which depends on the willingness of consumers to pay a premium for high quality, fresh and local vegetables.

Based on the information provided in Table 13, large-scale farming has been selected for the eHouse production. Since this is a large-scale vertical farm, a commercial space is needed to house the food production. There are different options which are suitable for this, with the popular one being a skyscraper, due to its high floor area to footprint ratio. This type of building is, however, very expensive because it is constructed to serve a different purpose and hence is priced according to that fit.

A warehouse has thus been selected as the ideal building type, due to its large and expansive floor area, and inexpensiveness due to its industrial build.

5.2 GEOGRAPHIC LOCATION

To determine the geographical location of the VF, warehouses were searched around the Western Cape area. One of the key characteristics that the warehouse needs to have is a high ceiling, due to the stacked nature (3 levels) of the CEA technology

(approximately 9m high) that the warehouse must accommodate. The warehouses (see Appendix B for pictures) meeting these criteria are shown in Table 14 below.

Table 14: Selected warehouses being sold in Western Cape

Warehouse #	Location	Unit Cost	Distance from City Centre	Total
1	Killarney Gardens	3	2.1	5.1
2	Somerset West	1.5	1.0	2.4
3	Strand Central	1.6	0.9	2.5

Criterion 1: Unit cost – This simply considers the cost per m² of the property. A higher rating (max 3) is allocated to properties which have a lower cost per m², based on the information provided in Table 15 below.

Criterion 2: Distance from City Centre – Because locality is an important factor for VF, the distances from the City Centre are shown in Table 15 and were used to allocate a rating. The higher rating was given to properties with the shortest distance to City Centre.

Table 15 Property (warehouse) information

Warehouse #	Location	Size (m²)	Total cost (Rand) - millions	Unit cost (Rand/m²)	Distance from City Centre (km)
1	Killarney Gardens[16]	2,560	14.5	5,664	20.8
2	Somerset West[17]	1,200	14	11,667	45.2
3	Strand Central[18]	730	7.9	10,822	48

5.2.1 Geographic Location Decision

From the total score in Table 14, warehouse #1 scored the highest overall and is most suitable for the VF. The warehouse is ideally located 21km from Pick ‘n Pay’s distribution centre, 8km from Woolworth’s distribution centre, and 25km from Food Lover’s Market Headquarters.

[16] (Property24, 2018c)
[17] (Property24, 2018b)
[18] (Property24, 2018a)

5.3 PRODUCTION PROCESS

The Metropolis Farms' CEA technology has been selected for the VF, due to its high yield, affordability, and many other reasons which are described below. Figure 14 below shows the layout and features of the system. Some of the key features of the technology and the entire Metropolis business offering include:

- The system grows in 1m² what would normally require 1,210 m² of traditional real estate. It is capable of growing flowers, cannabis, tomatoes, strawberries, peppers, broccoli, cauliflower, fiddleheads, root vegetables like carrots, radishes, or potatoes. Metropolis also provides consultation regarding the best strains and seeds to grow (Metropolitan Farm USA, 2018);
- Metropolis provides a turnkey solution complete with electric, plumbing, lighting, and aeroponic or hydroponic (depending on the crop) CEA technology. The complete farm can be built within 1-2 weeks (Metropolitan Farm USA, 2018);
- The system uses only .22 pounds of nitrogen as compared to the 200 pounds required by conventional farms. Depending on the crop, the technology uses 95-98% less water than conventional farms. Compared to other indoor farms, it uses 40-60% less energy due to its environmental controls. (Metropolitan Farm USA, 2018);
- The system has the ability to speed up or slow down crop growth by 15% based on supply chain needs (Metropolitan Farm USA, 2018).

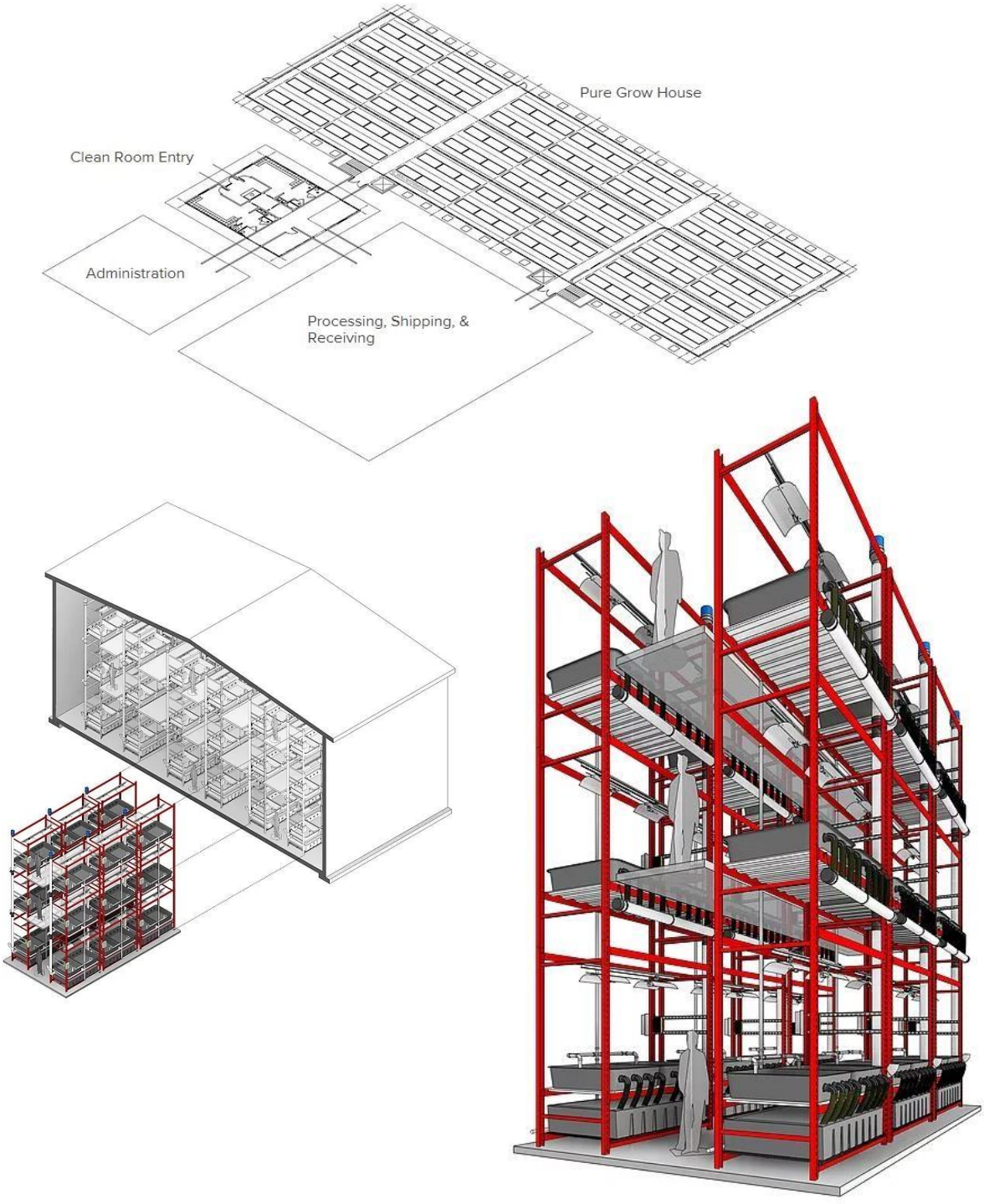

Figure 14 Metropolis Farms CEA technology (Metropolitan Farm USA, 2018)

- The system combines a specialised High-intensity diode (HID) light, instead of Light emitting diodes (LED), with a specific metal reflector, hence generating far less BTUs while creating more light. This results in 20-30% savings on energy from this component alone. Running the lights during the night instead of during the day

also helps to cut down BTUs, because during the day, the sun is heating up an indoor environment, and the lighting would simply add more heat which would need to be removed by means of a cooling system. (Metropolitan Farm USA, 2018) Generally, plants are intolerant of continuous light for 24 hours; therefore, 12 to 14 hours of light per day are given to plants (Sarkar & Majumder, 2015); and

- The optimal way for a plant to grow is by the plant leaf being one temperature, and its roots a different temperature, which is how the plant manages its heat. The technology can differentiate each tower within the same room, and different crops can, thus, be optimally grown in the same room (Metropolitan Farm USA, 2018).

5.3.1 Sources of Supply

To estimate the input requirements (electrical power, seeds, nutrients, and water) for the eHouse, a 40,000 m² VF design was used as a basis. This is a 37-storey VF, five of which are underground, housing the three floors of Aquacultural and two of waste management sub-systems. The 32 floors above ground comprise of the 25 floors for agricultural production and two for food processing sub-systems among others (Banerjee, 2014). Section 7 details the inputs for this VF.

Figure 15 shows the declining cost of solar power in SA over recent years. Currently, it costs less to use solar energy rather than grid power, and grid power will continue to rise in cost as solar power becomes cheaper. For this reason, a solar energy system with battery back-up will be installed in the eHouse to meet 100% of its power requirements.

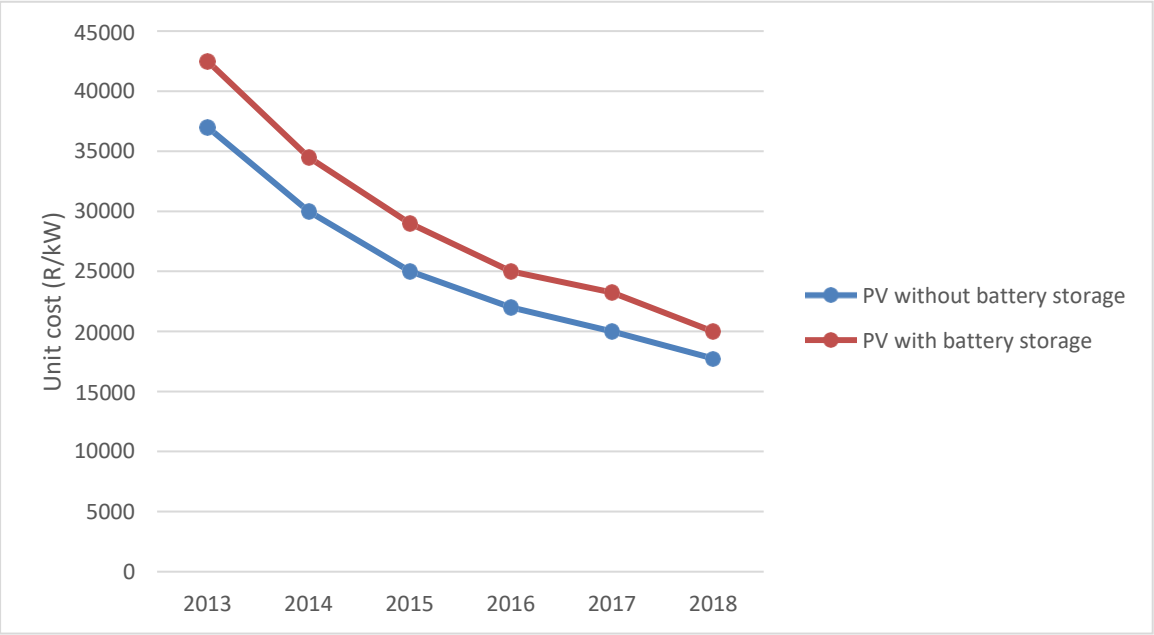

Figure 15 The Cost of PV solar systems over time (Pineo, Cloete-Beets, Tshehla, & Janse van Vuuren, 2016)

5.4 ORGANISATION

The Divisional Organisational Structure (Departmentation) has been selected for Elysium and is based on the division of work per functional activity. In this structure, groups are mostly self-managed and focus on a narrow aspect of the company's products or services. The division's focus allows it to build a common culture which contributes both to higher morale and a better knowledge of the division's portfolio (Chand, 2016). Elysium's organisational structure is shown in Figure 16 below, with a manager in charge of his/her functional activity.

According to Banerjee (2014), to handle a stack area of 403 m² per hour (harvest and preparation of new seed trays) an estimated workforce of 6 - 10 workers (based on 8hour work time per day) are required. This was used as the basis for determining the number of Master Growers required. It was estimated that 15 workers were needed for processing of food at the VF presented in the paper by Banerjee (2014) which was used as a basis to determine the 1 Food Processor/Packer required in the eHouse.

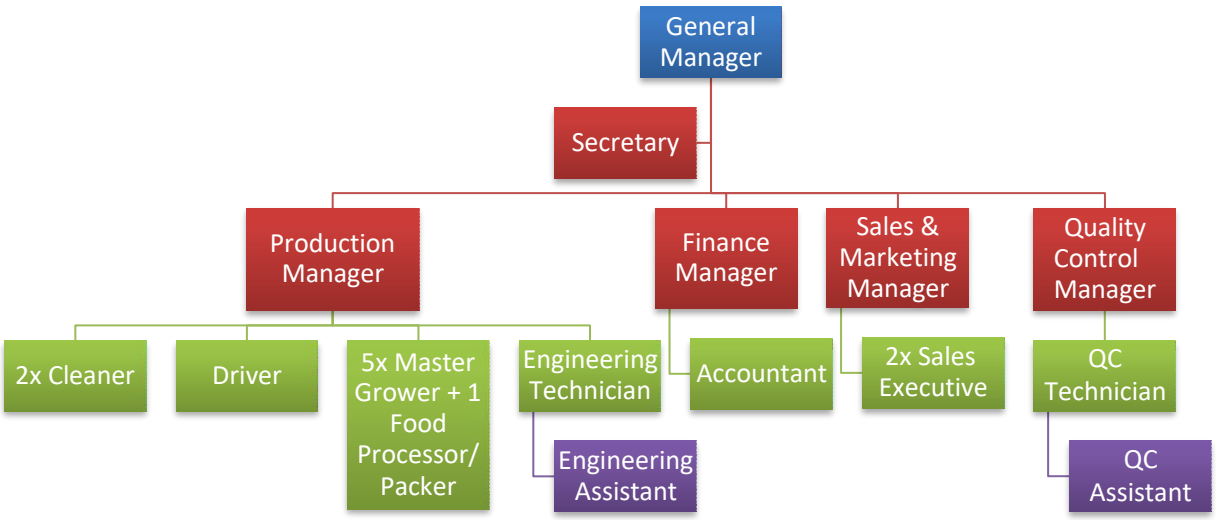

Figure 16 Elysium's organisational structure

Table 16 below shows the roles and responsibilities of each team member.

Table 16 Roles and responsibilities of the Elysium team

Role	Responsibilities
General Manager	Ensuring the creation and implementation of a strategy designed to grow the business. Overseeing overall daily operations of the organisation.
Secretary	Performing routine clerical and administrative functions.
Production Manager	Ensuring that all production-related processes run reliably and efficiently.
Cleaner	Ensuring the proper sanitation of all areas of the eHouse, including the office and growing area.
Driver	Ensuring timely delivery of goods to predetermined customers on specific routes, reviewing orders prior to delivery, loading and unloading trucks and providing exceptional customer service to Elysium's client base
Engineering Technician	Performing highly diversified duties to install, troubleshoot, repair and maintain production and facility equipment.
Engineering Assistant	Assisting the Engineering Technician in executing his/her duties.
Master Grower	Preparation of new seed trays, caring for the crops and harvesting.
Processor/Packer	Cleaning and packaging of produce.
Finance Manager	Reviewing financial reports, monitoring accounts, and preparing activity reports and financial forecasts. Investigate ways to improve profitability, and analyse markets for business opportunities.
Accountant	Preparing various financial reports. Substantiating financial transactions by auditing documents.
Sales & Marketing Manager	Planning, developing, implementing, and evaluating advertising, merchandising, and trade promotion programs. Developing field sales action plans.

Role	Responsibilities
Sales Executive	Maximising sales by establishing contact and developing relationships with the client, and recommending solutions. Maintaining relationships with clients by providing support, information, and guidance.
Quality Control Manager	Ensuring produce and the environment meet quality standards set by the company.
QC Technician	Conducts routine quantitative and qualitative inspections/sampling of raw material, in-process and final products. Performance of calibration checks, preventative maintenance tasks, and simple repair to analytical instrumentation.
QC Assistant	Assisting the QC Technician in executing his/her duties.

6. RISK ANALYSIS

This section looks at the associated risks of this business venture, and the measures that must be put in place to mitigate each risk and hence improve the probability of success. Figure 17 below gives an overview of all the identified risks with consideration of the impact and probability of occurrence of each.

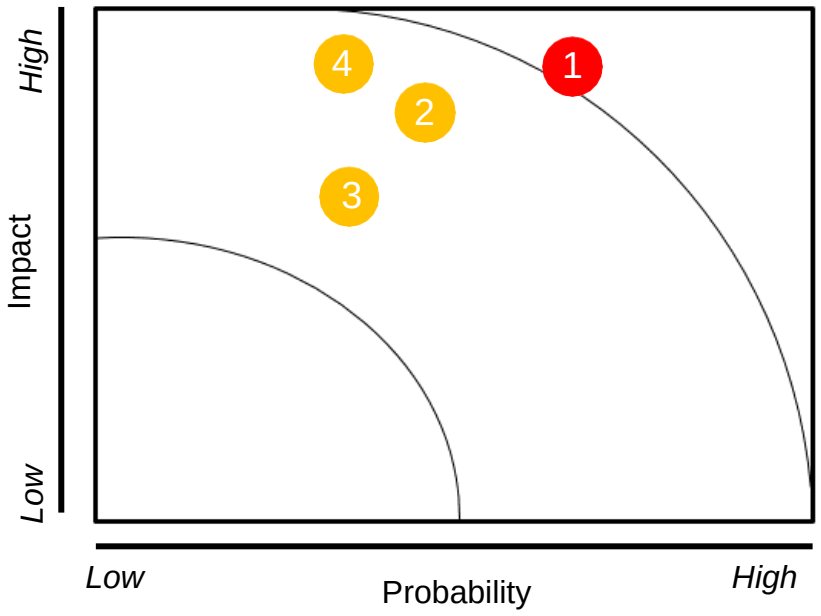

Figure 17 Risk overview

Table 17 below shows the detailed risk description and mitigating measures put in place to minimise the associated risk.

Table 17 Risk and mitigating measures

#	Risk	Mitigating controls
1	A high degree of competence in plant science, precision monitoring, and engineering skills is required to ensure optimum growth.	• Agriculture, agronomy, civil planning, architecture, engineering, economics and public health will be engaged in the early stages of the project for planning and maintaining of the vertical eco-farms. • A rigorous recruitment and training program will be instituted in the early stages and throughout the life of the project, with Metropolis Farms forming a key partner in this regard, as they have decades of experience in this environment and have the best knowledge of the CEA technology. • A particular focus will be on recruiting personnel who pay attention to detail, are computer literate, and analytical.
2	The essential factors of plants to grow are nutrients, water, light, and air, and these need to be provided in precise quantities and timeliness. Pathogen attacks such as damp-off due to verticillium wilt caused by the high moisture levels associated with hydroponics and over watering of soil based plants need to be prevented.	• The metropolis's CEA technology has been chosen specifically for its proven results which have obtained through refinement of their system over 24 versions. The CEA technology has precise monitoring technology, and they provide continuous support months into the installation of the system. • The training programmes will have a detailed focus on improving the workforce's understanding and operation of the technology utilised.
3	Failure to any system components of the vertical irrigation system may lead to rapid plant death.	• A full-time Engineering Technician, Assistant, and 2 Cleaners have been factored into the budget to ensure that the environment and CEA technology are properly inspected, sanitised, and maintained to specific requirements.
4	Contamination in the system may compromise safety and quality of produce, which may endanger consumers.	• In addition to two full-time cleaners being factored into the budget, a Quality Control department has been established to ensure that produce and the environment are constantly tested and monitored for contamination and quality (taste, texture, yield, etc.). • A particular focus will also be on ensuring that quality ingredients are sourced from reputable, responsible companies.

7. FORECASTS & FINANCIAL DATA

This section looks at the various financial risks and benefits of this investment.

7.1 OVERALL FINANCIAL PERFORMANCE

Table 18 shows the key performance indicators over the 10-year horizon considered for the investment. The WACC of 12.29% was determined using that of an investment firm, namely, Coronation Fund Management, which generally considers 7- to 10-year investments. The IRR (28%) is well above this WACC (12.29%), and this is, therefore, an attractive investment as investors will get a good return on their investment.

Table 18 Key financial performance indicators over 10 years

Indicator	Value (over a 10-year period)
Capital investment	R46.67m
NPV	R19.83m
WACC	12.29%
IRR	28%
BEP	5 years

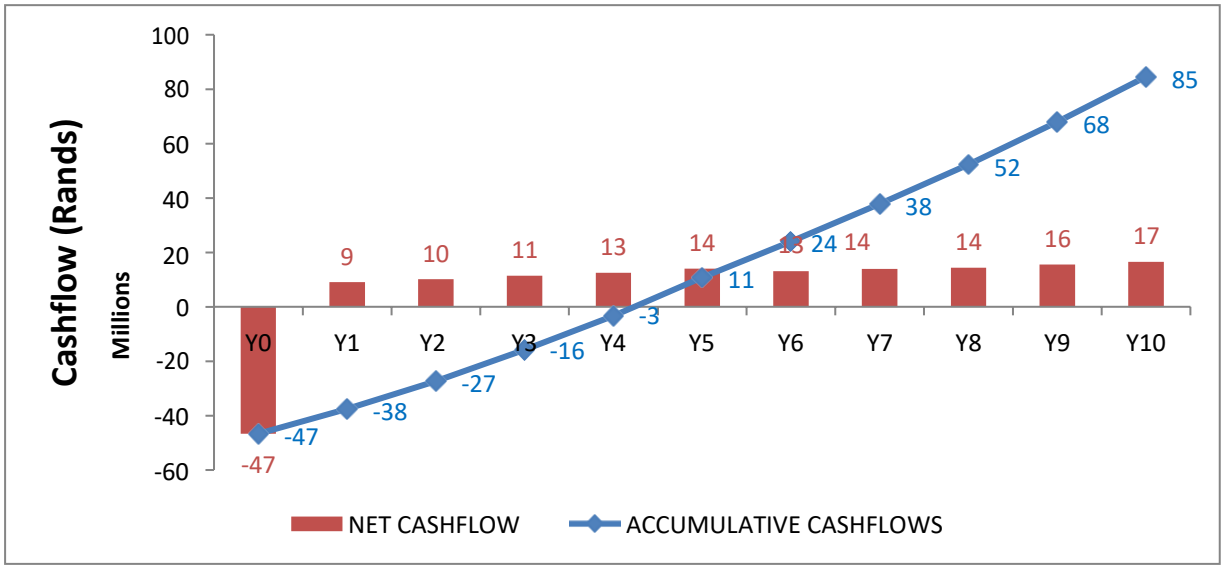

Figure 18 Break-even analysis over a 10-year period

7.2 RATES

In the income statement, each input takes into account the time value of money with an escalation of 6% inflation rate for revenues and expenses each year. Corporate tax is taken at 28%.

Table 19 Rates

Rates	
Inflation	6%
Corporate tax rate	28%

7.3 REVENUE

The sales volumes and revenues are shown in Table 20 below. It is important to note that volumes have been deliberately underestimated, as the Metropolis CEA technology being used promises to yield 1210x the yield from conventional farming, whereas we have assumed an average of 40x across all crops. Prices are based on Woolworths' current selling price. A 10/30/30/30 production split has been selected for the crops, in order to reduce the dependency on a single crop for revenues.

Table 20 Annual sales volumes and revenue per crop

	Basil	Baby Tomatoes	Mini Cucumbers	Lettuce	Total
Woolworths Price	262.38	58.32	48.54	51.69	
Production split	10%	30%	30%	30%	
VF yield (kg/m²)	63.0	32.5	45.2	27.7	
Stacked VF yield (3 levels) (kg/m²)	189.00	97.50	135.60	83.10	
Yield (kg)	48 384	74 880	104 141	63 821	291 226
Annual Revenue (Rand)	**12 694 752**	**4 366 752**	**5 055 292**	**3 298 875**	**25 415 671**

As shown in Table 21, in year 1, production has modestly been assumed at 80% of full capacity, due to the possibility that sales may initially be low and production may not be as efficient as anticpated. Production efficiency will increase over time as the learning curve is overcome by the team and sales agreements are put in place with retailers.

Table 21 Annual production ramp-up

	Y0	Y1	Y2	Y3	Y4	Y5	Y6	Y7	Y8	Y9	Y10
Production ramping		80%	85%	90%	95%	100%	100%	100%	100%	100%	100%

7.4 EXPENSES

The expenses are shown in Table 22 below. Some of the key points include:

- Warehouse renovations have been assumed at R500,000 in case there is additional work which needs to be done in order to get the warehouse to the required specification for operation;
- A 30% contingency has been added to the CEA technology, taking into account any shipping, import taxes and installation costs that may be incurred;
- A 10% contingency has been added to the solar system taking into account any inefficiencies which may result in the system over the years, or any sustained periods of power outages. A 10% electrical bill (from the power grid) has also been assumed as a back-up, in case of solar system failures or extended overcast weather periods; and
- For training and development, South African companies typically spend an average of 3.11% of their payroll, and majority source up to 50% of this amount from SETA.

Table 22 Fixed and Variable expenses

	Expense (Rand)	Unit Price (Rand)	Quantity UoM	Quantity
Capital	**46540284**			
Warehouse	14500000	-	m²	2560
Warehouse renovations	500000		-	
CEA technology (+30% contingency for shipping, import tax, installation etc.)	30208000	9077	m²	2560
Solar system installation with battery (+10% contingency)	964384	20000[19]	kW	44
Delivery vehicles	267900	267900[20]	Unit	1
Office equipment and furniture	100000			

[19] (Agriculture: Market Intelligence Report, 2016)
[20] (Automart, 2018)

	Expense (Rand)	Unit Price (Rand)	Quantity UoM	Quantity
Salaries	**4069199**			
Master Grower	292598	60958[21]	Unit	5
Master Growers (for 403m² per hour)			Unit	6
Daily working hours			Hours	8
Processor/Packer	60958	60958[18]	Unit	1
Engineering Technician	213230	213230[22]	Unit	1
Engineering Assistant	60958	60958[18]	Unit	1
Cleaner	74322	37161[23]	Unit	2
General Manager	937277	937277[24]	Unit	1
Production Manager	358838	358838[25]	Unit	1
Finance Manager	483 886	483 886[26]	Unit	1
Accountant	249951	249951[27]	Unit	1
Secretary	169779	169779[28]	Unit	1
Marketing & Sales Manager	323417	323417[29]	Unit	1
Sales Executive	460000	230000[30]	Unit	2
Driver	143252	71626[31]	Unit	2
QC Assistant	60958	60958[18]	Unit	1
QC Technician	179775	179775[32]	Unit	1
Operational	**715696**			
Plant Nutrients	400580	626	Litres	640
Plant Nutrients (for 40,000m²)			Litres	10000[33]
Plant seeds	41862		Rand	41862[32]
Plant seeds (for 40,000m²)			Rand	654100
Delivery vehicle fuel	40276			
Vehicle payload			Tons	1.335
Delivery trips			Unit	218
Roundtrip			km	144
Total delivery travel			km	31 413
Vehicle fuel consumption			Litres/100km	10.2[34]
Total fuel consumption		12.57	Litres	3 204
Electricity (10%)	31360	1.4[35]	kWh	22400
Electricity (for 40,000m²)			kWh	3500000[36]

[21] (Payscale, 2018a)
[22] (Payscale, 2018b)
[23] (Payscale, 2018c)
[24] (Payscale, 2018d)
[25] (Payscale, 2018e)
[26] (Payscale, 2018f)
[27] (Payscale, 2018g)
[28] (Payscale, 2018h)
[29] (Payscale, 2019i)
[30] (Payscale, 2018j)
[31] (Payscale, 2018k)
[32] (Payscale, 2018l)
[33] (Banerjee, 2014)
[34] (Hyundai, 2018)
[35] (Soventix, n.d.)
[36] (Banerjee, 2014)

	Expense (Rand)	Unit Price (Rand)	Quantity UoM	Quantity
Water	10554	0.0323[37]	Litres	327040
Water (for 40,000m²)			Litres	5110000[36]
Rates and taxes	120 000	10000	Per month	12
Internet unlimited	17988	1499[38]	Months	12
Phone line unlimited	7188	599[39]	Months	12
Consulting/support (CEA technology)	45888	239[40]	Hours	192
Sales commission		**37.5%**		
Broker fee (Fresh Produce Market)		12.5%	Of sale	
Chain store profit margin		25%[41]	Of sale	
Processing and packaging		9%[42]	Of sale	
Marketing	**237 550**			
Building a website	4 950	4950[43]	Once-off	1
Hosting and maintaining a website	600	600[43]	Per year	1
Developing a mobile app	120 000	120000[44]	Once-off	1
Hosting and maintaining a mobile app	4 000	4000[44]	Per year	1
Content creation, social media and ad campaign management	108000	9000[45]	Per month	12
Training and development				
Internal company spend		3.11%[46]	Of payroll per employee	
SETA grants (rebate)		50%[46]	Of training budget	

[37] (Johannesburgwater, 2017)
[38] (Telkom, 2018)
[39] (Telkom, 2018)
[40] (Payscale, 2018)
[41] (Tradeintelligence, 2017)
[42] (Spitz, 2013)
[43] (Webs, 2018)
[44] (Internet up start, n.d.)
[45] (Gumtree, 2018)
[46] (IQbusiness, 2014)

7.5 INCOME STATEMENT

Table 23 shows the income statement, where all revenues and expenses have been escalated each year to account for inflation. Depreciation on our assets provides a welcomed corporate tax break for the write-off periods as recommended in The Forum SA (n.d.).

Table 23 Income Statement

	Y0	Y1	Y2	Y3	Y4	Y5	Y6	Y7	Y8	Y9	Y10
REVENUE	**0**	**20332537**	**22899520**	**25618996**	**28490967**	**31515432**	**33406358**	**35410740**	**37535384**	**39787507**	**42174757**
Sales Revenue		**20332537**	**22899520**	**25618996**	**28490967**	**31515432**	**33406358**	**35410740**	**37535384**	**39787507**	**42174757**
LESS EXPENSES	**46665234**	**10226898**	**11189393**	**12209242**	**13619714**	**14555356**	**15290878**	**16208330**	**17592753**	**18211680**	**19304381**
Capital	**46540284**	**0**	**0**	**0**	**332196**	**130000**	**0**	**0**	**411923**	**0**	**0**
Warehouse	14500000										
Warehouse renovations	500000										
CEA technology	30208000										
Solar system installation (+10% contingency)	964384										
Delivery vehicles	267900				332196				411923		
Office equipment and furniture	100000					130000					
Salaries		**4069199**	**4313351**	**4572152**	**4846482**	**5137270**	**5445507**	**5772237**	**6118571**	**6485686**	**6874827**
Master Grower		292598	310154	328764	348489	369399	391563	415056	439960	466357	494339
Processor/ Packer		60958	64615	68492	72602	76958	81576	86470	91658	97158	102987
Engineering Technician		213230	226024	239585	253960	269198	285350	302471	320619	339856	360248
Engineering Assistant		60958	64615	68492	72602	76958	81576	86470	91658	97158	102987
Cleaner		74322	78781	83508	88519	93830	99460	105427	111753	118458	125565
General Manager		937277	993514	1053124	1116312	1183291	1254288	1329545	1409318	1493877	1583510
Production Manager		358838	380368	403190	427382	453025	480206	509019	539560	571933	606249
Finance Manager		483886	512919	543694	576316	610895	647549	686402	727586	771241	817515
Accountant		249951	264948	280845	297696	315557	334491	354560	375834	398384	422287

	Y0	Y1	Y2	Y3	Y4	Y5	Y6	Y7	Y8	Y9	Y10
Secretary		169779	179966	190764	202210	214342	227203	240835	255285	270602	286838
Marketing & Sales Manager		323417	342822	363391	385195	408307	432805	458773	486300	515478	546406
Sales Executive		460000	487600	516856	547867	580739	615584	652519	691670	733170	777160
Driver		143252	151847	160958	170615	180852	191703	203206	215398	228322	242021
QC Assistant		60958	64615	68492	72602	76958	81576	86470	91658	97158	102987
QC Technician		179775	190562	201995	214115	226962	240580	255014	270315	286534	303726
Operational		**715696**	**758637**	**804156**	**852405**	**903549**	**957762**	**1015228**	**1076142**	**1140710**	**1209153**
Plant Nutrients		400580	424614	450091	477097	505723	536066	568230	602324	638463	676771
Plant seeds		41862	44374	47037	49859	52850	56021	59383	62946	66722	70726
Delivery vehicle fuel		40276	42693	45254	47969	50848	53898	57132	60560	64194	68045
Electricity (10%)		31360	33242	35236	37350	39591	41967	44485	47154	49983	52982
Water		10554	11187	11858	12569	13324	14123	14970	15869	16821	17830
Rates and taxes		120000	127200	134832	142922	151497	160587	170222	180436	191262	202737
Internet unlimited		17988	19067	20211	21424	22709	24072	25516	27047	28670	30390
Phone line unlimited		7188	7619	8076	8561	9075	9619	10196	10808	11457	12144
Consulting/support (CEA technology)		45888	48641	51560	54653	57933	61408	65093	68999	73139	77527
Sales commission		**5083134**	**5724880**	**6404749**	**7122742**	**7878858**	**8351590**	**8852685**	**9383846**	**9946877**	**10543689**
Broker fee (Fresh Produce Market)		1524940	1717464	1921425	2136823	2363657	2505477	2655805	2815154	2984063	3163107
Chain store profit margin		3558194	4007416	4483324	4985919	5515201	5846113	6196879	6568692	6962814	7380583
Processing and packaging		**182 992.83**	**206 095.68**	**230 570.97**	**256 418.71**	**283 638.89**	**300 657.22**	**318 696.66**	**337 818.46**	**358 087.56**	**379 572.82**
Marketing	**124950**	**112600**	**119356**	**126517**	**134108**	**142155**	**150684**	**159725**	**169309**	**179467**	**190235**
Building a website	4950										
Hosting and maintaining website		600	636	674	715	757	803	851	902	956	1014
Developing a mobile app	120000										
Hosting and maintaining mobile app		4000	4240	4494	4764	5050	5353	5674	6015	6375	6758
Content creation, social media and		108000	114480	121349	128630	136348	144528	153200	162392	172136	182464

	Y0	Y1	Y2	Y3	Y4	Y5	Y6	Y7	Y8	Y9	Y10
ad campaign management											
Training and development		**63 276.05**	**67 072.61**	**71 096.97**	**75 362.79**	**79 884.56**	**84 677.63**	**89 758.29**	**95 143.78**	**100 852.41**	**106 903.56**
Internal company spend		126 552.10	134 145.23	142 193.94	150 725.58	159 769.11	169 355.26	179 516.57	190 287.57	201 704.82	213 807.11
SETA grants (rebate)		63 276.05	67 072.61	71 096.97	75 362.79	79 884.56	84 677.63	89 758.29	95 143.78	100 852.41	106 903.56
EBITDA	**-46665234**	**10105639**	**11710127**	**13409754**	**14871253**	**16960076**	**18115481**	**19202409**	**19942631**	**21575827**	**22870377**
LESS DEPRECIATION		**6321452**	**6321452**	**6321452**	**6321452**	**6337526**	**109049**	**109049**	**109049**	**128981**	**128981**
CEA technology		6041600[47]	6041600	6041600	6041600	6041600					
Solar system installation (+10% contingency)		192877[47]	192877	192877	192877	192877					
Delivery vehicles		66975[47]	66975	66975	66975	83049	83049	83049	83049	102981	102981
Office equipment and furniture		20000[47]	20000	20000	20000	20000	26000	26000	26000	26000	26000
EBIT		**3784187**	**5388675**	**7088302**	**8549801**	**10622550**	**18006432**	**19093360**	**19833582**	**21446847**	**22741396**
LESS TAXES		**1059572**	**1508829**	**1984725**	**2393944**	**2974314**	**5041801**	**5346141**	**5553403**	**6005117**	**6367591**
NET INCOME		**2724615**	**3879846**	**5103578**	**6155857**	**7648236**	**12964631**	**13747220**	**14280179**	**15441729**	**16373805**
ADD DEPRECIATION		**6321452**	**6321452**	**6321452**	**6321452**	**6337526**	**109049**	**109049**	**109049**	**128981**	**128981**
NET CASHFLOW	**-46665234**	**9046066**	**10201298**	**11425029**	**12477309**	**13985762**	**13073680**	**13856269**	**14389228**	**15570710**	**16502786**
ACCUMULATIVE CASHFLOWS	**-46665234**	**-37619167**	**-27417869**	**-15992840**	**-3515531**	**10470231**	**23543910**	**37400179**	**51789407**	**67360117**	**83862903**

[47] (The Forum SA, n.d.)

8 CONCLUSION

In conclusion, vertical farming is a highly attractive method of food production due to its high yield per unit floor area, proven through the growing presence of numerous vertical farms around the world. If approached and designed correctly, vertical farming can be both good for the environment and the consumer, whilst being profitable.

In this paper, a decision criteria based methodology was followed in order to determine the most suitable crop and geographical location, for food production to take place within the South African environment. A number of business management and finance methodologies were leveraged in order to evaluate the external market, make key decisions on the business model to be followed, and produce detailed financial forecasts,

The output of these methodologies is for the establishment of a 2,560 m² vertical farm in Cape Town, within which a controlled- environment agriculture (CEA) technology from the United States will be used to facilitate the production of microgreens, cucumbers, tomatoes, and lettuce. The produce will be distributed through chain stores, the Cape Town Fresh Produce Market, and deliveries made directly to customers, through a 70%, 20%, 10% split, respectively. The chosen target market is persons of Social Economic Measure (SEM) 8-10. A total capital investment of R46.7m is required, with a Net Present Value (NPV) of R19.83m over a 10-year period. The break-even point is 5 years, with an Internal Rate of Return (IRR) of 28%, which is well above the Weighted Average Cost of Capital (WACC) of 12.29%.

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