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Plant-based food innovation and ecological sustainability

by

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Research report submitted in partial fulfilment
of the requirements for the degree of
Master of Management in the field of Innovation Studies
University of the Witwatersrand Business School

Dr Diran Soumonni

2018

Abstract

The purpose of this study was to understand plant-based food innovation and its impact on ecological sustainability. Across a period, the broader impact of humanity's developmental surge was not considered outside of economic gain. As time extended and resources were bankrupted, scholars had to consider the relationship between social gain and natural capital loss. The balance sheet represented a power bias, as human evolution was all-pervasive. The Rio Earth Summit of 1992 established the foundation for addressing the disparities and positioning sustainable development on an adoption trajectory as a global imperative.

These global forces necessitated innovation. Food production and consumption were articulated as a cause for concern and listed on the United Nations Sustainable Development Goals Agenda. Advancement in technology that adopted an inclusive conservation approach could liberate humanity from the clutches of its desire and ramification on global resource depletion. Extensive technological changes in a paradigm would result in a cumulative effect on the constructs of sustainability.

Fundamental shifts in the economy, the environment and social domain would likely occur. This study assessed these changes resultant from plant-based food innovation, through a dual case study approach.

Plant-based food innovation is considered a viable tenet of the multidimensional food production economy.

Declaration

I, _____, declare that this research report is my own unaided work except as indicated in the references and acknowledgements. It is submitted in partial fulfilment of the requirements for the degree of Master of Management in the field of Innovation Studies at the Wits Business School in the University of the Witwatersrand, Johannesburg. It has not been submitted before for any degree or examination in this or any other University.

…….

Misha Dhupelia

1791808

31 July 2018

Dedication

Dedicated to the lives, of those lost and to come, of my sentient non-human friends.

Acknowledgements

Acquiring a Masters Degree while working full time is no small feat and is a weight shared by numerous avenues of support. I owe immense gratitude to a number of people.

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- Grant, for the simplicity and wonder that is you. It is difficult to articulate the depth of my appreciation and gratitude for you because it runs deeper than I can measure. I will always be humbled and in awe of the karma that brought us together and allows me to have you in my life.
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CHAPTER 1
INTRODUCTION

1.1. PURPOSE OF THE STUDY

The purpose of this study was to understand food production as a feature of sustainable development through investigating innovation within the plant-based food industry and its impact on ecological sustainability

Issues of sustainability are no longer abstract concepts that can be left for the scientific community alone to solve. Their impact on daily lives brings to the fore changes that necessitate humanities' participation in the preservation of ecosystems, not for the current generation alone, but future generations to come.

Implicit in the character of the United Nations was the need to develop and embed sustainable practices across the spectrum of human activity. This was based on the severity of global resource depletion, and through this, birthed the Sustainable Development Goals initiative (Griggs, et al., 2013). These goals were, in part, the impetus in the regeneration of business practices, development of a green goods and services economy and promoting habitual behavioural change through the adoption of sustainable living. This is mirrored in the following statement: 'As our concern for sustainable development has broadened, so the demands on innovation have become more profound and pervasive (Smith, Voß, & Grin, 2010, p. 7).

Parallel to the broadened concern is the spectrum of sustainable development challenges that required consideration. Smith, et al. (2010) cited some of these as ranging from greenhouse gas (GHG) emissions, environmental degradation and water shortages to lack of access to clean energy sources and production & consumption patterns.

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1.2. CONTEXT OF THE STUDY

To assess whether innovation in the plant-based food industry is a viable construct for sustainable development, an understanding of sustainability is proffered. The Brundtland definition of sustainability is the most widely accepted, and it reads as follows: “Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs” (McKenzie, 2004, p. 2).

This definition of sustainability incited discussions about sustainable business practices and the development of goods and services within a green economy. This refers to a climate that considers the impact on the ecological landscape and seeks to minimise its damage while still effectively contributing to social and economic development. Smith, et al. (2010) further discussed innovation as a lynchpin in framing the solution to developing holistic sustainable techniques that are cross-sectoral. This extended not only within the business practice and technological regime change but also across the developments of products and services; utilisation of resources and embedding sustainability as construct amongst lifestyles of people. This consideration was also supported by Rennings (2000) who appreciated the pervasive nature of sustainability and suggested that “sustainability means long-term and far-reaching changes in technologies, infrastructure, lifestyles and institutions” (Rennings, 2000, p. 2).

As such, the ubiquitousness of sustainability prompts an agenda that should theoretically operate within three spheres – economy, ecology and society. The focus of this research was to understand the impact of plant-based food innovation on ecological sustainability, with consideration on the economic and social ramification.

Food production systems and equivalent consumption patterns are at the core of ecological sustainability. De Boer and Aiking (2011, p. 1260)

postulated that coupled with exponential population growth is increased demand for primary provisions such as food, the production of which is a significant contributor to ‘global environmental pressure’.

This study aimed to unpack the innovation processes within the plant-based food sector and assess and to what extent it can meet and transform issues pertinent to sustainability.

1.3. PROBLEM STATEMENT

Ockwell, Ely, Mallet, Johnson and Watson (2009) and Godfray, et al. (2010) agreed on the severity of anthropogenic impact on the earth; a large contributor of which is CO_2 as a by-product of food production. Persistent levels of these emissions have far-reaching consequences on the natural ecosystem, which is subsequently hurled into imbalance. To address these adverse effects, it is now widely recognised that food production systems and the food chain, in general, must become fully sustainable. Factors such as climate change, land degradation and water usage are high priorities on the world agenda. The exasperation of natural resources by current food production & consumption patterns necessitates that innovation adopts a new trajectory if it is to bring about sustained economic development. According to Smith, et al. (2010), this is must be shaped at a systems, firm, and product level.

Present day food consumption exhibits an increased tendency towards demand for meat and dairy products. Ely and Bell (2009) and Godfray, et al. (2010) proposed that this is predicated on increased wealth capacity amongst certain nations. This trend of increased wealth equating to an increase in consumption is strenuous on the earth’s finite natural resources to meet the growing demand. There is seemingly a, correlation that exists between the increase in consumption and depletion of natural resources.

Morris, Kirwan and Lally (2014) and Tilman and Clark (2014) both submitted that greenhouse gas emissions, released as a result of livestock production are a substantial contributor to climate change. According to Tilman and

Clark (2014), the emissions arising from beef and lamb production are 250 times more than that of legumes. Godfray, et al. (2010) also explained that a substantive amount of grain or plant matter is grown and fed to livestock to enable their on-going production. They go on to suggest that more efficient use of those plant-based foods would be to streamline the process by adopting a plant-based diet, which could feed more people, versus being used to feed animals, thus providing a viable solution to global hunger issues and sustainable food production. However, Godfray, et al. (2010) also suggested that not all meat production is harmful and that certain livestock have higher release points of methane than others, and circumvention is plausible through improved methods of rearing and breeding. By their admission, Godfray, et al. (2010) suggested that continued population growth coupled with demand requires an innovative solution that offers a long-term sustainable view as opposed to a short-term solution to meet global needs.

Economically, while certain nations enjoy progression, Ely and Bell (2009) and Godfray, et al. (2010) questioned whether their prosperity is at the expense of disadvantaged or developing economies who are potentially displaced while meeting the needs of developed economies.

Inextricably linked to the proliferation of meat-based diets, is the social ramification, which sparks a range of health issues, impacting global communities. Morris, et al. (2013) and Tilman and Clark (2014) have both cited cases where an increase in meat and dairy products has been linked to an upsurge in chronic diseases. Morris, et al. (2013) predicted that meat consumption will double by 2050, which does not bode well for lowering the risk of associated health issues including obesity. However, Tilman and Clark (2014) also suggested that adopting a ‘healthier’ diet does not directly relate to it being more environmentally beneficial and vice versa. As such it becomes imperative to investigate the impact of plant-based food innovations that are ecologically, economically and socially sustainable. .

1.4. SIGNIFICANCE OF THE STUDY

There is increased pressure on the planet and its resources, which has signalled for a change from the status quo in business and consumer practice. Stakeholders, such as Departments of Food & Agriculture; government policy makers; big businesses; plant-based food innovators and environmentalists would benefit significantly from understanding whether innovation in food systems, specific to the development of plant-based foods could positively impact ecological sustainability. This study presents an opportunity to fulfil a gap in the existing body of knowledge, specific to the development and impact of plant-based food innovation, and hopefully through its findings, present a viable case to support a change in food patterns.

1.5. DELIMITATIONS OF THE STUDY

The focus of this study is innovation in plant-based food as a construct of sustainability, understood within the context of food production systems. The scope of research aimed to investigate, through a case study methodology, whether innovation in plant-based foods can positively impact issues of global sustainability. The study did not include an in-depth review of animal and agricultural practices or other developments in food innovation such as cell agriculture.

1.6. ASSUMPTIONS

Assumptions included that both case studies cited would be willing participants open to sharing information regarding their innovation and sustainability practices. It further assumed that respondents would be knowledgeable within their area of expertise and that this would contribute positively toward the study.

1.7. CONCEPTUAL FRAMEWORK

Adaptive management has been described by Norton and Steinemann (2001) as a framework to approach sustainability through learning and

active change. As a construct, sustainability cannot be discussed without approaching it through the lens of ecology, economics and social theory. The adaptive management framework integrates these aspects and appreciates the evolutionary nature of each. While different components may be imbued with particular importance at a point in time, one cannot neglect the other aspects, as adaptive management is a collaborative process.

These components are not static and are subject to change. Over time, ecology is extended through the conservation of resources. Social theory is the viability of human societies over time and attempts to understand the development of community empowerment. Economics refers to resources, which to last over time, require innovation. This was perhaps better articulated by Holling (2000) who ardently expressed that these three spheres are inextricably interlinked and as such represent what he termed a “complex adaptive system” (Holling, 2000).

Smith, et al. (2010), Rennings (2000) and McKenzie (2004) echoed this sentiment when they stated that sustainability is unlikely to be achieved if a silo outlook is adopted versus a simultaneous appreciation of the integration of three key spheres.

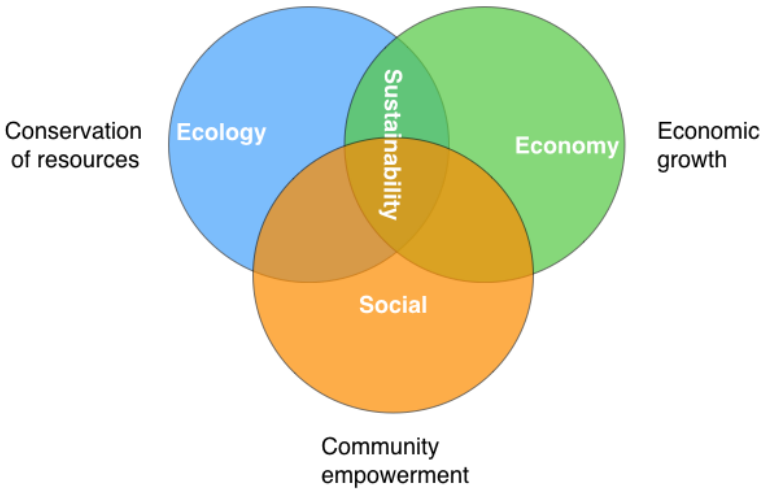


Figure 1.1: Adaptive management framework

This initiates a widening of the problem framing for sustainable development and the role of innovation in achieving a certain level of accomplishment. These pathways to inclusive and sustaining innovation converge at the crossroads of 'ecological integrity and diverse environmental and social values' (STEPS Centre, 2010, p. 16).

Lee (1999) propagated for a baseline understanding of nature to be developed if humans are to perpetuate their current assertive role. This rudimentary knowledge is essential if learning is forthcoming. Through experimentation, adaptive management practitioners learn and implement these findings to make better decisions infused with a concern for both humanity and the planet. This standpoint springs forth from the bedrock that is Holling's seminal work of 1978 in which he recommended the development of policy that is robust and accommodated for changes in the environment that are both natural and man-made and the subsequent modification it heralds. In a bid to suggest solutions to current food consumption practices linked to sustainable innovation, a full-bodied approach is necessary. This is operationalised through the three central axioms of adaptive management as explained by Norton and Steinemann (2001), which are the following:

1) **Experimentalism**: Learning and the subsequent knowledge gleaned which influence actions that are implemented in a bid to reduce uncertainty.
2) **Multiscalar analysis**: An integrated model that allows one to understand the complex interactions of the environment. Policies are designed to evaluate their consequences in time intervals ranging from present to future.

3) **Place sensitivity**: Study of the geographical context in a given situation and associated place-based values, along with relevant stakeholders.

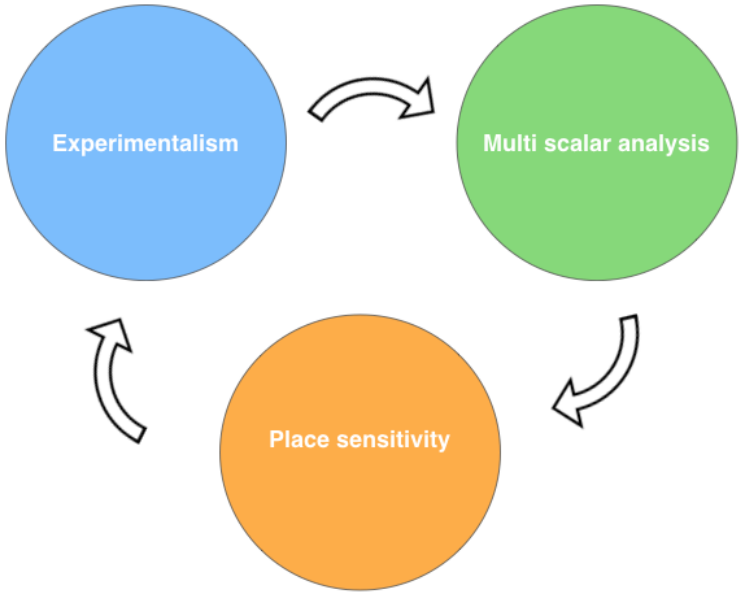


Figure 1.2: Three central axioms of adaptive management

Using this framework, the research was operationalised in the following way:

- Unpacking two case studies as a foundation of the research, from a global North and South perspective relating to innovative practices linked to sustainability efforts.
- Examining the scalability of practices within the organisation and extension of these into a greater ecosystem.
- Overview of plant-based food production practices at a firm level and the impact thereof based on contestations or opportunities derived from external policy.
- Appraisal of placed-based values in the Global North and South about food consumption patterns and receptivity.

Through this lens, this research aimed to unpack the role of innovation in plant-based foods and its impact on ecological sustainability. This was done through an analysis of two cases, which sought to explore how a firm can sustainably innovate by leveraging the adaptive management framework.

1.8. RESEARCH QUESTIONS

The following are the research questions (RQs) the study sought to answer:

RQ1: What is the current role of innovation in developing sustainable plant-based food production practices in the global North and South comparatively?

RQ2: How are the economic resources of a given organisation mobilised to promote plant-based food innovation?

RQ3: Are there significant impacts of innovation in plant-based foods on the various dimensions of sustainability in the society? If so, what explains these?

1.9. OUTLINE AND STRUCTURE OF THE REPORT

Chapter 1: Introduction

This introduces the purpose of this research report. It sets the scene with regards to the areas that needed to be explored and their relation to the research topic. There is further discussion around the significance to the study, its delimitations and research questions that the study aimed to answer.

Chapter 2: Literature review

The literature review investigates themes prevalent to innovation, sustainability and plant-based foods. Constructs related to the problem are explored independently and ultimately woven to illustrate a relationship, and identify a gap in the existing body of knowledge. There is a summation that ties the content together to illustrate the objective of the study.

Chapter 3: Research strategy and methodology

This chapter illustrates the manner in which the research was conducted including the methodology, review of case studies, review of participants, data collection and analysis.

Chapter 4: Presentation of results

In this chapter, the findings from the research are presented according to the conceptual framework that shapes the discussion of this report. Excerpts from the semi structured interviews are collated and shared to add texture to the summary of findings.

Chapter 5: Analysis of results and discussion

This chapter addresses the findings and synthesises them together with the literature showcased in Chapter two. In doing so, this chapter cements the relationship between the problem and existing body of knowledge, as well as how the study contributes to new understanding aveues of understanding.

Chapter 6: Conclusions and recommendations

This chapter serves to make definate links between the intended outcome of the study and its subsequent findings. Conclusions are drawn based on the data and offered alongside potential solutions or recommendations as well as scope for future research regarding this**.**

1.10. CONCLUSION

This study aimed to establish if a connection exists between constructs within the realm of ecological sustainability in relation to innovation in the plant-based sector. Through a qualitative, case study-based research approach, the intent was to unpack innovation in plant-based foods and assess whether there is a subsequent impact on global sustainability issues.

CHAPTER 2
LITERATURE REVIEW

2.1. INNOVATION AND SUSTAINABILITY

The pursuit of economic development by most countries' has necessitated process and product innovation across all industries.

Innovations' ability to transcend from ideation, invention and ultimately adoption, has proven useful across a myriad of sectors. Recent literature has unearthed discussions surrounding the role of innovation in moving toward sustainable efforts. Kemp (1994) and Juma, Tabo, Wilson and Conway (2013), in their respective papers, discuss the need for innovation to meet growing concerns around environmental degradation perpetuated by concerning agricultural environment, factors impacting climate change and anthropogenic tendencies. This is further entrenched in the New Sussex Manifesto, which acknowledged the sometimes-egregious side effect of economic and technological advancement and sought to remedy this by encouraging a more holistic view of the environment within which innovation was being deployed.

In the late 1970s, scholars from Sussex University, at the behest of the United Nations, published a document entitled the Sussex Manifesto. It initially adopted a narrow view of innovation and was concerned squarely with economic productivity. This is stipulated by Ely and Bell (2009) in their working paper, which states that economic development was at the helm of science and technological innovation. Fast forward 40 years and the manifesto challenged innovation scholars to reflect the broader impact of their technological innovations. A new Sussex Manifesto redeveloped in 2010, called for inclusion of poverty, social justice and environmental sustainability considerations. This was primarily due to dialogue developing around the anthropogenic impact on the global sustainability discourse. The role of innovation in responding to this challenge was paramount according to Ely and Bell (2009), who suggested that the focal point for innovation had

shifted from economic growth to a more inclusive view. The innovation agenda should now include development that is sustainable and beneficial to a plethora of actors, while still in pursuit of economic progression.

To appreciate the role of sustainable innovations, calls for introspection surrounding sustainability as a construct. McKenzie (2004) attempted to define sustainability. The unpacking of the term has evolved since the early 1960s. It first came to mean economic growth encompassed as being sustainable and providing affluence through employment and subsequent increases in living standard measurements (McKenzie, 2004, p. 1). Fast-forward to the 1980s and the International Union for the conservation of nature developed a more comprehensive definition that reflected a concern for the environmental component (McKenzie, 2004, p. 2). Toward the late 1980s, the Brundtland definition of sustainability became the most widely adopted in that it considered the nature of development across the board, by ensuring sufficient allocation of resources for current and future generations.

This definition along with the newly defined Sussex Manifesto precipitates how the agenda of sustainable development is met, and the role of innovation in the delivery thereof. The United Nations at the Rio Summit in 2012 developed a set of ‘sustainable development goals’ (Griggs, et al., 2013, p. 305). It calls for the implementation of change across six definite agendas that are designed to protect the earth’s natural resources while still providing for its ever-burgeoning population. These goals include “thriving lives and livelihoods, sustainable food security, sustainable water security, universal clean energy, healthy and productive ecosystems, and governance for sustainable societies”. (Griggs, et al., 2013, p. 305).

Rennings (2000) and Leach, et al. (2012) both mentioned the importance of the goals as outlined by the UN, but brought forth a theme about what needs to be achieved and the role of innovation in doing so. According to Leach, et al. (2012), innovation’s trajectory would need to be far more pervasive.

The development of this approach to sustainable innovation has intrinsic characteristics. These are expressed by Smith, et al. (2010), Kemp (1994) and Ockwell, et al. (2009) all of who attested to the multi-collaboratory nature of innovation that underpins its success. This is perhaps best articulated by Smith et al who intimated that sustainable development is hinged on the three key components comprised of mass – the people and objects; the speed at which development is transpiring and the overall trajectory it follows.

Kemp (1994) spoke of an aperture that exists for wide-scale technological overhaul vs incremental changes if sustainable development is to be a reality. Ockwell, et al. (2009), Leach, et al. (2012) and Seebode, Jeanrenaud and Bessant (2012) further supported this thought in their discussions that suggest that innovation has the impetus to move society forward. However, its trajectory is now in some part governed by the sustainable development requirements as set out by world leaders. This trajectory requires a fundamental shift in the way in which technologies are developed, businesses are shaped, and human consumption patterns evolve.

The Kyoto protocol, which was developed by the United Nations Framework Convention for Climate Change (UNFCCC) as a means to understand how to mitigate climate change, documents this regime change (Telesetsky, 1999). Through globally agreed upon goals, a consensus was reached that countries had to own responsibility for the human-induced activity that was resultant in climate change. Agarwal and Narain (1996), in their report ‘Global Warming in an Unequal World’, discussed statistics as inferred by the World Resources Institute that suggests the concept of ‘environmental colonialism’. Deconstructed, this simply refers to the fact that developed and industrialised economies mitigate their responsibility towards climate change by suggesting that developing countries are equal contributors and emitters of gases that lead to global warming. However, when gauging the emissions from countries versus their per capita breakdown, there was a

marked disproportion. This discourse was eventually set aside, and the Kyoto Protocol was enforced in 2005. This recognised the dispersion of responsibility to mirror the quality, quantity and nature of emissions emanated from responsible parties. As such, industrialised economies that had been polluting for a far more extended period, and prospering accordingly, had a greater sense of responsibility in finding solutions to combat climate change as well as reduce their emissions. Developing countries were tasked to pollute less while in pursuit of economic growth and progress.

Apart from the many market mechanisms that were introduced to curtail the emanation of greenhouse gas emissions, in the global discourse on sustainability, innovation is a key participant in the mitigation of climate change. This view is put forward by the United Nations through The United Nations Framework Convention on Climate Change which outlines the necessity of technology in mitigating the ‘anthropogenic emissions of greenhouse gases’ (United Nations, 1992) and is supported by the New Sussex Manifesto.

Kemp (1994) and Seebode, et al. (2012) suggested innovation at the firm level as the impetus for change in the approach to developing innovations that encourage sustainable development. With access to abundant resources and financial means, firms can impact the consumer marketplace that would encourage and prompt a lifestyle change in adopting sustainable innovations. This was summarised by Kemp where she claimed that a regime change would require firms to be complicit in their commitment to innovation, which could have a widespread impact on the development, improvement and diffusion of innovation (Kemp, 1994, p. 16). Rangaswami, et al. (2009), in their paper ‘Why sustainability is the key driver of innovation’, discussed a five-stage process that companies can espouse to deliver on innovations that alleviate an environmental burden. This is in support of the above-mentioned discussion as Rangaswami, et al. (2009) revealed that only a small percentage of the planet’s population currently benefit from the

‘economic system’; however, the density of the burden placed on it affects almost everyone. With projected population growth, the imperative is for companies to move toward practising strong sustainability, which is characterised by complex systems where an organisation is fully balanced regarding the adaptive management framework. They can meet ecological, economic and social needs, and all actors share the same viewpoint. There is an appreciation for the natural capital and that it cannot simply be replaced, and as such, organisations value the ecological system over economic gain. A baseline understanding exists that there can be no economic benefit if the ecological system is imbalanced.

While Seebode and Jenrenaud in their 2012 paper, Managing Innovation for sustainability, adopted Kemp’s views, they also introduced the notion of ‘systems level thinking’. This suggests a move from simply managing innovation for sustainability toward generating an impact that can infuse change across the spheres of economy, social systems and the environment. This is described as a shift from eco-efficiency to ‘eco-effectiveness (McDonough & Braungart, 2002)’ (Seebode, et al., 2012, p. 8). This wave of thought underpins the constructs for sustainable innovation being economic, environmental and social progress. This rhetoric was echoed by Holling (2000) who advocated that an inclusive approach to sustainable development is the foundation on which future growth is built. Isolation and partiality toward any one element over the other are likely to result in an unwanted planetary chasm. It must be acknowledged that the interlocking of ecology, economy and social theory is paramount in assessing the impact of human activity on the environment. In his seminal work, Holling (1978) posited that changes in the environment are both natural and man-induced. A static approach to understanding these changes is arbitrary, as it does not offer a ‘live’ view of what action should be forthcoming. He suggested that ecosystems are dynamic and should be treated and understood in relation to the spectrum of human activity and involvement.

The status quo on sustainable efforts is reactive in nature. Holling (1978) offered an alternative viewpoint to environmental assessments and suggested that it needs to be inclusive and proactive – integrates environment, economic and social impacts, as these cannot be considered separately when humanity and the planet are so inextricably interlinked. Current practices are too insular and only show concern for environmental forces and not their subsequent impact on the economy or social factors or vice versa. Lee (1999) intimated that natural ecosystems are complex – and face impact by both human involvement and natural causality. With a ceaseless influx of human development, planetary changes are certain. This begs the question as to how sustainable development would be achieved in light of various forces of change.

Innovative activity with an ecological focus can mitigate anthropogenic degradation of natural resources. This might pose as a challenge to a wide range of stakeholder groups. However, the earth's natural resources are being diminished faster than they can regenerate (Rangaswami, et al., 2009) which attests to why the Sustainable Development Goals were developed, to protect the planet and its people. Leach (2012, p. 1) suggested that we are inhibiting "an environmentally constrained planet". This is supported by Ockwell, et al. (2009) who attested to the need to reduce greenhouse gas emissions significantly, the bulk of which has been accepted as being man-made, and doing so with a sense of urgency to avoid a severe impact on the earth, which is guaranteed if change is not mobilised. Lee (1999) reiterated this claim regarding continued population growth and subsequent development will see humans inhabit and consume abundant natural capital. This consumption precipitates a need for conservation and rhetoric that is rooted in sustainable development.

According to Smith, et al. (2010), the early 1990s saw a shift in policy and adoption of environmental technologies and promoting innovation within that sector. This included not only a modification to the manner in which business was conducted, but also to the nature of what was being produced

and developed. This thread was further supported by Seebode, et al. (2012) who suggested that firms embraced new knowledge, skill development and technologies, which in turn birthed a demand for a green goods economy including products and services.

Rennings (2000) implied that the uptake of green goods was an important supplement in the global rollout of sustainable innovations, as it was unlikely that sustainable development goals would be met just through the development of environmental technologies. He suggested that market regulation encouraging “environmental process innovation” in tandem with product innovation would be central to efficient diffusion (Rennings, 2000, p. 327). Smith, et al. (2010) supported the point as they posited that environmentally sound technology was integral in revolutionising industries, which ultimately would elicit modifications not only to business practice but lifestyles too.

In meeting sustainable development goals, Lee (1993) suggested that an explicit need exists to understand how the relationship between humanity and the earth is structured so that it is understood what the required inputs are. Humanity, in pursuit of development, has fundamentally changed the face of the earth and its elements. As such, these two forces find themselves inextricably linked in an arduous relationship. The development of new technology is insular, and there is no consideration for the environmental impact. Institutions or social entities have a pervasive influence in shaping the trajectory of progress for humanity. However, humans have no understanding or appreciation of their self-imposed austerity on the earth’s resources. This has to be better understood to achieve a level of sustainable development. Lee (1993) declared that through understanding the economic use of ecological resources, one can incite global social learning.

2.2. FOOD PRODUCTION AND CONSUMPTION PATTERNS

This regime change specific to sustainability, suggests a conversation about current food production systems, consumption patterns and the breadth of

change required to consider ‘long-term environmental sustainability’ (Smith, et al., 2010, p. 5). Godfray, et al. (2010) are in support of a food industry overhaul as current practices are untenable and have adverse effects. These include greenhouse gas emissions predominantly from the agriculture industry, water shortages and land degradation. Juma, et al. (2013) also discussed how innovation in food production is necessitated by issues pertinent to the African continent such as concerning agricultural climate propelled by issues surrounding climate change. These concerns, however, aren’t limited to an African context and can similarly be found in both developed and emerging economies of the world, which attests to why scholars such as Godfray, et al. (2010) have advocated for more sustainable food production practices.

De Boer and Aiking (2011) postulated that food production should be considered at a ‘macro’ and ‘micro’ perspective. The macro perspective is about current food production practices and the extension of those ramifications on factors that affect the depletion of natural capital. The micro perspective is about consumer food choice and the underlying factors that drive it. De Boer and Aiking (2011) suggested that a combined view of these perspectives would precipitate discussions around global food security, possibly leading to the adoption of a plant-based diet as a sustainable solution. This viewpoint is reiterated by Tilman and Clark (2014) who assessed the relationship between diet and sustainability and introduced the notion that our dietary choices have dire consequences on the environment, specifically the farming of animals. This is supported by their findings that illustrate a link between lower greenhouse gas emissions and plant-based foods.

The Food and Agriculture Organisation of the United Nations (2006) published a document titled ‘Livestock’s long shadow’. It focuses on the global relevance of thelivestock sector that necessitates a discussion about its long-term impact in the face of growing population and demand for meat and milk. Concerning livestock, the study provides evidence showing that

18% of GHG emissions are produced from the sector. “This is a higher share than transport” (Food and Agriculture Organisation of the United Nations, 2006). This contribution to climate change is sobering and is predicated on current food consumption patterns amongst slightly more affluential countries.

The role of sustainable innovation in mitigating the current trajectory of food adversity is paramount. This can be analysed through the lens of economic, social and ecological constructs, which many scholars have deemed intricately linked with issues pertaining to sustainability. From an ecological standpoint, food production specific to the curation of meat-based foods is a culpable contributor to negative externalities of climate change through the emission of greenhouse gases. This is validated by (Morris, et al., 2013) who quoted Steinfeld, et al. (2006) in saying that a consensus exists amongst various players that greenhouse gases emitted through the production of livestock contribute significantly to climate change.

Tilman and Clark (2014), who attribute the emission of GHGs in large part to food production, more specifically beef and lamb who are shown to emit 250 times more than legumes, support this. Animal agriculture is a major contributor to GHGs through the release of methane, a fact supported by Godfray, et al. (2010) and Agarwal and Nairan (1996) through a report published by Crutzen which states “almost 75 percent of all animal-related methane comes from the world’s 1,300 million heads of cattle”.

Parallel to the discussion regarding the offset from meat-based food production, are the natural resources required to facilitate this. Current manufacturing processes are incurring debt with the earth’s natural capital, which was described by Pearce, Barbier and Markandya (as quoted in Jabareen, 2014) as any natural asset including land, soil, fresh water and the inherent ability of the earth to absorb and diffuse offsets from production. Godfray, et al. (2010) postulated that food production must adopt sustainable practices as inherent if the earth is to continue producing renewable resources at a rate that is convenient to its ability.

Economically, Morris, et al. (2013) suggested that from a nutritional, culinary and social standpoint, meat is regarded as chief in achieving stature within these circles. Additionally, a dichotomy exists amongst the population of developed and developing countries germane to consumption and production. Agarwal and Nairan (1996, p. 5) reported that “per capita meat consumption is six times higher” in developed countries than in the developing ones at “78kgs/year as compared to the latter (14 kg/year)”. This can be attributed to economic access. However, growth can be seen in markets such as India and China due to ‘increased wealth’ of consumers (Godfray, et al., 2010). Tilman and Clark (2014) in their research also noted the increased meat consumption as economic viability intensifies; however, there hasn’t been an increase in resources to support the demand. This begs the question as to how additional food production could be sustained from the existing resources such as land and water, while emitting added substances that contribute to the rising greenhouse gas levels.

Comparable to the economic facility to participate in purchasing of meat products is the social prestige attached to it. Morris, et al. (2013) discussed the ‘meatonomic system’ as introduced by Robinson Simon, which encourages regular consumption that can be attributed to overproduction. As countries and their populations become prosperous, this is exhibited through their purchasing power. However, this behaviour births concerns regarding the adverse effects of augmented consumption on long-term health. Godfray, et al. (2010) and Tilman and Clark (2014) articulated the concern over the mounting rise in obesity and other related ailments such as diabetes, cancer, heart disease, many of which have been attributed to increased levels of an omnivorous diet. This is detrimental to a mortality rate of populations from both the Global North and South.

Solutions have been put forward to mitigate the sustainability challenges of current food production practice; however, the long-term validity of these is uncertain. Initiatives such as ‘meat-free-Monday’, what Morris, et al. (2013) describe as an “LMI- less meat initiative”, are social innovations designed

to encourage the uptake of a meat-free day, the long-term effects of which could mitigate the contribution to greenhouse gas emissions and increase overall health and well-being. However, Morris, et al. (2013) raised concerns about the effectiveness of such a practice in reaching overall goals of sustainability. Godfray, et al. (2010) introduced the notion of a 'yield gap', which speaks to better management of food production through new technologies and increased knowledge. However, this is not a globally implementable solution, as it would need to be tailored to suit specific countries and practices. Additionally, there is no certainty as to the positive impact this could have on the environment. The earth's resources have already been exploited to their full extent. Therefore, it is agreeable that innovation for sustainable food production is a requisite for long-term global sustainability. This is a sentiment that is shared by both Godfray, et al. (2010) and Tilman and Clark (2014) but perhaps more succinctly encapsulated by Sabaté and Soret (2014) who stated that in order to achieve a sufficient and impressionable indent on food sustainability, a dietary shift that is reminiscent of more plant-based foods would make great strides in alleviating the burden on the natural environment. This is due to its less onerous effect on ecological elements required in the production thereof. If this approach is not adopted, the earth could be on a collision course that might render it incapable to recuperate from.

2.3. PLANT-BASED FOOD INNOVATION

Ecologically-centric companies are investigating new and improved methods concerning food production that could provide an optimistic outlook to challenges such as land degradation, water usage and greenhouse gas emissions. The meat and dairy industry utilise practices that are unfavourable to the global sustainability agenda. Sabaté and Soret (2014), as well as Pimentel and Pimentel (2003), exemplify this when they suggest that global food security is under direct threat if efficiencies of production are not introduced. Pimentel and Pimentel (as quoted in Sabaté & Soret, 2014), determined that 11 times the amount of fossil energy is required to

produce animal protein vs plant protein. De Boer and Aiking (2011) suggested that as a result of phenomenal population growth, pressure has been incited on natural resources that are likely to buckle under constant pillage. The estimated world population in 2050 is 9.1 billion and the pressure to meet global food security agenda is imminent. Many studies discuss how plant proteins are more favourable to sustainable production practices as opposed to animal protein. However literature surrounding the development of plant-based foods, specific to mock meats, as a tool for sustainable innovation is minimum. Extensive content has been shared in relation to innovation for sustainability, specific to the ecological paradigm, as well as current food consumption and production patterns. This research aims to contribute to the body of knowledge regarding the production methods of plant-based foods, specifically mock meats and their impact on resources, and whether they will contribute to the global environmental sustainability agenda.

2.4. SUMMARY

The route map for innovation is primarily directed by the need to sustain the people and planet, which it inhibits. Businesses adopting a triple bottom line (people, planet and profit) have to embed this ideology into the fabric of their operation and not as a corporate social responsibility initiative. According to McDonough and Braungart (2002), if this creed is the driving force of business and not a plugin, its potential positive impact on the ecosystems is rife. Porter and Kramer (2011 as quoted in Seebode, et al., 2012) adopted a view similar to McDonough and Braungart (2002); however, extended this to the constructs of social, environmental and economic theory. They suggested that by creating ‘shared value’ amongst these three, could see regeneration amongst natural capital.

Food production systems will require a massive overhaul if they are to support increasing populations and economies. Plant-based food potentially requires less access to natural resources and can sustain diets across the spectrum. Pimentel and Pimentel (2003 as quoted in De Boer & Aiking,

2011) stated that the production of an animal protein requires up to 100 times more water than 1kg of grain protein. This supposition warrants a further introspection into understanding how innovation within the plant-based food industry can be instrumental in shaping sustainability strategies for long-term global development.

2.5. THEORETICAL FRAMEWORK

Smith, et al. (2010) postulated that economic fulfilment is no longer the singular driving force for innovative activity. If innovation is to flourish, then the challenge it faces is to induce change across the environmental and social landscapes for it to conjure sustainable development.

The trajectory of sustainable innovation has prompted an overhaul of business production models, generation of a viable and thriving green goods economy (Seebode, et al., 2012) and societal adoption of an eco-friendly lifestyle. This view is supported by Leach, et al. (2012) as outlined below.

Innovation's trajectory is shaped by global sustainability criteria specific to economic, ecological and social spheres. Leach, et al. (2012) discussed three dimensions that steer sustainably-led innovations, namely the following:

Direction – looking at the trajectory of innovation and that it is aligned to delivering innovative capabilities that are robust and can meet the sustainable development goals our planet faces.

Diversity – encourages cross-sectorial and micro/macro innovation to produce pathways that assist in achieving the goals as outlined above.

Distribution – understanding the human impact of innovation policies linked to sustainable development.

Rennings (2000, p. 320) supported the above and additionally suggested that technology alone will not produce a clear-cut pathway to sustainability

and parallel to the adoption of technology is a societal lifestyle shift supported by institutional change.

In support of business and consumer transition, the efficiencies surrounding food production and subsequent consumption patterns are studied. According to De Boer and Aiking (2011, p. 1260), population growth coupled with economic prosperity is exacerbating food production, which in turn activates undue pressure on natural ecosystems. It is suggested that plant and animal production is intensified to meet the demands of a burgeoning population, straining resources through degradation of land; high consumption of water and release of greenhouse gas emissions, threatening climate change.

Holling (1978) suggested that ecosystem metamorphosis is resultant from a dual combination of a natural proclivity for change and human impact, as has been discussed above. Lee (1999) referred to it as “tension between human power and natural wealth”. If innovation for sustainable development is to be explored, the onus rests with humanity to wholly understand the earth’s requirements in developing appropriate solutions. Holling (1978), in his seminal work ‘Adaptive environmental assessment and management’, suggested that the expanse of human knowledge on natural ecosystems is slight and this limits our ability to accommodate or design a policy that is bespoke. This short-sighted approach can also be attributed to the extensive consideration that is offered to the environment, and that lacks extension to the social and economic concerns that influence this. Holling (1978) rallied for a policy approach that is inclusive in its integration of environmental, economic and social concern. To design and develop such policy, knowledge becomes a key component – both that which is known and how to treat the unknown. This is the crux of Hollings’ view on adaptive management, which he describes as “an interactive process using techniques that not only reduce uncertainty but also benefit from it. The goal is to develop more resilient policies” (Holling, 1978, p. 9).

Walters' (1986) expansion of this theory is centred on the prospect of learning continuously through the management process and policies, which should be viewed as experimental in their design and implementation. He put forward three key areas that should be considered in policy design, which include the following:

1) A mathematically inclined model that assists with predicting uncertainties which in turn help generate alternative hypothesis in the development of policy.
2) Statistical analysis and optimisation that aid in finding optimum policies in relation to current and potential uncertainties.
3) Design and implementation of policies that are dynamic and responsive.

Walters (1986) shared a similar sentiment to Hollings' (1978) theory about the integration of social, economic and environmental dynamics and asserted that gaining knowledge through learning and doing persistently is integral in understanding whether something would work.

Lee (1993) echoed the commentary as made by the former scholars regarding adaptive management approach to learning through policy experiments. In his 1999 paper, which is an appraisal of adaptive management, he suggested that the adaptive management as an ideology for understanding versus operationalising issues of sustainability is where it resides. Its implementation will become vital in the pursuit of sustainable ecosystems. Lee (1993) was emphatic about the relationship between humanity and the earth and encouraged humans to build a reliable database of knowledge to know how to manage complex ecosystems. Using adaptive management, one can, therefore, learn while doing. This supports the thought that action is taken immediately and not when all variables are known as nature is dynamic and time and resources cannot be deferred. Lee (1999) suggested that adaptive management is resultant from the fact that humans cannot manage ecosystems, but they can manage the people

that interact with the ecosystem. It is a process of learning through experimentation to better improve the management of ecosystems through policy design and implementation. He suggested that policy design is integrated with what he termed compass and gyroscope. The compass can be likened to physical and social science that stewards the right direction in the shaping of public policy. Moreover, gyroscope can be thought of as democracy, which brings the answers generated by science into the free market open for discussion and debate. This element is critical for Lee who suggested that the inherent learning characteristic of adaptive management requires that the participants directly impacted by the experiments or closely involved in the ecosystem, should participate.

In looking at the sustainably led innovation framework, overlaid with current food production and consumption, this research sought to determine what impact innovation in plant-based foods will have in achieving a level of ecological sustainability, tangential to which is the global food security goal.

2.6. STATEMENT OF HYPOTHESES OR PROPOSITIONS

RQ 1: What is the current role of innovation in developing sustainable plant-based food production practices in the North and South comparatively?

Proposition one: The rapidly growing population both in developed and developing economies breeds a further intensity in food production and consumption practices. As consumer affluence matures, so too does the demand for food, which is often meat-based, that epitomises the newfound prosperity. If the sustainable development agenda is to be adopted and reached, innovation has to adopt a prime position in goal accomplishment. Its nature extends from that of economic or technological prowess to global social and ecological concern.

RQ 2: How are the economic resources of a given organisation mobilised to promote plant-based food innovation?

Proposition two: Sustainability has been built into the fabric of organisations and is no longer confined to a singular effort. Rangaswami, Prahalad and Nidumolu (2009) suggested that early adopters of the new 'innovation frontier' are spearheading a model that integrates sustainability into the fundamental baseline development of a company. As such, resources are being channelled toward innovation that has an environmental concern at its core.

RQ 3: Are there significant impacts of innovation in plant-based foods on the various dimensions of sustainability in the society? If so, what explains these?

Proposition three: The provision of innovation in plant-based foods has generated an upsurge in the adoption of a green economy. This is extended through consumer purchasing power; increase in green goods and services; and environmental recuperation.

CHAPTER 3
RESEARCH STRATEGY AND METHODOLOGY

3.1. INTRODUCTION

This chapter discusses the intent, scope and nature of the research methods undertaken to gain insight specific to the research problem. This research report adopted interpretivism as its paradigm. The fundamental intent that underpinned the research inquiry was to assess the level of impact if any, that plant-based food innovation has on factors pertinent to ecological sustainability. Contextually, the research is exclusive in that the focus is explicitly based on two case studies and therefore, does not aim to extrapolate the findings to the general public, however, adopts an deductive approach.

3.2. RESEARCH STRATEGY AND DESIGN

This study made use of a qualitative research approach to gain in-depth insights pertaining to the impact of plant-based foods on ecological sustainability. This approach is relevant to the study at hand as it seeks to "explore, understand and describe" (Du-Plooy-Cilliers, Davis & Bezuidenhout, 2014, p. 174).

A case study approach was utilised to investigate the research problem as outlined. "A case study is a thick and detailed description of a social phenomenon that exists within a real-world context. The case study recounts a real-life situation by rigorously describing the scenario in which the phenomenon occurs. It is an attempt to understand a phenomenon within specific circumstances". (Du-Plooy-Cilliers, et al., 2014, p. 178). This view is shared by Eisenhardt (1989) who suggested that a further characteristic of a case study is to unpack the undercurrents within a singular setting. Robson (2002, p. 178 as quoted in Saunders, Lewis & Thornhill, 2009) defined **case study** as "a strategy for doing research which involves an empirical investigation of a particular contemporary

phenomenon within its real-life context using multiple sources of evidence" (Saunders, et al., 2009, pp. 145-146).

There are three approaches to case study methods as outlined by Du Plooy-Cilliers, et al. (2014, p. 179). These include the following:

- 'An illustrative or typical case study': Is an exemplar of investigating the details of a single case with the aim of providing clarity around a suggested hypothesis or argument.
- 'An exploratory case study': Examines a case in the broader context within which it is situated.
- 'An explanatory case study': Provides an explanation as to the characteristics of the case.

This research design is exploratory and deemed appropriate for the nature of what this study sought to undertake. It involved the use of two cases and investigating each one using the same structure and criteria and aim to understand both cases within the context of innovation for ecological sustainability. A dual case study approach according to Yin (1981) is suitable when trying to study a phenomenon common to both cases. This was echoed by Saunders, et al. (2009) who suggested that multiple case studies offer the researcher the ability to ascertain whether phenomena, as unearthed in one case, are likely to occur in another and in doing so, generalise these findings to an extent. Each case is approached with its merit and investigated to contribute to the study in its entirety. The comparative approach is gainful as it allows for one to explore a phenomenon within a specific industry, from divergent angles and contribute to the body of knowledge robustly.

Meticulousness in the investigation of each case is expected, and for this study thematic analysis was deployed to uncover patterns from the raw data in order to analyse themes specific to the research questions.

The case study required access to two companies – one based in South Africa and the other in the United States of America (USA). The researcher knew that access to the local company would be without effort, whereas access to the American company would encounter some limitations and these would need to be managed to ensure equity across the data gathering process.

Both cases – Fry's Family and Impossible Foods adopt a parallel stance on the sustainability dialogue and operate businesses that are purpose driven. They aim to positively impact the global food agenda through an innovative approach to constructing meat alternatives developed from plant molecules. However, their methodology to plant-based food production varies, which suggests room to investigate the approach and techniques in relation to meeting the environmental burden placed by current food production practices. There are three key comparisons to draw between both organisations that lend them to being dissected through a case study review.

Company architecture

Fry Family Foods is a well-established, South African family-run organisation that has been operational since 1991. They export a diverse plant-based food range to over 20 countries and have a substantive foothold in South Africa, Australia and England. Apart from being available in retailers, they are also widely found in restaurants and are instrumental in their activism of promoting plant-based diets.

Impossible Foods is a startup in Silicon Valley, California, founded in 2011 by a biochemistry professor, Dr Patrick O. Brown. Their mission is to reduce the impact of animal agriculture. After failed attempts at mobilising thought and dialogue through scholarly conferences, Dr Brown set about investigating how to create a food product that would assuage the mounting environmental and health burden that is attested to livestock and meat production. As a company in its infancy, their production line is limited to the

United States (US), and cannot be found in retail outlets just yet. However, there is a growing restaurant location list, citing over 150 restaurants in which their Impossible Burger can be found.

Global North and South

A comparative case study approach that probes the innovative stance and capabilities of companies representative of the North and South, as well as food sustainability, is critical. It is acknowledged that there are several emerging economies within the North and as such, the Global North is not representative of only fully developed economies. However, for purposes of this research, and based on the small number of plant-based food innovation companies, Impossible Foods represents the Global North and its developed economy, and Frys Family Food represents the Global South.

The discourse on sustainability is a global imperative. However, the level of responsibility assigned to developed versus developing countries is unevenly weighted. This disparity, however, is relevant given the prosperity that developed countries have and are benefitting from, which warrants their increased activity in being sustainably solution driven. Developing economies, while also significant contributors to the discussion, aim to minimise their resource footprint and adopt sustainable approaches while in pursuit of economic development and not as an afterthought. This notion is supported by Ockwell, et al. (2009) who reiterated the necessity for both developed and middle income emerging economies such as South Africa to limit their impact on climate change by adopting more sustainable approaches to economic activity. By doing so, they develop a definitive pathway for ‘innovation trajectories’ that moulds a globally sustainable regime (Ockwell, et al., 2009, p. 5).

Food production and consumption patterns play an integral role in the stewardship of sustainable living. Populations of the North, while only comprising 20% of the earth’s inhabitants is responsible for up to “85% of

the global consumption of non-renewable energy" (Agarwal & Narain, 1996, p. 16).

Firm-level innovation

Fry's Family foods were developed to mimic the taste and texture of meat, sans any of the negative ecological externalities. A large part of their product offering is non-genetically modified imported soy. This comprises anywhere between 15–30% of their final food product which also includes other plant-based proteins and vegetables. They are organisationally oriented through innovation adopting a DUI (doing, using and interacting) approach. The soybean is a widely grown legume and the most versatile in that it lends itself to consumption in its purest form, or further developed to resemble meat alternatives. This forms the base of many of Fry's products, who through adopting a learning by doing stance, created a range of mock meat products ranging from 'beef' and 'chicken' burgers to sausage rolls, nuggets, crumbed schnitzels and pies. Through persistent interaction between the end consumer and Frys, they have furthered this product line into what they term their 'crafted range' utilising existing plant-based whole foods such as quinoa, flaxseeds, and chia seeds to extend their offering. Their product line now includes not only mock meats but also cereal and non-dairy ice cream.

Impossible Foods inherently operates in by means of an STI (science, technology and innovation) approach to their business model. Through a concentrated research phase, the scientists at Impossible Foods set about to understand the attributes of meat and imbue that into their plant-based offering. The findings from this phase led them to isolate a molecule known as leghemoglobin. A naturally occurring molecule, an identical version can be found in animal muscle and can be attested to what makes meat 'meaty'. By isolating this molecule from a plant derivative, Impossible Foods created a burger that is an almost replica of a meat-based burger, however with far less impact on the environment and health benefits that outweigh that of a meat patty.

3.3. SELECTION OF PARTICIPANTS

Sampling methodology is critical in case study research as the population in this instance is exclusive to people who are closely involved with or aligned to the spheres of plant-based food innovation and sustainability. As such, non-probability sampling was used and Saunders, et al. (2009) described this as “a range of alternative techniques to select samples based on your subjective judgement” (Saunders, et al., 2009, p. 233). The relationship between the sample and their propensity to answer the research question is paramount. Accordingly, purposive sampling was selected and Saunders, et al. (2009) described this as “judgement to select cases that will best enable you to answer your research question(s) and to meet your objectives. This form of sampling is often used when working with very small samples such as in case study research and when you wish to select cases that are particularly informative (Neuman, 2005)” (Saunders, et al., 2009, p. 237).

In addition to the investigation of phenomena via two case studies, which have been expanded upon below, to triangulate the data further and add a level of richness to the contextual understanding, experts in the field of innovation/plant-based foods and sustainability were interviewed. To ensure a robust sample of respondents, the following benchmark was set:

- Respondents had to include at least one mid-senior level manager from the incumbent organisations. These respondents were sampled based on their experience and direct involvement in the development of the plant-based foods.
- Remaining respondents had to be experts in the following areas:
    - Plant-based food production/innovation
    - Sustainability
    - Regulatory organisations
    - Supply chain

They were sampled based on their familiarity with each case and critical ability to offer commentary on both.

Table 3.1: A profile of the respondent sample

Description of respondent	Sample
Senior executives at the incumbent organisation	2
Plant-based food production/innovation specialists	4
Experts in the field of sustainability	3
Experts in regulatory organisations	4
Experts in supply chain	1
Total number of respondents	14

The sample was derived due to their intimate knowledge of constructs pertaining to plant-based food innovation and its impact on ecological sustainability. They were uniquely placed to provide multi-faceted and textural insights based on their experience and ranking within their various industries. The anonymity of the participants is preserved.

Case one: Frys Family

South Africa is home to the Fry's Family Food Company. Started by Wally and Debby Fry as newlyweds, they aimed to find a way to feed their family plant-based meals. Wally was a goat farmer and his wife Debby, a vegetarian. When their first daughter Tammy was born and was being raised vegetarian, creating plant-based meals became an imperative in their household. This led to experimenting with creating familiar meat-based foods in a plant format. Their success led to them retailing in a local supermarket, and years later they run a multi-million rand, international operation in 25 countries which has expanded across varying categories of food (Fry Family Food Co, 2013).

Their product line includes soy-based 'beef' and 'chicken' burgers, traditional sausages, schnitzels, pies, nuggets, spicy korma pieces and

recently expanded to include artisanal ice cream flavours and a new protein filled cereal.

The company has received criticism for their use of soy as well their use of palm oil in the manufacture of some of their products. However, there is little or no discussion about the positive impact their “principles before profit” ideology has had on contributing to issues of global sustainability.

Fry’s Family “are steadfast in minimising this impact by ensuring that all their raw materials are not genetically modified (Non-GM), are sustainable and are continuously taking measures to reduce their CO_2 footprint. Fry’s Family products are manufactured in a dedicated meat-free factory and carry endorsements from the highest authorities on vegetarianism in the world” (Fry Family Food Co, 2013).

Case two: Impossible Foods

Based in the US, Impossible Foods has developed a plant-based burger that resembles the taste and texture of a beef burger, without any of the environmental impacts. An ingredient known only as ‘heme’, which is abundantly present in animal muscle, was isolated from a plant substitute and used to develop the Impossible Burger. They are currently only available in limited restaurants within certain cities, with a view to mass production and making this available across as many eateries and retail outlets across the USA. According to Impossible Foods (2017), “Because we use 0% cows, the Impossible Burger uses a fraction of the Earth’s natural resources. Compared to cows, the Impossible Burger uses 95% less land, 74% less water, and creates 87% less greenhouse gas emissions. Moreover, it is 100% free of hormones, antibiotics, and artificial ingredients” (Impossible Foods, 2017).

Both companies described above have innovated at the firm level, with far-reaching impact, and investigation into each could help determine whether the diffusion of these innovations has a bearing on addressing issues of ecological sustainability.

3.4. RESEARCH METHODOLOGY

The overall approach used for this research was qualitative. The study attempted to identify themes in trends related to innovation for sustainability through a case study approach, adopting semi-structured interviews as a research tool.

3.4.1. Data collection and instrument

A combination of primary data and existing literature on the topic was utilised to gain information specific to the research problem. The literature review was useful in establishing and framing the scope of work that needed to be undertaken through primary data collection. The existing body of knowledge had yielded an abundance of information germane to innovation, sustainability as well as food production and consumption patterns. However, at the time of this study, little scholarly evidence existed specific to plant-based food innovation and the impact on the ecological construct of sustainability.

The primary research tool utilised was the semi-structured interview. This is qualitative in nature and allows room for the researcher to probe certain topics based on the conversational flow. According to Saunders, et al., 2009), “In **semi-structured interviews**, the researcher will have a list of themes and questions to be covered, although these may vary from interview to interview. This means that one may omit some questions in particular interviews, given a specific organisational context that is encountered in relation to the research topic”. The inherent fluidity of this data collection method extends itself to allowing the researcher to explore content specific to the interviewee or their organisation, that ultimately assists in meeting the research question.

Specific to this study, semi-structured interviews were conducted predominantly utilising Skype. This is due to the nature of participants and the multinational organisations they work for. Advancing technology allowed for a face-to-face simulated interview, and as such, afforded the researcher

the chance to gain insightful commentary and unpack specific contextual remarks in a bid to answer the research questions. Data was collected via voice recordings, and these were stored in a password-protected folder on a laptop as well as online storage facility that is accessible only through a certified login. Consent forms and interview transcripts were filed and stored in a similar manner ensuring maximum protection. Through primary research that is underpinned by thematic case analysis, this study aimed to contribute to the body of knowledge by looking at the development of these product innovations and their impact on global sustainability.

3.5. DATA ANALYSIS

The nature of qualitative data collection, to some extent, dictates the nature of its analysis. Through qualitative data collection, the analysis happens concurrently.

The departure point in analysing data gathered from semi-structured interviews is transcription. Saunders, et al. (2009, p. 485) referred to it as “reproduced as a written (word-processed) account using the actual words”. Interviews conducted for this study were transcribed verbatim, through the services of a touch typist, from audio recordings done on an iPhone.

Analysis of the data commenced once the transcriptions had been successfully rendered. Thematic analysis was deployed as a tool of data analysis. Nowell, Norris, White and Moules (2017) suggested that it “is a method for identifying, analysing, organising, describing, and reporting themes found within a data set” (Braun & Clarke, 2006). It is advantageous as content generated by research respondents can be analysed for similarities or differences, which could produce useful insights. The researcher must be immersed in the transcriptions, which will assist in the emergence of theories, and patterns, which lends itself to coding the subsequent data.

In reviewing two cases, it is necessary to draw out themes and issues specific to the research problem. By adopting this approach, comprehensive

descriptions of the data were developed which allowed for meticulous analysis. In doing so, the research problem was addressed.

3.6. LIMITATIONS OF THE STUDY

Qualitative research adopting an interpretivist paradigm suggests that one cannot separate the researcher and their value proposition, from that which they are investigating. This is supported by Elmiana (2017) who stated that "the research activities in which they are involved will influence them or be influenced by them and the relationship between the two will naturally develop" (Elmiana, 2017, p. 83). While these concerns are legitimate and do constitute limitations to the study, further limitations linked to the case study included the following:

- This study involved two cases. However, they operate in vastly different contexts within South Africa and the US. The Frys Family are based in KwaZulu-Natal and would require access, travel and their availability. However this is far more accessible than Impossible Foods with whom a relationship would need to be established that allowed for investigative analysis while circumnavigating time zones.
- Additionally, equivalent access to company information across both cases is pivotal to the feasibility and success of the study.
- Lastly, due to the sampling methods and research approach, findings are not generalisable to the greater public. However these cases do meet the specific criteria of the research problem that was investigated and allowed for this to be explored and understood.

3.7. ETHICAL CONSIDERATIONS

This study followed the ethical principles as outlined by Wits Business School. Participants were duly informed about the basis for the research, including its purpose, and what specifically would be required from them. The research instrument was shared with participants prior to commencement of the interviews in order to ascertain if any questions

would be regarded as invasive. If the participant was comfortable with the information required, all ethical clearances were sought. It was made clear that the participant could opt out at any time and was under no obligation to answer all questions. The anonymity of the participants was preserved and demographic information shared in the report was to illustrate parity amongst gender whilst the age range demonstrates level of experience in their respective industry. The research is transparent regarding data collected and analysed.. Data was recounted accurately and used for purposes of the research unless otherwise agreed upon by all parties.

3.8. RELIABILITY AND VALIDITY

Reliability in research methodology refers to the ability for the study to be replicated and yield consistent results. Elmiana (2009) expanded on this as "the main quality of qualitative research is whether the interpretations made from information gathered (authenticity) and participants perceptions have been authentically represented in the research process and also the findings are comprehensible with social context and data from which they were derived (Fossey, et al., 2002)" (Elmiana, 2009, p. 89).

Validity assesses whether the results from the research are indicative of that which was set out to be investigated at the start. This is categorised into internal and external validity whereby internal assesses the design of the research and external is the assessment of the results retrieved.

Du Plooy-Cilliers, et al. (2014) suggested that the constructs of validity and reliability materialise differently within the paradigm of a qualitative study. These are bundled into a concept of trustworthiness, which is then further divided into the following four categories:

- "Credibility refers to the accuracy with which the researcher interpreted the data that was provided by the participants.
- Transferability refers to the ability of the findings to be applied to a similar situation and delivering similar results.

- Dependability refers to the quality of the process of integration that takes place between the data collection method, data analysis and the theory generated from the data (Lincoln & Guba, 1985; Shenton, 2004; Collis & Hussey, 2003, pp. 278-279).
- Confirmability refers to how well the data collected support the findings and interpretation of the researcher" (Du Plooy-Cilliers, et al., 2014, pp. 258-259).

Accordingly, these were the measures implemented to ensure reliability and validity as understood within a qualitative study:

- The data collection was conducted over a period of a month with 14 participants. In addition to discussion both pre and post the interview process, data was triangulated through respondents tangential to the case study as well as through theories outlined in the literature review.
- While the study might not lend itself to being extrapolated to the general public, the nature of the organisations investigated, an account of the characteristics of the participants, as well as the research instrument could be utilised in a similar context.
- A detailed account of the research process undertaken has been shared including the nature of respondents sampled (as outlined in Table 3.1) and semi-structured interview questions used as outlined in Appendices A and B.
- An example of a detailed transcription from the interviews is available in Appendix D.
- All transcripts have been meticulously recorded; copies of the audio recordings from interviews with date and time stamp are safely stored; and consent forms were sent via email to all participants, acknowledged and signed before interviews commenced.

3.9. SUMMARY

The research methodology was qualitative, adopting the interpretivist paradigm. A thematic analysis of two case studies was conducted, supported by extensive secondary research to provide context to the exploratory nature of the research.

CHAPTER 4
PRESENTATION OF FINDINGS/RESULTS

4.1. OVERVIEW

Results from the research initiative are presented and showcased in this chapter. The findings are organised as follows: Background on the respondent sample, second to which are the findings. These are showcased through a selection of direct quotations from the respondent sample. These excerpts were extracted during the transcription process and are presented in accordance with the conceptual framework of adaptive management and their relevant themes. A summary after each theme highlights key outtakes.

4.1.1. Brief introduction

This study aimed to assess the impact of plant-based food innovation on ecological sustainability. Respondents were selected based on their eruditeness pertaining to the scope of research and to triangulate the data obtained from the two case studies.

A total of 14 interviews were conducted, and the respondent sample was selected based on the following criteria:

- Respondents are mid-senior level decision makers and influencers in the organisations being explored.
- Respondents are regarded as experts in the fields of:
    - plant-based food production/innovation;
    - sustainability;
    - regulatory organisations specific to plant-based foods; and
    - supply chain management.

What follows is a profile of the respondents illustrated through the use of graphs and tables to depict their background and experience. Their demographic and work experience profiles are listed in Table 4.1

4.1.2. Profile of respondents

Table 4.1: Demographic and work experience profile

Respondent	Gender	Age range	Years of experience
Respondent 1	Male	30-40	7
Respondent 2	Male	30-40	5
Respondent 3	Female	30-40	4
Respondent 4	Male	40-50	13
Respondent 5	Female	30-40	4
Respondent 6	Male	30-40	23
Respondent 7	Male	40-50	3
Respondent 8	Female	40-50	15
Respondent 9	Female	30-40	5
Respondent 10	Female	40-50	8
Respondent 11	Male	40-50	6
Respondent 12	Female	30-40	4
Respondent 13	Female	30-40	5
Respondent 14	Female	30-40	17

The combined work experience of respondents equates to a mean average of 8.5 years, specific to their area of expertise. This lends credibility to their rhetoric specific to the area of research**.** The graph in Figure 4.1 below illustrates the gender composition of the respondent sample to demonstrate balance and equity.

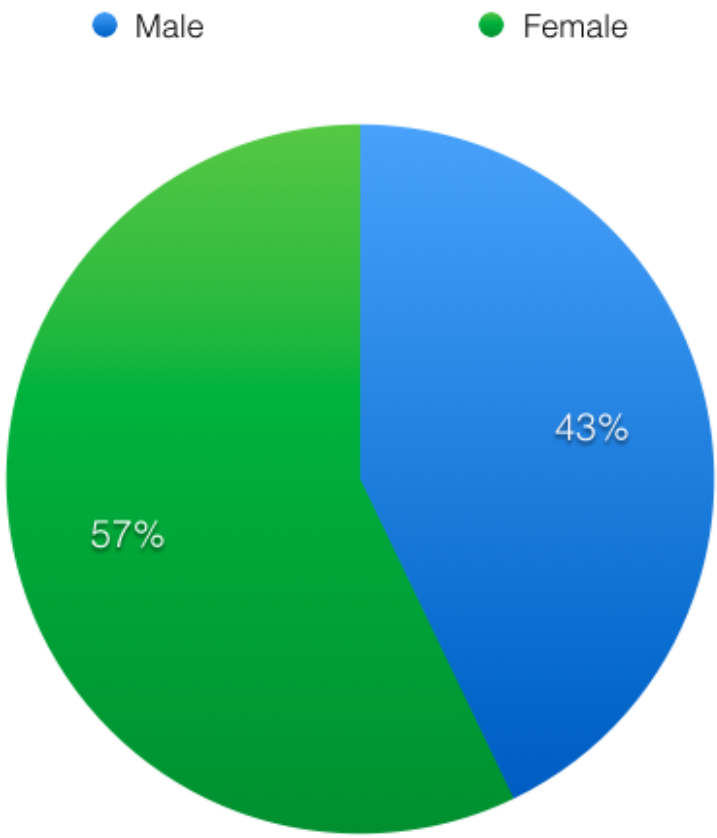


Figure 4.1: Composition of male and female respondents in the sample

4.2. PRESENTATION OF FINDINGS AND DATA RESULTS

A semi-structured interview approach was adopted for this research purpose. A set of questions was designed to elicit responses specific to the research problem. However respondents were afforded flexibility to elaborate on areas of expertise or inherent knowledge and were probed when further input was necessary. The findings are presented according to the prevalent themes of the conceptual framework, and various selected respondent answers are highlighted. A summary of all the content is offered after each theme and then reviewed holistically at the end of this chapter.

The findings have been discussed in the root of the adaptive management framework, which is a dialogue that integrates environmental, economic and social theory. The framework seeks to understand how the trajectory for sustainable innovations is better moulded to earth's requirements by understanding the ecosystem. It is appreciated that these elements are dynamic and collaborative, which makes it critical to assess their complexity properly. Additionally, natural ecosystems, apart from their causality, are now massively impacted by anthropogenic interference. To understand how to manage better the ecosystem within which humanity operates, a reliable baseline of data and knowledge must be acquired.

Norton and Steinemann (2001) proposed that adaptive management could be operationalised through three fundamental principles that help understand the relationship between people and ecosystems. These, along with the broader framework, will be unpacked in relation to the case studies under scrutiny.

***Experimentalism*:** This refers to how practices within an organisation can be scaled and diffused into the greater ecosystem.

Multi-scalar analysis: This refers to external policy and the contestations or opportunities ensuing.

***Place sensitivity*:** This refers to an appraisal of the placed-based values of the community within which the organisations operate and how they can impact business strategy.

4.3. RESULTS PERTAINING TO THE ECOLOGICAL TENET OF ADAPTIVE MANAGEMENT (EXPERIMENTALISM)

4.3.1. Respondent feedback pertaining to the ecological tenet of adaptive management (experimentalism)

Table 4.2 below contains a selection of the responses from the research sample pertaining to their views on the ecological tenet of adaptive management (experimentalism).

Table 4.2: Respondents' views on the ecological tenet of adaptive management (experimentalism)

Some of the more technologically sculpted forms of plant-based meat like the Beyond Burger and the Impossible Burger are coming out of companies in California, in Silicon Valley that are doing kind of bio medically inspired research to kind of isolate ingredients like haemoglobin like the Impossible Burger that are being used in more chemically replicate the taste and smell of meat. *Animal agriculture places one of the most significant threats to Global sustainability and so the proliferation of alternatives like plant-based meats and hopefully soon cleaned meats will address some of the most pressing problems that humanity faces.* *Plant-based foods for example use about a 10^{th} of the resources in comparison to animal-based meats. So it is a considerable amount of reduction in water consumption and Co_2 and even when it comes to natural resources.* *There's a lot of environmental issues like we're running out of water – the UN said that in 2030 if we keep up the current production capacity we will have 40% too little water to keep up, so that means water heavy products are gonna be going up in price of course and lacking in availability and meat and other animal products.* *[It's a] new frontier we are moving toward and away from the traditional animal agriculture being the way that we get our protein and without a doubt when you look at pound for pound food that comes from meat, protein that comes from plants, protein that comes from animals it scores all the points in terms of requiring less land, water and less emissions.* *There is a wide range of other essential plant proteins that could be used so there's both research into the different characteristics of lentil protein different pulse proteins looking at other vegetable sources as well to*

characterise the protein, the viability of it the composition to look at whether vegetable proteins that are easier to exclude or better to form textures that are more a meat structure.

They want to disrupt the entire meat industry; they want to make the old way of producing simply non-existent, they want a compassionate takeover. So they are seeing the need to reinvent our food system.

I think you should look at the value chain of all these plant-based products. You look at it in detail and might find footprints, in terms of water consumption or processing or whatever energy that is even higher than traditional meat. So, in general, of course, we know that it has a lower footprint but some parts of it can be even higher, and we need to look at that.

Whether you are using the same crop in human food or whether that crop that was formerly corn is grown for feed and the land that was used to grow the crop and instead can be used to grow corn for human consumption or to grow wheat or to grow soy or lentils. Those specifics end up in favour of plant-based meats water use and land use.

If we look at ecology and all ethics, it's probably better to have some animal product's in terms of like we have land that is not useful, otherwise, they cannot be utilised by other than by animals, so I think a much lower meat production would be good, probably zero production is probably not the best thing if we are honest about that but that may change in the future.

I think from that perspective Fry's is operating with several different technologies that we have developed, and I think it makes us quite innovative. Totally different machinery, totally different line, totally unique in its own way. When we made Fry's meat alternatives, there was no technology that existed. You could not get the machine just off the shelf. Of course ovens and freezers, but most of it the machinery had to be purpose-built for its function.

Our use of the land is lower. We require 200 litres of water to produce a KG of Fry's whereas as KG of beef is about 160000 litres of water – so we have done that research with the world preservation foundation.

I think that the key, the answer to that is that being a vegan product, makes it more sustainable already compared to the meat product. So from the land use perspective, from an electricity usage from water usage from global warming perspectives, Co_2 and methane emissions, all of these are far lower.

The Business Model here is focused on creating delicious plant-based meat and dairy products, in doing so in a way that the product itself is a functional equivalent to what you would get from an animal. We really need to have a robust research and development function that can create not only these functional proteins but understand flavour dynamics, understand texture, understand how all these things come together to build a bill of materials for the product formulation, that will meet all the same handling taste, texture all those requirements that all this characteristics that you see in ground beef and that's the same across all the incumbent livestock products that we are replicating through plant-based ingredients.

We see this as a transformative technology, so the product itself is oriented to a big environmental mission. As a result everyone who is in the company and every function within the company, whether it is manufacturing, supply chain, marketing, sales is part of that sustainability mission.

Well it depends on consumer adoption and keep in mind that we are really small, so those numbers are the result of the life cycle assessment that we performed of our product at that scale against the typical US production system because obviously there is everywhere from grass fed which is 3–6 percent of the market to confined animal feeding operation in this is a representative of certain numbers for the average of your production systems, it's a tough question because again we super tiny, the ground beef market, ground beef alone in the United States is 9 billion pounds I believe and we making a million plus a month.

4.3.2. Summary of findings pertaining to the ecological tenet of adaptive management (experimentalism)

Findings discussed above were extrapolated in relation to the ecological tenet of adaptive management and also considered the key principle of experimentalism. Respondent feedback was aligned to themes concerning global trends in plant-based food innovation, specifically their ecological footprint; possible impact on sustainability; scale and intensity of resources; and the business models of the two cases in question.

All respondents agreed that plant-based food production's trajectory is barrelling toward a global trend. This is precipitated by a need for innovation that addresses the severity of current food production systems and their subsequent security. Respondents suggested that business models that include a start-up culture or adopting technology driven by innovation for sustainability are mostly responsible for the proliferation of plant-based alternatives in the marketplace. Constructs of sustainability including the ecology, economy and social aspect of plant-based food innovations were mentioned by 11 of the respondents as being critical to effective innovation in both the Global North and South. The findings specific to the economic and social impact will be unpacked in greater detail as part of the summary of findings for the respective themes that follow. The prominence however attached to these constructs being mentioned as interdependent by respondents, is critical to supporting the consideration regarding their intersection in the sustainability discourse. Respondent eight suggested that sustainability must be considered in a holistic sense and referred to this as *"sustainability in the green economy"* underscoring the importance of these concepts.

Six respondents considered that the ecology could not be divorced from a discussion about innovation for sustainability. Respondents noted the density of animal agriculture on natural ecosystems as severe. Rapidly

diminishing natural resources as a result of current food production require several solutions to solve the problem. These could be presented through an innovative lens, which utilises new technology to produce and develop different forms of protein that are less resource intense on natural capital such as land and water and the resultant emissions into the atmosphere. Respondents recommended extensive research into the production of various plant-based proteins (soy, wheat, pea protein) in a bid to comprehend the nature of the relationship between the ecosystem and its human counterpart. Disruption of the food system through innovation could birth a profound appreciation for the inner workings of the ecosystem and offer insight into scalability of practices. The current value chain for plant-based food innovation is elevated; however, it can be scaled as demand increases.

Fry's Family Food Company is one of the companies cited for consideration in this research endeavour. This is an exclusive family-run business with innovation as the driving force in their sustainability agenda. As a business that was started 25 years ago, ahead of the plant-based food revolution curve, all the technology was custom built and developed. This is a testament to the entrepreneurial and innovative culture that creates value in their product line, as well as emphasising their commitment to the greater ecosystem at play. The inherent nature of the product, in that it is plant-based, lends itself to the sustainability claim. By default, it is less resource intensive where according to the respondent, 200L of water are required to produce 1kg of Fry's vs 16000L of water required to produce the equivalent weight in beef. Apart from the product, innovation for sustainability exists across the business value chain, and the relationship between the ecosystem and their company and its key players is evident in the following areas:

- A water recycling system that forms part of the manufacturing process and recycles grey water.

- Installation of solar panels lining the factory roof which generates power to run the operational systems.
- Sourcing of sustainably segregated palm oil, which is only available outside of South Africa, and is a testament to their mobilisation of resources in support of sustainability.
- Recyclable packaging available in countries outside of South Africa and not in SA due to complexities around retail freezer cycles and subsequent food safety.

The impact of their innovation and adaptive characteristics on the dimensions of sustainability in society can be measured from an ecological standpoint, not only in the production of their goods which require significantly less land, water and electricity usage than a meat equivalent, but also the positive impact on biodiversity and global warming.

Impossible Foods is the second company examined for this research purpose. They are a Silicon Valley start-up with a focus on mitigating the environmental residue of animal agriculture.

The business model for Impossible Foods is three-pronged; they consider themselves a food and tech company that is imbued with a vital planetary mission. The company mission as articulated by the respondent is to *"reduce the environmental burden associated with our food system".* This credo informs the business essence which is underpinned by innovation for sustainability and is seen in the development of their product line hugely driven by intense research and development (R&D) efforts. This work yielded a breakthrough innovation where in-house scientists, isolated a particle known as heme that helps replicate meat in texture, flavour and other characteristics. This functional protein was then genetically engineered for them to create a beef like a plant-based burger that takes on the same properties as animal-derived beef.

This focus on sustainability and agriculture in food systems extends to looking at both market impact and consumer engagement coupled with an

introspective view of operational sustainability. This manifests in the company in the following ways:

- A newly developed production facility is operating on a 2020 zero waste agenda.
- Operationally, all facets of the business are committed to sustainability, and this was articulated by the respondent in that they consider *"systems impacts, long-term strategies, how we incorporate these environmental and social roles into our 20-year strategy".*
- A *"reduce before you produce"* mantra birthed an alternative idea to a solar panel powered building. Instead, the company through the use of sensors and skylights managed to achieve a level of sustainability while being considerate of cost saving.

The impact of their innovation on the dimensions of ecological sustainability in society cannot be measured at the same scale as current animal agriculture practices due to the small company footprint. This is dependent on rapid consumer adoption and furthering their plant-based food innovations into an extended product line. However, in a life cycle assessment performed on their core product, the beef burger, results reveal that it uses 95% less land and water than a typical animal derived beef patty.

4.4. FINDINGS PERTAINING TO THE ECONOMIC TENET OF ADAPTIVE MANAGEMENT (MULTI-SCALAR ANALYSIS)

4.4.1. Respondent feedback pertaining to the economic tenet of adaptive management (multi-scalar analysis)

Table 4.3 below contains a selection of the responses from the research sample pertaining to their views on the economic tenet of adaptive management (multi-scalar analysis).

Table 4.3: Respondents' views on the economic tenet of adaptive management (multi-scalar analysis)

I mean just the fact that in a couple of years that these companies like Impossible Foods, a handful of companies collected about 700 million Dollars in venture capital, that's a lot more than the whole animal rights movement has combined, so the money that is going towards this food innovation is really significant.
We saw a massive increase in demand in South Africa but especially in the developed world for plant-based meats. More in the developed world because people having more the luxury to be able to choose more, let say, ethical or more environmentally friendly choices because they see the impact on the funds.
You get a lot of people that now recognise that there is a market for plant-based product and they are starting their own and home businesses.
There are a lot of companies that, like traditional conventional dairy producers that buy plant based companies and start the development of plant-based cheeses.
You have Goldman Sachs that invested quite heavily into plant milk and we have a very financial liberal millionaire, in Denmark invest in Super Meat, an Israeli clean meat company.
Developing economies, the only way I think that plant-based meats will succeed is if they cost competitive.
The biggest thing I think that is beneficial about having meat and dairy companies getting involved is not even necessarily their money and distribution and influence, which is very important but is it is a vote of confidence.
It's just making these products more available and even more similar to meat like the Impossible Burger, you know overseas. The more similar they are to meat taste wise and texture wise and price wise the more people will choose those as alternatives.

I think they actually need to market it better.

I think that government is going to have to step up with a lot of investment, the problem of animal agriculture again is so severe that in the same way that governments are subsidising clean energy research, they ought to be subsidising clean meat research then plant based meat research, animal agriculture is a leading cause of climate change, it produces more greenhouse gas submissions than all of our transportation combined, cars, planes, trucks everything and if we are serious about wanting to address climate, if we are serious about wanting to meet the standards of the Paris agreement (UNFCCC, n.d.), then we have to get serious about reducing our reliance on animal agriculture, or we defeat ourselves and government can pave the way by funding research and by giving direct subsidies to companies that are doing this as well.

From a nutrition standpoint the government policy is to promote plant-based proteins because they are more sustainable there is higher crop yield and we can get more protein to more people.

Companies need to be more responsible; they have to drive the good behaviour.

If you can show that the plant-based foods are going to be better for exports, it's going to deal with food security, which is on the minister of Health's top list. If it is going to create small-scale farmers and an entire coach of where we used mining or manufacturing but now we are actually farming, and that is driving an agenda across the world, they would be behind this plant-based foods diets like 100%.

If they really wanted to be true government they would look to promote plant based Business over anything else because just food security, Global Food security as you know can be sold from people shifting to a plant based diet. They would initiate policies that promote, subsidise, whatever the terminologies that would use in Government to encourage Business, E-commerce, to focus on growing and developing and manufacturing plant

based products and to move people away and to discourage, completely discourage animal agriculture.

So, government has an absolute responsibility in terms of health and environment and in terms of ethics.

Yes. They should be driving the education in terms of sustainability and the benefits of plant based foods.

Yeah I guess I think it would be good for the US FDA to monitor water usage of all agricultural industries – using resources sustainably.

We need a dialogue between industry, government and farmers to be able to actually come up with a joint agenda in terms of how we will address the growing needs of our society and population.

So government can do both stuff on the side of production and the side of consumption, so on the side of consumption they can help raise awareness and the side of production it also relates to consumption, is that it can enable and facilitate a production of and distribution of good plant based products like by tax incentives, by premiums, by maybe even like in some countries is the case being in a law that in public canteens and public restaurants, they has to be a vegan option.

I think the government has got a role to play with low-income people, in terms of education, especially in South Africa. The awareness of diets and also plant based foods. They should also allow innovators to produce alternatives.

From a financial perspective it is such a growing industry. Like in South Africa we've got Clover who, who bought out Good Hope Soy. And so that's the dairy industry buying into a soya milk company. And that's because they can see the benefits of well they can see where the trends are going.

That some of the biggest meat based companies, animal-based companies in the world are investing heavily in Vegan Food Companies, is testament to the fact that those guys, though they are for the bottom line, they understand trends, they understand flow in demand.

But you know the companies that are making all these specialty products you know like Beyond Meat. You know I don't know what they put in their products. But their products are still quite high. Because of the new technology behind it. And they need to see whether it is viable. They have to cut their cost and their overheads. But I think once demand starts to grow and they start using whole foods to make these products, the price will definitely come down.

For the company it depends. The first investment they have to make is the development cost for a new product. So, at first, it might be a huge investment. "For the company it depends. The first investment they have to make is the development cost for a new product. So, at first, it might be a huge investment.

Even from the standpoint of an individual, the price of a pound of beef is going to be higher than a pound of lentils or the price of the equivalent amount of protein that's coming from lentils or vegetables. It's going to be a lot easier for plant based meat companies to produce a product that's at the same price point as a meat product or lower [as] the inputs are less costly.

I think plant based food production is economically viable. The turnaround time is definitely much shorter. I think the footprint in terms of the resource footprint is definitely much lighter.

You would be able to enter these emerging markets so I am thinking that because its such a strong economic factor, its very feasible that this would be a way to have way more sustainable, healthy protein coming into the Global South.

At the moment I think the number of objections by most people/critics is to say: Now look vegan food is very expensive. It's only because it doesn't have the conscious scale that the meat/dairy industry has at the moment.

There's a lot of complex decision making, it's not just about cost as much as it is about we need to get through to people in the best possible way in the most food-safe possible way. So there are a lot of constraints when making these decisions and sometimes you just have to weigh up all the

aspects that you looking at there's a cost factor there's an actually getting food to people in a neat packaging that they actually gonna buy off the shelf cos that's what you trying to do and then there's the 3rd aspect of the sustainability so it's very difficult to make these decisions sometimes but that's what we have to do.

We don't have to make money for anyone else, we only just decide based on the purpose of the business. Our decisions are based on our purpose. We always say it's our advocacy, Fry's is a form of advocacy for us. We measure our success on the number of animal's lives we've saved if someone chose a Fry's product instead of meat product.

I guess I guess economic policy does affect, mostly from an exchange rate perspective because we importing raw materials and we exporting food, so I think that has the biggest impact on our business when there's exchange rate fluctuations.

The way that we allocate funding across the company, obviously we have to be really strategic with it and one of the certain part of the core philosophy of sustainability in Impossible foods is let's be really rigorous and let's be diligent we want to make sure that any resourcing we throw at the operational footprint over the company is something that is going to net the greatest rewards…and it's going to actually address core impacts.

I think right now purpose and mission align very strongly with growth and revenue growth, we need to bring in money in order to scale, whether that's coming through venture capital or not that we started generating our own revenue and the more product that we produce and the more people we capture is consumers and more customers we have that's growth, and it's mission impact, so I think they quite tightly down together right now.

[external policy] We pretty agnostic to it, it would be great if they were regulatory or political mechanisms in place that would help accelerate some of the work that we were doing in terms of scaling the production system.

Public policy is important for these sectional agreement around sustainability are important, increasingly it seems like there's a private Industry commitment to figuring out ways of addressing lets say the UNSDG is, market solutions around product, I think are really important, capitalism is not great for the environment because you predicate growth on resource use and extractive practices but when innovation allows you to create a product that can help perform environmentally in term of other qualities, a product that's much more impactful on the environment I think we might be poised as a food system and even broader than that to really make some progress against these historically wicked problems, I am very optimistic that maybe collectively we are reaching a certain point.

4.4.2. Summary of findings pertaining to the economic tenet of adaptive management (multi-scalar analysis)

The following findings are discussed in relation to the economic tenet of adaptive management, with attention to the key principle of multi-scalar analysis. Respondent feedback was solicited around themes pertaining to the investment behaviour of the two case studies presented; the economic viability of plant-based food production as a tenet of global food production systems; as well as government and policy involvement in driving this agenda. Half of the respondents identified marketing as a theme that encapsulates the manner in which plant-based food innovation could be prioritised within the organisation. This is an umbrella term for encompassing a range of activities that could be undertaken by the organisations and included the following suggestions:

- Develop strategic and targeted above the line campaigns, which could include traditional advertising such as television commercials to actively market the offering and cultivate healthy rhetoric around plant-based food innovations.

- In-store visibility of products, such as placement in traditional meat aisles which would disrupt the industry, while redefining and shaping consumer buying behaviour
- Shape the social discourse around plant-based food innovations by capitalising on the inclination for concern around health and wellness. This can also be extended to markets that include flexitarians and reducitarians with transitory palettes. This was supported by respondent one who alluded to the relationship between cultivating demands to drive down costs.

Five respondents agreed that government intervention or policy at a national level was necessary to embed greater earnestness within businesses in harnessing their economic resources toward supporting plant-based food innovation. These were suggested to take the form of market mechanisms echoing the structure of carbon tax which could force “companies to drive good behaviour” as per respondent five. This could include offering subsidies to companies driving a green innovation agenda with their consideration set extending to food security. Additionally, the government could enforce nutrition policies that support a higher intake of whole foods and legumes, which has a dual effect on encouraging food education and curbing the use of natural resources. The link between business purpose and profit, if not inherent in company culture, could be driven via government subsidies that promote green business transactions. This could develop a climate that is affable to entrepreneurship driving a clean or green business agenda.

Respondents ten and twelve highlighted the necessity for sustainable packaging. This appeals to an environmentally conscious consumer who wants to lessen the impact of their ecological footprint, through sound economic choices. In doing so, companies make the purchase decision easier for the consumer, thereby promoting their plant-based food innovation over a similar or competing product on the shelf.

Lastly, respondents two, six and eleven, suggested that transactional relationship between incumbent companies (such as traditional dairy farms) and the insurgents (plant based milk alternatives) could yield a decidedly favourable union. Plant-based food innovation companies, apart from access to new technology, are far more resource efficient which in turn generates a better economic impact. With companies pooling resources, competitive price points can be developed and offered to the consumer, which in turn assists with greater adoption and diffusion of products and subsequently positively impacts the value chain, thereby making these products more accessible and affordable. Respondent two also suggested that companies who adopt an agenda point from the sustainability programme, are likely to see a shift in their operating ecosystem that would allow for their economic resources to promote plant-based food innovation. One such example tendered was a company previously known as Cargill Meat Solutions who operates in a number of countries around the world, and then changed their name to Cargill Protein Solutions, realising the consumer markets affinity toward plant-based proteins and included this in their service offering.

Fry's is a unique case of a business that isn't answerable to shareholders or having to deliver on profit margins except for the family itself and continued growth of the business. As such, purpose cannot be extrapolated from the business as it is deeply embedded into its fibre. This lends itself to supporting the sustainable plant-based food innovation agenda unreservedly, and the respondent suggested that the business is a form of advocacy and is measured by *"the number of animal lives we have saved if someone chose a Fry's product instead of meat product".*

Impossible Foods' resources are intensified toward producing an optimal product, which is then supported by sales and marketing efforts to build the brand further and support its vision. Purpose and profit are inextricably linked as they aim to permeate a bigger consumer market to drive their product, which delivers, on a purposeful agenda.

4.5. FINDINGS PERTAINING TO THE SOCIAL TENET OF ADAPTIVE MANAGEMENT (PLACE SENSITIVITY)

4.5.1. Respondent feedback pertaining to the social tenet of adaptive management (place sensitivity)

Table 4.4 below contains a selection of the responses from the research sample pertaining to their views on the social tenet of adaptive management (place sensitivity).

Table 4.4: Respondents' views on the social tenet of adaptive management (place sensitivity)

I think because health is an easy motivator for an individual because when they look at their lifestyles, look how healthy they are, it is easier for them to make those changes for themselves. *With the Internet the availability of knowledge, literally at your fingertips within a few seconds. There is just so much more information out there that people can use to educate themselves. And because of that the demand is growing. You know people want to be healthy, they are concerned about the impact that they are having on the environment. And with this knowledge and the knowledge that they educated themselves with they are now having a demand for vegan food.* *This is thanks to films like What the Health and Cowspiracy and all these documentaries that are educating people on why it is important to go vegan.* *Yes, plant based foods and veganism currently in the UK it is growing by 36% in the last 10 years to over 580 000 people. In the US it has gone up to 6% of the population.* *Germany and Europe is the world leaders in plant based product innovation. The largest number of plant based products is being developed in Germany and the UK but the US is still before us.*

I think now we have a different discourse or landscape where its OK to say you're just cutting down you don't have to go all the way so you can you don't have to make this identity shift which I think a lot of vegans do.

A lot of it has been driven actually by meat reducers or flexitarians. The fact is a lot of people choose campaigns such as Meatless Mondays and Veganuary are choosing to eat less meat or choose a different source of protein on certain days or certain months. I think that is one of the biggest drive in the change in the market that we are seeing.

[Plant-based foods] is completely sustainable in all ways. It's not just an environmental thing, ecological thing, it's for our health also its National policy to cut down on meat, so the South African government recognises the fact that a lot of our diseases are caused by excess of meat consumption.

That being said, there is also such damning evidence against red meat with cancer. There is like no question that it is definitely better to have a plant-based diet.

But to be perfectly honest with you, there is still a lot of greenwashing that is still taking place. So we need our consumers to become a lot more educated and aware in terms of the impact.

Food safety- the fact that we are always under the threat of massive wide scale, whether its pig flu or bird flu or mad cow disease, that doesn't form part of the discussion and is an externality that is produced by the meat industry that is born by consumers and isn't really told. That's another thing that's completely mitigated once you've taken animals out of the protein chain.

I have a few patients who are overseas and there is just a lot more variety and I think people are a lot more aware of all the plant based alternative products even before they become plant based. So, for example, I know people who eat coconut yoghurt, soy yoghurt and legumes, non-dairy creamers, just because those products are so widely available and they are

so well marketed. And that they are so visible in supermarkets and that's without any awareness of like the benefits of eating plant based alternatives.

I know it is much more adopted in the UK. It is more readily available. It's rather a reactive point to health than a change in mind-set. But it still is very slow; like super-slow. There is definitely a status attached to eating meat in South Africa.

Main driver is health and what is causing us to try these products from a meat eater perspective is because we understand that it's healthier so we try it okay...it is just a lot easier in the State's and in the UK, Europe because of access to the product.

In China for example they are working towards reducing meat consumption by 50% across the entire country. China's government is focusing on cleaner technology. So plant based meals takes preference rather than animal-based food. So China is like really jumping on top of this. Like Korea as well, they joined in on the Meatless Monday initiative. Coming from Korea, which is to a great, extent a carnivore paradise, you will expect people not to be interested in plant based eating. They are – there is a big desire for it. It shows how plant based foods have developed to all countries in the world.

I think for example when you think about Asia, I think there is a very great chance because naturally, originally these cultures would eat a lot of plants anyway.

"In Germany and Europe, we are experiencing a change about the perception of meat and that in fact it is not needed to be healthy or strong when thinking about masculinity and stuff like that. So this is slowly changing by good examples of like athletes and actors and popular people.

In Israel the population, sizeable population there is vegetarian and growing more rapidly than in the US, and in India they're starting from a background of having a greater population that is already vegetarian so kind of meat replacement foods are popular in areas that cater to both segments of the population.

A lot of the problems are being caused by western over-consumption of animal products. I think there's this dynamic that we see in the Global South and west where now there's a growing middle class and China and India so they also copy the consumer patterns that we have in the west and this on an ecological scale, is completely unsustainable.

"When I compare US with Europe I always see what my impression is, there's more consumer products available but in terms of legislation the US is behind Europe, like legislation in terms of health, environment, animal welfare, these two things do not necessarily coincide like you have less consumer products. Less options in Europe, less quality also, but still we have better legislation these different domains and in America it's the opposite".

"In South Africa as well. People are eating more plant-based options and moving away from – not moving away from the meat aisle. People are definitely including more plant-based foods as part of their protein intake. I live in Berlin, which is the vegan capital of the world. So here its honestly not like veganism is a thing, its as mainstream accepted as any other diet in the world. You can go to any corner café, you will find soya, soymilk, almond milk and I am talking 24 hour little shops in the middle of town you will find it. We've got vegan and vegetarian restaurants on every corner. It's advertised in the national print. It's more in the mainstream here than in South Africa.

Impossible Foods is doing a very good job in terms of marketing. It's quite good, they have a very positive, inclusive approach. Very young, very inspirational.

I think that setting aside the kind of idea that they are marketing directly to vegetarians and vegans I think that are really marketing to flexitarians- people who are trying to add more vegan foods into their diet on occasion.

I do think we have certain hurdles to overcome and that is that especially in developing markets a meat-based diet is often considered as a sign of wealth. So there is a need to fit the paradigm. It means that we can create

a paradigm shift but as long as meat-based diets are synonymous with wealth, it does create issues.

I think one you will see a change in the medical industry as rates of heart disease and various types of cancers decline and type two diabetes as well, so I think that is one change and the other is I think you are likely to see BMI come down, average BMI come down, body mass index, which will also have all types of impacts on everything from fashion to medical and more.

I think just social media like you know people, share information on social media and they have access to a lot of information that they would not get through mainstream media. And they get to see you know what goes on at factory farms and you learn about the environmental impacts of factory farming.

Immediately there is a whole lot of different reactions that social environment generates and it's either respect, there's a level of ridicule because it is what are you doing? Why are you not doing what we doing because this is the norm, why are you doing something different to the norm?

Heart diseases, Type 2 diabetes are the leading health issues in the Western countries. I can see people are consuming far too many animal products, which is going to have a major impact on peoples' health and put strain on health services and hospitals due to all these conditions. I can see people are starting to fight the consuming of animal products and people are switching to plant-based products.

We have more and more national chains like coffee shops and restaurants that are offering plant based milk based on consumer demand and plant based milk as a while are approaching a quarter of the overall milk consumption market in the US- you'll find them at every grocery store. Part of that is driven by people who are lactose intolerant by allergies, but I also imagine a part of it is driven by health concerns or concerns about the dairy industry.

Now it is becoming more synonymous with being eco-conscious. So there is an opportunity for a shift from that perspective. But there needs to be more dialogue around it. There needs to be a lot more transparency.

Traditionally meat has been the symbol of power and dominance over nature and there was visible and tangible proof that we were highest on the food chain and so I think it kind of spoke well into human kinds collective ego that we meat, and I think that's one of the reasons why its such a powerful symbol.

What happens when people start looking at their food with more concern? They start to investigate more, they start reading and they just educate themselves. Once someone moves into that sort of direction they don't stay there very long. They may start finding the benefits of moving towards maybe a more whole fruit, plant based diet.

Our communication has definitely shifted in terms of the words that have been used to explain what the kinds of foods that we make. So our branding change- it used to say Fry's Vegetarian so it changed about three years ago to the Fry Family Food Company, and it has a vegan brand on the top right-hand corner. And our product has we never vegetarian, it's always been a vegan product – just a more friendly way people more accepting of vegetarianism than veganism.

Everything that we do is below the line PR, digital connecting with the consumer, answering them as people, speaking to them one on one, attending events, we work a lot with charities and not for profits organisations and advocacy work. We do a lot of speaking, international speaking at events, as authorities on plant based living and plant-based diets.

We started meat-free Mondays in South Africa and we did a lot of research with the people that signed up and we found that its about 60-70% of people that have started MFM are now doing more than just one day a week meat-free. It just shows that when you can plant a thought or just an idea it can grow in someone's mind and I think Fry's is a good seed planter you know.

I think we [Impossible Foods] hit the nail on the head from early on, that is we want to create an optimistic and aspiration brand around the product, one that did not make people feel bad about their eating, that's part of the reason we want to bring people in based on taste, based on food culture and hitting those marks and I think that, that has been something pretty consistent throughout the past.

4.5.2. Summary of findings pertaining to the social tenet of adaptive management (place sensitivity)

The intent behind the social tenet of adaptive management is to understand the impact of place-based values on innovation in plant-based foods. Respondent feedback is germane to themes around the environmental and social impact of food and the adoption and diffusion in the Global North and South. Nine of the respondents agreed that the environment is in an embattled relationship with current food production practice, which is exasperated by social choice and consequence. However, high investment into plant-based food innovations driven by venture capitalists and celebrity culture is reshaping the landscape. Eleven of the respondents suggested that the impetus for this innovation originates in developed economies such as the US, specifically Silicon Valley and the UK and Europe including Britain and Germany. The start-up culture is significant in driving innovation. However, respondent eight suggested that this is happening in *"isolated pockets"* and while the developed countries' role is significant in driving a research agenda, access to products, combined with education is going to be the hallmark of successful diffusion in developing economies. Four respondents did suggest that there is a movement toward adopting plant-based innovations in countries such as Brazil, India, China, Korea, Israel and even South Africa. This could partially be attributed the psychographics of the population who are predisposed to a plant-based lifestyle and are investing in technology to further this agenda such as China.

Nine of the respondents alluded to the sociological paradigm attached to a meat diet that is prevalent in developing countries. Respondent 11 suggested that this the case of growing middle class that is *"copy pasting the consumer patterns of the west"* who manifest a show of wealth or growth through the purchase and consumption of meat products; however, this is tangential to issues of global sustainability. As such, respondent 11 suggested that developed economies *"lead by example"* which could set up the emerging markets to adopt and diffuse plant-based food innovations successfully within their context and ultimately lead to them leapfrogging the initial technology.

Seven respondents suggested that the social stance holds water in forging ahead as concerns for health, propelled through popular culture documentaries and less meat initiatives, offer valuable incentive and direction for innovation in developing plant-based foods that also meet the taste and expectation of certain cultures.

Respondent eight suggested that eco-conscious living has become a trend. This was supported by respondent two who added that health-conscious individuals who might not share the ideology of plant-based living, are however instrumental in driving change in the food system through their purchasing power. Respondent ten stated that local retailers are now developing and labelling plant-based products as a result of growing health awareness, as also articulated by four other respondents. Respondent six reckoned that a change in health and body mass index would directly impact other peripheral industries such as medical and fashion.

Parallel to the self-concern is that of the grand narrative of the 21st century, which is the concern for climate change being driven in large part by millennials as discussed by respondent two.. With access to information comes education, which in turn is driving demand across value chains. There is a move toward articulating the outdated approach to food in favour of an ideology that supports food security and sustainable food supply. The specifics around the use of land and water favour plant-based food

production on the environmental scale. Socially, there is a caveat about the nature of adoption dictating behaviour. Respondent three suggested that people who adopt a plant-based diet as a social justice issue are likely to be more compassionate in their behaviour toward others. Respondents one and ten both cited examples whereby this is suggested. Respondent one explained that prisoners in a facility in the US adopted a plant-based diet and there was a noted improvement in their temperament. Respondent ten cited an example in an impoverished township in Cape Town, the residents of which were taught about plant-based lifestyles and exhibited less violence which led to a decrease in crime within the area. The findings suggest that once the environmental impact of a plant-based diet is understood, it transforms into a social ideology and starts changing the fabric of society and their approach.

From a social standpoint, Fry's, have been instrumental in bringing dialogue to the fore and promoting ideologies such as Meat Free Monday, which advocates for a reducitarian lifestyle. They adopt a non-traditional, below the line approach to advertising which creates causes for meaningful engagement with the consumer through their Fry's AGM (Annual Green Meeting); e-cookbooks and other forms of advocacy work with non-profits. They consider themselves thought leaders in the plant-based arena. According to the respondent, they have also recently moved away from using the word vegetarian on their packaging and now label them vegan, which might seem irrelevant. However it is not, given that their products have always in fact been plant-based, but previously could be construed as 'extreme.' This is a testament to the growing acceptance of plant-based foods.

Socially, Impossible Foods are creating positive rhetoric around food culture and growing a market of typically omnivorous eaters who can make conscious and healthy choices, thereby lessening their ecological footprint and growing in social awareness.

4.6. SUMMARY OF DATA PRESENTATION

The findings presented above are specific to two organisations that operate in the plant-based food innovation sphere representing the Global North and South. Apart from introspection into their company practices, with regards to innovation and sustainability, responses were sought from experts in the industry whose experience could add robustly to the body of knowledge and offer an informed viewpoint.

All the respondents agreed that there is a shift toward plant-based food innovation globally. There was agreement that this is being driven in large part by developed economies such as the USA, UK, and Europe; however, countries such as China and to an extent Brazil, Israel and India are also showing signs of technology adoption and secondary innovation. Eleven of the respondents agreed that the severity of the food system necessitates a move toward a more sustainable approach to food production and to an extent, consumption patterns. All of the respondents agreed that companies such as Fry's and Impossible Foods are intrinsic to furthering this agenda; however, there was disparity amongst respondents as to how this should be achieved. Feedback varied according to an ecological, social, economic, political and business standpoint in terms of achieving the global sustainability agenda.

The cases in question adopt a multi-pronged approach to innovation for sustainability as outlined by the experts, with constructs weighing in differently depending on business objectives. Evident in both cases is the pole position innovation occupies in achieving sustainable plant-based foods. This is inextricably linked to their business purpose, deeply embedded in the company culture, which is a testament to how the economic resources of both companies are mobilised to achieve the greater good. The sustainability for innovation trifecta – ecology, economy and social theory – is offered equitable consideration in both companies' operating agenda specific to internalities and externalities. Strategically and at face value, the two case studies present quite similarly, however, further

introspection suggests subtle differences in their product development that impacts their innovation for sustainability approach. This is deliberated on in greater detail as part of the analysis that follows.

CHAPTER 5
ANALYSIS AND DISCUSSION OF THE RESEARCH FINDINGS

5.1. INTRODUCTION & BACKGROUND

The purpose of this study was to assess the impact of plant-based food innovation on ecological sustainability. This was operationalised through two organisations that specialise in plant-based food innovation, one based in South Africa and the other in the United States of America. These cases are hallmarks of innovative practice in the Global North and South and were examined for this study through an adaptive management framework lens to assess the feasibility of a positive impact on the constructs of ecological, economic and social sustainability.

Fourteen respondents from a cross-section of industries pertaining to food production, innovation and sustainability were interviewed. These included mid to senior level executives at the organisations that were examined as the case study. The interviews were conducted over a period of three weeks and the data gained added context to the existing literature and assessed it in practice.

The analysis in this chapter is arranged according to the three research questions that the study sought to answer. Further, the analysis is synthesised with the literature review to offer parity amongst the discussion as well as illustrate how this research undertaking can contribute to the body of knowledge on innovation for sustainability. The following sections are organised according to each research question and the appropriate literature aligned to the outcomes of the interviews.

5.2. THE CURRENT ROLE OF INNOVATION IN DEVELOPING SUSTAINABLE PLANT-BASED FOOD PRODUCTION PRACTICES IN THE NORTH AND SOUTH COMPARATIVELY

RQ1: What is the current role of innovation in developing sustainable plant-based food production practices in the North and South comparatively?

This research questions aimed to unpack the role of innovation in the global sustainability agenda and had several precursors that had to be examined. The first was to understand the innovation context and its definition trajectory. The second was to unpack the evolving nature of sustainability including the goals as set out by the UN; and lastly, to understand the interlocking of these theories in facilitating plant-based food production practices.

It was widely held by respondents that innovation plays a pivotal role in plant-based food production trends. The upsurge in the development of this food category is resultant of food security concerns and current unsustainable food production practices as discussed by Godfray, et al. (2010). These findings correspond to the literature in the following way: scholars such as Kemp (1994) and Juma, et al. (2013) suggested that the landscape of innovation was broadening from the previously held views of economic growth to adopting an outlook inclusive of the environment within which it functions and adopting a sustainability lens. This is supported by the New Sussex Manifesto as well as Ely and Bell (2009) where innovation holds a dual role of economic benefit and sustainable output. This is parallel to the United Nations Sustainable Development goal, which outlined sustainable food security as an imperative.

There was a collective thought amongst respondents that developed economies were integral to driving this sustainability agenda in large part because of their access to resources, technology and availability of funding. It was further agreed that learnings should be diffused to emerging markets

that are prone to imitate consumer patterns of the North and therein lies the impetus to lead by example. This is supported in the literature by the Kyoto Protocol as developed by the UNFCCC that developed economies of the Global North, who enjoyed extended prosperity resultant from industrial and technological progress were accountable to find solutions to mitigate the adverse externalities derived from their on-going progress.

Respondents agreed that the intersecting challenge of innovation for sustainability included a focus on ecology, economy and social theory. Ecological concerns extend to issues pertaining to land degradation; water usage; CO_2 and methane emissions, burning of fossil fuels; and the direct contribution of all these to climate change. Economic concerns included the resource intensity and scale of production, which is discussed further as part of RQ2. Social theory includes the concern for health, adoption of less meat initiatives and food safety. As per the literature, Hollings (1978) presented the initial framework for adaptive management which integrates these three spheres and suggests that they are interlocking and cannot be considered in isolation, especially in relation to sustainability which is necessitated by mass anthropogenic impact. He further discussed ecology as the conservation of resources; an economy which is the innovation in resource and social theory in reference to humanity and their growth. The holistic nature of sustainability is a consensus shared by both, the respondents and the literature.

To appreciate food production's bearing on the ecology requires an understanding of the ecosystem within which it presents. This can be articulated through the underlying tenets of the adaptive management framework, as proposed by Norton and Steinemann (2001) who discussed the following three principles that underpin the relationship between people and ecosystems:

- Experimentalism
- Multi-scalar analysis

- Place sensitivity

These concepts are useful in exploring issues of sustainability that have a sizeable impact on the ecology and are reminiscent of both nature and man-induced changes. This approach is a derivative of Leopold (1968) “Thinking like a mountain”. He postulated that his initially held view of killing as many wolves as possible in order to enjoy the abundance of deer hunting was myopic. In his last kill, he attributed a “fierce green fire dying in her eyes” (Leopold, 1968, p. 130) to a metamorphosis in his thought pattern. He realised that his singular act could be the precipice for an imbalance in the ecosystem. This birthed his appreciation for the interrelatedness of elements in ecology. This is evident in the findings as respondents alluded to a succession of actions, which in some part, contribute to the collapse of our ecosystem. This can be attributed to population growth, which in turns stimulates demand for products, which subsequently pressurises the ability for natural capital to regenerate at tremendous speed; thus encouraging a capitalist economy with little concern for the elements and giving rise to an entire set of parallel concerns such as health and food security. Growth cannot be predicated exclusively on resource use without considering how to be equitable.

Both Fry’s Family Foods and Impossible Foods have innovation at the helm of their business philosophy. As such, its role is central to the development and diffusion of plant-based foods in the Global North and South. Fry’s has an international footprint, operating in 27 countries, whereas Impossible Foods is currently limited to specific areas in the US, with their sights set on expansion into Asia. Apart from the built-in sustainably led approach, both companies deliver, albeit differently, on the functional equivalent of meat-based products. This is necessitated by animal agriculture practices, ecological degradation, resource ineffectiveness of current food production and growing health concerns which manifest as a form of advocacy with Fry’s and planetary mission within Impossible Foods. This is supported in the literature by Juma, et al. (2013) who denoted that concern regarding

food production is not limited exclusively to developing economies, but also to developed countries who are considered as complicit in forcing the hand of earth and it manifesting as climate change.

5.3. HOW THE ECONOMIC RESOURCES OF A GIVEN ORGANISATION ARE MOBILISED TO PROMOTE PLANT-BASED FOOD INNOVATION

RQ2: How are the economic resources of a given organisation mobilised to promote plant-based food innovation?

In this research question, prominence is afforded to the economic inputs required to mobilise plant-based food innovation. This is necessary as economic growth has been a hallmark of innovation and this relationship needs to be understood in the context of the current global landscape.

Respondents suggested that internalities and externalities exist in terms of how economic resources of the given organisations can be mobilised to support plant-based food innovation. The internalities are explained as follows:

Businesses must be imbued with a sense of purpose, derived from adopting any one of the United Nation Sustainable Development Goals. In doing so, the business acts meaningfully and contributes to the development of a green economy. This is supported by the literature, in which Smith, et al. (2010) suggested that in the early 1990s, apart from adopting technology that was operationally environmentally beneficial, businesses extended that level of consideration to their product development. Seebode, et al. (2012) reiterated that the combination of adoption of technology and subsequent production of goods gave rise to a green goods economy. Concerning Fry's Family Foods and Impossible Foods, both adopt a purpose-driven business model with economic resources advancing that specific agenda. Fry's adopts advocacy as its purpose, and at Impossible Foods philosophy is rooted in sustainability. Through a combination of green technology and resultant product line, both companies aim to capture and grow a consumer

market, which meets a dual objective in advancing financial viability and purpose-driven business practice. This contemplation is summarised in the literature by Rangaswami, et al. (2009) who explained that organisations characterised by strong sustainability appreciate that economic benefit is deeply embedded in ecological appreciation. This understanding is critical to delivering on innovation that aims to balance man made earth debt. A further point expressed by Rangaswami, et al. (2009) as part of their 5-step process to achieving sustainably-led innovation is that characterised as “creating next practice platforms”. This thought while not explicitly expressed in the literature review, is of relevance, as it hinges on a predisposition of questioning the status quo. This is in reference to existing business patterns and the assumptions that set them in place. In doing so, businesses can carve out a forward-looking path that disrupts the norm to replace with it with an innovative vision. This contemplation is evident in Impossible Foods’ approach to product development. Their dedicated R&D team uncovered a protein called haemoglobin that is present in the root nodules of leguminous plants. Instead of causing further environmental ruin in harvesting this protein, the team of scientists genetically engineered this and used associated technologies to then scale the protein to replicate typical meat textures and flavours. This is testament to honing economic resources to develop a market solution that promotes plant-based food innovation as well as their experimental approach in understanding the ecological impact of their food on the greater ecosystem and how it could be scaled.

The externality as suggested by respondents is in relation to economic resources being driven to promote plant-based food innovation through shaping consumer behaviour in the marketplace. Efficient diffusion of products through strategically crafted market mechanisms could serve to promote plant-based food innovation further. This is a derivative of firm-level strategy rooted in innovation optimised for sustainable development. Kemp (1994) and Seebode, et al. (2012) supported this thought token in the literature when they iterated that the locus of sustainability is ingrained in

the innovation approach. Firms who rally their resources can be all pervasive in creating demand for green goods and sculpting consumer lifestyles to match. Fry's and Impossible Foods are exemplars of this approach. Both company strategies harness innovation for sustainability at their core through the development of plant-based foods designed to transform consumer purchase and consumption habits.

A third finding and externality was that of mobilising economic resources through partnerships and venture capitalists. Respondents suggested that the existing champion businesses partner with the challenger brands who are typified by their innovative and entrepreneurial drive, through harnessing resources to deliver best practice in sustainable innovation to the end consumer. This is inherent in the literature as expressed by Smith, et al. (2010), Kemp (1994) and Ockwell, et al. (2009) who stated that they encourage cross-sectoral support if all-encompassing change is to be brought forward. This is unequivocally entrenched in Kemp (1994) who proposed that firms forging new territory are unlikely to make substantial inroads without the support of incumbent firms, characterised by their operating swiftness; market dominance and economic prowess. This professional union will give way to a new regime of innovative thinking expressed through state-of-the-art products.

5.4. THE IMPACT OF INNOVATION IN PLANT-BASED FOOD ON THE VARIOUS DIMENSIONS OF SUSTAINABILITY IN SOCIETY AND HOW THESE ARE EXPLAINED

RQ3: Are there significant impacts of innovation in plant-based foods on the various dimensions of sustainability in society? If so, what explains these?

This research question sought to ascertain what impact, if any, from plant-based food innovation, can be alleged on the environmental and societal constructs of sustainability.

The first finding is intrinsically linked to the previous research question regarding the mobilisation of economic resources and the subsequent impact on dimensions of sustainability. Driven by investment from incumbent firms and venture capitalists and celebrity culture, the impact of plant-based food innovation is signalling that the environmental tide is turning. This speaks to Lee's (1993) point about the affirmative environmental actions that can be gleaned from institutions and social entities.

Second to this is a discussion specific to individual concern about the impact of consumption. While consumers might not adopt a plant-based ideology, the rhetoric surrounding food production and consumption patterns has precipitated a more considerable discussion regarding the food value chain. De Boer and Aiking (2011) highlighted this point in suggesting that food production be considered from a 'macro' and 'micro' standpoint. The macro perspective is parallel to the initial consumer concern regarding food production practices and by extension, their environmental footprint. The findings suggest that climate change is a cause for acute concern and by default, heralds a new approach and introspection into the business of food. Factors impacting climate change are varied; however, according to Livestock's Long Shadow, the UN report on animal agriculture, 18% of all greenhouse gas emissions results from the farming of animals as a consequence of consumer demand. This percentage holds more weight than the combined global transport emissions and is valid in its concern.

With an extensive, innovative product range, Fry's Family Foods is positively impacting the global sustainability agenda through the development of plant-based foods that are inherently less resource intense than conventional animal agriculture. The findings suggest that a kg of Fry's products requires up to 200 litres of water to produce whereas the equivalent weight of beef requires 16000 litres of water. This is indicative of only one natural resource. However, Pearce, Barbier and Markandya (as

quoted in Jabareen, 2014) cited other natural assets including land and soil as depreciating rapidly.

Impossible Foods, as a start-up, have no real evidence to support the environmental claim for their product, except for a lifecycle assessment conducted in the initial stages of product development. According to the respondent, the ground beef industry in the US is 9 billion pounds, compared to the 1 million pounds being produced by Impossible Foods. However, their 'beef' patty requires 95% less land and water usage which when translated against a 9 billion pound animal agriculture industry, already presents optimistically regarding resource usage. Additionally, the impact of their business philosophy on company-wide approach to sustainability can also be seen in a zero waste initiative in their production facility. This is supported by Godfray, et al. (2010) who in the literature suggested that sustainable food production must become the norm instead of the exception in order to allow the earth to birth its resources according to when it is ready versus human necessity.

The 'micro' perspective on food as put forward by De Boer and Aiking (2011) relates to the social nuances that influence consumer food choice. The findings suggest that access – be it to wealth, information or products – acts as a stimulus in shaping consumer-purchasing patterns. Developed market consumers tend to favour adoption of plant-based foods far more readily due to their widespread availability and normalisation within the food culture. This can also be attributed to ease, with which information about food is accessible, thereby helping define their food choice. Less meat initiatives as explained by Morris, et al. (2013) such as meat-free Mondays and a reducitarian approach are also favoured within this setting. However these initiatives have not diffused nearly enough to see a pervasive impact. Conversely, some emerging markets still favour and aspire to a meat-based diet as an indicator of wealth and progress. Access to animal-based products is indicative of an upward social trajectory and is mirrored in the social food paradigm. This wave of thought is underpinned in the literature

by Morris, et al. (2013) who intimated a causal link between economic prosperity and purchasing power. A long-term health impact has also been cause for concern over food choice. The findings suggest that the increase in heart disease and cancer has been linked to animal-based products, some of which has been classified as carcinogenic. This is supported in the literature by Godfray, et al. (2010) and Tilman and Clark (2014) who expressed concern about the rise in illness such as cancer, heart disease and diabetes, many of which have been linked to animal-based diets.

5.5. SUMMARY OF THE DISCUSSION

The findings as extrapolated from the research, together with the literature review correspond to pertinent issues relating to sustainability, innovation and their reciprocal relationship. A correlation exists between the constructs of sustainability that the respondents sdeem imperative and the adaptive management framework as put forward by innovation scholars. The contribution to knowledge is generated specific to plant-based food innovation and its impact on the social, ecological and economic impacts on sustainability, which is what the research sought to achieve.

There is consensus regarding the global framing of the sustainability agenda and the predominant role that innovation has to fulfil. The call to action regarding the shared relations between developing and developed economies, as voiced in the Kyoto Protocol, is still relevant for the present day. In adopting a forward-looking and inclusive view of the anthropogenic impact, innovation is integral in extinguishing the narrow view that it previously operated within.

Purpose-driven businesses are leading the charge on sustainable innovation as the impetus to create change. This meaningful approach, which reiterates respect for balance within the ecosystem, is characteristic of organisations that practise strong sustainability. The mobilisation of industries, technological advancement and knowledge sharing approach is an accelerant for promoting a plant-based innovation agenda.

A wave of societal change is also chief in shaping a plant-based food innovation agenda. With a widening view of food production practices, their ecological imprint and health implications, consumers are shaping the discourse.

CHAPTER 6
CONCLUSIONS AND RECOMMENDATIONS

6.1. INTRODUCTION

The purpose of this research was to isolate plant-based food innovation within the context of two case studies and assess its impact on ecological sustainability. In doing so, this study aimed to address an avenue to be explored in relation to production and consumption. The literature review, while dense with content relating to innovation and to sustainability and food production practices, has very little that ring-fences all three concepts specific to plant-based food innovation and alternatives as a tool on the sustainability belt.

The case studies selected highlight two plant-based food innovation organisations, operating in the southern and northern continents. Their distinctiveness lies in their operational hierarchy, as one is a stalwart in the industry, and the other a Silicon Valley start-up. Both are characterised by strong sustainability. However, the approach within the adaptive management framework differs.

This chapter presents the major findings of the study and offers conclusions to each of the research questions as presented at the outset of the report. Recommendations to relevant stakeholders are suggested based on the knowledge drawn from the research together with a suggestion for future areas of research.

6.2. MAJOR FINDINGS

One cannot refute the intersecting challenges ensuing from escalating human growth within the bounds of finite natural capital. The industrial revolution and its machine age offspring set in motion man's quest for technological prowess. Friedrich Lists' National System of Production was the bedrock for the systemic nature of technological development and economic growth. While it operated in an ecosystem, this was definitively in

relation to innovation, knowledge accumulation and diffusion. Natural resources were not extended any consideration. Fast-forward several years; a simultaneous retrospective and forward-looking view would reveal that the exploitation of resources while climbing the rungs of the prosperity ladder was austere. The locus of innovation was now shifting from a silo view of economic gain to a more inclusive consideration set as outlined in the New Sussex Manifesto of 2010, incorporating environmental sustainability.

The global discourse on sustainability was being shaped to some extent, prior to this. However, companies and countries alike were enjoying the positive ramifications of their actions, whilst lacking in accountability for the negative externalities. Global market mechanisms were introduced to curtail the adverse effects; however, they lacked robustness and vision to meet the needs of future generations while catering for the current. The innovation framework was now broadening to consider developing technology that was environmentally sound, economically beneficial and socially solvent.

Some of the challenges posed by the United Nations Sustainable Development Goals included eliminating hunger; mitigating climate change; and promoting responsible production and consumption patterns. Countries and organisations were in the driving seat, but it required consumer participation for it to be effective. Push and pull strategies were at play – companies, through technological development linked to sustainable concern, – were also responsible for cultivating a healthy level of awareness amongst their consumer set through delivering goods and services reminiscent of a green economy. As consumers developed an awareness of the anthropogenic remnants from their quest for growth, which was all-pervasive, it gave way to the pull strategies and consumers were now demanding sustainable business practice that not only delivered on the equivalent in goods and services but did so while extending the consideration set to the earth’s capital.

The food economy is a formidable player in the global discourse on sustainability. According to the United Nations Sustainable Development Goals, “The food sector accounts for around 30 percent of the world’s total energy consumption and accounts for around 22 percent of total Greenhouse Gas emissions” (United Nations, n.d.). The role of innovation in delivering equitable and sustainable access to meet the world’s expanding population is paramount. The interlocking principles that are characteristic of the adaptive management framework must necessarily be embedded in organisational business practice if a sustainable food economy is to endure.

Earth’s capital is depleting faster than it can regenerate. This is in large part attributed to an anthropogenic footprint that is resource intense in meeting consumer demand. Ockwell, et al. (2009) suggested that this is deepening CO_2 emissions, which in turn adversely impacts climate change. Food production expedited its capacity and practices, and in doing so, redefined the trajectory of the planet’s natural resources. Animal agriculture, in large part, has been a key pressure point on resources such as land, water and energy. Pimentel and Pimentel (2003) suggested that “producing 1 kg of animal protein requires about 100 times more water than 1 kg of grain protein” (Pimentel & Pimentel, 2003, p. 1261).

Similar findings can be attributed to the two case studies in question, both of which cite the use of far less natural resource capital in the development of their plant-based alternatives. The ecological value chain for plant-based food innovation, while still in its infancy and not up to scale with current animal agriculture practices, still presents a case for lower footprint and better efficiencies of scale.

The economic implication for adopting plant-based alternatives presents encouragingly both from an organisational and consumer perspective. The findings suggest that plant-based food innovation is transitioning from trend to lifestyle, and any business along the food value chain is poised to benefit. Start-ups are predicating their entire business philosophy on delivering

sustainable alternatives to meat, and are recipients of substantial funding from venture capitalists and pop culture icons, which see the value in this investment. Additionally, traditional dominant market leaders in the realm of animal-based products are expanding their product offering by aligning with new tech-savvy, resource abundant firms, that have sustainability at the core of their organisational mission and are set to revolutionise the food economy. These purpose-driven companies are naturally inclined to be profit making as a result of their sustainable business practice. A hallmark of successful innovation in this sector is a robust system of innovation.

The Internet of things has enabled an empowered and educated consumer. The chasm between food production and consumption has lessened, and consumers can no longer be divorced from production to palate. This is driving an increased concern for health and its long-term impact on lifestyle, together with demands for full transparency across the food chain. This is not exclusive to developed markets and can be seen across emerging market economies that have a healthy dose of self and environmental concern.

Urgent calls for a more sustained way of living have given rise to a new regime in which innovation for sustainability is at the forefront. Technological advancements have progressed from delivering on economic value to an all-encompassing global concern.

6.3. KEY CONCLUSIONS OF THE STUDY

The following three subsections deal with each research question proposed at the start of this study and provide solutions as unearthed through the research process.

6.3.1. The first research problem sought to understand the current role of innovation in developing sustainable plant-based food production practices in the North and South

The role of innovation is prolific. It is the root of being able to deliver on issues pertaining to sustainability, and more specifically with regards to the food economy. The upsurge of the start-up culture, centred around delivering on viable solutions to the global food crisis, is being driven entirely through innovative practice. This is testament to the fact that innovation has transcended the boundary of economic affluence to incorporate concern that addresses global resource depletion and social crisis. Current food production practices intensified in their delivery to meet demand, but the silo approach did not reflect the inclusivity required in today's food production paradigm. The role of innovation is to bridge demand with sustainable sources of supply. The ecological imperative with which it is imbued must also deliver on successful economic impact and social compensation for it to be wholly inclusive.

Plant-based food production presents as a viable tenet of the overall global food production system. However, its innovative capacity is limited to certain developed markets like the US, UK and Australia, and to a lesser extent, some emerging economies like China, Brazil, Israel and South Africa. An extension of the innovative plant-based food production approaches into developing economies is crucial. Developed markets of the Global North are shareholders of innovative intellectual property, and through a sharing economy as offered in the Kyoto Protocol, must allow for emerging markets of the Global South to adopt and assimilate these innovations in order to deliver on global sustainability goals. Innovation, therefore, plays a critical role in permeating these sustainable practices.

The role of innovation, in the two cases under examination, proves to be central to their operating philosophy. Both Fry's Family Foods and Impossible Foods are driven by innovation for sustainability approach, which is deeply embedded in the fabric of their business practice. Fry's

Family Foods adopts a DUI (doing/using/interacting) approach to innovation. Through naturally occurring soy plants, they mould the element to create functional equivalents of meat-based products. Impossible Foods adopts an STI (science/technology and innovation) approach. Through extensive research and development, they are isolating naturally occurring molecules for closer inspection and then genetically engineering them, to lessen the impact on the environment, and to produce plant-based alternatives that are at parity with their meat-based counterparts. These companies operate in the Global North and South and as such represent the extensive role innovation plays in delivering sustainable alternatives, characterised by an approach reflective of strong sustainability.

Innovation is, and if not, should be front and centre in companies operating in food production and peripheral activities. It is operationalised through the broader adaptive management framework that aims to mitigate the insular view once adopted by innovation.

6.3.2. The second research problem sought to understand how the economic resources of a given organisation are mobilised to promote plant-based food innovation

The channelling of resources extends to all facets of business both internal and consumer facing. Companies that integrate innovation for sustainability into their ethos are well placed to deliver on efficiently mobilising economic resources to promote plant-based food innovation. Impossible Foods is testament to this, as innovation for sustainability is an umbrella concept that receives consideration across all their business units from R&D and marketing to sales, manufacturing and supply chain. Economic resources are geared to support any call to action that delivers on promoting plant-based food innovation. Fry's Family Foods is no exception as this is seen through the development of an extended product line that offers an array of consumer choice; efforts in developing sustainable packaging which in turn promotes their product to a more eco-centric consumer; as well as their

below the line marketing efforts that aim to spread their plant-based food innovation and its underlying assertiveness.

Augmented partnerships and the cultivation of a sharing business economy is another avenue in which resources can be mobilised to promote plant-based food innovation. A combination of good business philosophy and practice characteristic of start-up firms, together with access to resources and distribution networks of the existing conglomerates, bodes well to promote plant-based food innovation to a consumer.

Thirdly, assertive market mechanisms that create demand for plant-based products, which can be met by the innovative companies, further encourage mobilisation of resources.

6.3.3. The third research problem sought to understand if there are significant impacts of innovation in plant-based foods on the various dimensions of sustainability in society

Yes, the impact of innovation in plant-based foods extends across the sphere of ecological, economic and societal impact. While the impact is not entirely ubiquitous, it is significant in that a ripple effect is being created within the food industry and others tangential to it.

From an ecological standpoint, companies such as Fry's and Impossible Foods have illustrated the natural resource efficiency characteristic of their product line. In requiring almost 95% less land, water and energy, this is already a significant impact on the dimensions of sustainability. As these companies scale up, and consumer demand flourishes, it will yield important connotations for sustainable innovations.

Adopting a societal viewpoint, the impacts of plant-based food innovations are acute. Consumer food choices are shifting in part thanks to information about the food value chain, as well as the availability of products that normalise plant-based foods and encourage uptake. A derivative of this is a concern for the health impact of current food consumption, which has

illustrated links to chronic illness. Consumers are adopting new lifestyle choices that include more plant-based options recurring in their diet. Growing awareness about their ecological footprint and its ramifications on current living standards, and of those to come, has prompted the adoption of plant-based meals, which is testament to the impact of their innovation.

6.4. RECOMMENDATIONS FOR BUSINESS / STAKEHOLDERS

In light of the sustainability discourse and its pervasiveness across many sectors, it is necessary for the following stakeholders to heed the findings from the research as a starting point in adopting a more conscious approach in their business environments.

- **Private and public corporations within (but not limited to exclusively) in the food sector:**
    - The market is ripe for the swift adoption and diffusion of plant-based alternatives or similar offerings. Businesses are encouraged to look at diversifying their business portfolio and investing resources into adjacent or radical innovations, which have proven to be lucrative efforts for incumbent food companies such as Tyson & Cargill Meats. Friedrich (2018) pointed out how these giants of the meat industry are directing resources toward investment in both plant-based alternatives and clean meat. One such example is their unequivocal support of Memphis Meats, a Silicon Valley start-up, determined to reverse the profound impact of animal agriculture through new technology and innovative outputs.
    - Companies need also to consider the full extent of their business value chain and ensure that sustainable practices are deployed thoroughly across all business facets and not green washing to suit a need or consumer trend (such as the upsurge of steel straws in favour of abandoning plastic straws).

- **Government and regulatory bodies**
    - Government and regulatory bodies can occupy a dual role of advocating for changes in production and consumption patterns.
    - From a production perspective, the government should drive certain behaviour amongst companies. As the custodians of a country and its people, it is paramount that they encourage businesses to adopt a green approach to business. Subsidies should be awarded to companies who incorporate this ideology into the fabric of their business practice. Conversely, taxes should be imposed on businesses that ignore the call toward sustainable practices to emphasise the importance attached to changing behaviour.
    - Food security in the face of a rapidly increasing population is a real and present danger. Government policy could encourage the development of ideas/innovation germane to that.
    - From a consumption standpoint, education is central to cultivating a healthy appreciation of plant-based foods in societies that are deeply inculcated in a meat paradigm.
    - This could prove to be a linchpin in developing economies that are predisposed to the social currency of meat based on Western influence. The affordability and nutritional punch associated with plant-based foods serve as dual tenets in achieving excellent levels of health amongst its citizens and sustainable food practices.

6.5. SUGGESTIONS FOR FUTURE RESEARCH

The focus of this research paper was specific to plant-based food innovation as a tool to mitigate the negative externalities associated with current production and consumption practices. However, the proliferation of technology in this sector along with the variants of alternatives has given way to a number of ecologically friendly options that can be explored.

A prevalent theme that emerged from the research was that of clean meats or animal cell agriculture. Respondent 6, a long time animal activist and author, is well versed in this content. He explained clean meat as follows: *Clean Meat is a real meat that is grown without animals, it is not an alternative to meat, it is not a substitute for meat, it is real actual animal meat that is grown from animal cells rather than from animal slaughter, so imagine taking a tiny sesame seed size biopsy from a cow or a chicken or a pig and you can put that piece of tiny tissue into a cultivator and make the cells in their think that they still in the animal's body and then you feed them so that in the same way that they would be fed inside the animals body and they do what they do best, which is grow into muscle.*

In essence, this could prove to be useful in meeting a rapidly increasing population, while still satisfying their appetite for meat, in a manner that is entirely divorced from the harsh environmental, ecological and social impact. In a recent article by Friedrich (2018), the executive director of the Good Food Institute, he claimed that as much as plant-based alternatives were proliferating the marketplace, meat consumption was still on the rise and showed no discrimination between developed or developing economies. He offered a thought about looking to change the nature of the supply versus curbing the demand. Further research would need to validate this thinking and assess whether, by offering the consumer an environmentally friendly alternative, that is less resource intense and is the same property as meat, global food security and sustainability agendas could be met.

The process of cultivating clean meats does however beg certain questions. Animals would still have to be reared so that their cells could be extracted. Research would need to support the viability of this from an ecological standpoint in terms of resources and feed. In addition, food safety guarantees would need to be put forward in light of epidemics that have resulted from typical animal agriculture. Lastly, the impact of this on health would need to be considered as meat has been linked to several of the top

ranking diseases – would these be assuaged through the dispensation of clean meat when it is in essence still animal derived? Future research would need to determine whether clean meat is a viable tenet of the overall global food production system.

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APPENDIX A:

Semi structured interview questions for case study organisations

1. Please share your name, job title and how long you've been with the organisation?
2. In your capacity described above, can you explain what exactly your job entails?
3. What is the role of innovation in achieving your current product line?
4. What is your approach to sustainability within the organisation?
5. How are your economic resources mobilised to promote your approach?
6. Based on the above, is profit a driver of the business or is it a result of a purpose driven business?
7. How does your sustainable approach preserve or extend ecological resources?
8. In an effort to be sustainable, and extend ecological resources, how can you scale up the learning's from your business? (What works in a small scale within your company and how can this be extended into the bigger picture? How do you experiment along those lines?)
9. How does external policy (regional/municipal/governmental/global) impact your firm level strategy? (What are the contestations to policy and where do the opportunities lie? What might your future vision be and how is this shaped by policy?)
10. How do the values of your immediate society impact your business strategy? (This could relate to your advertising/marketing efforts; packaging; receptivity to your product etc.)
11. What impact from your innovation, if any, have you seen on the dimensions of sustainability in society?
12. Are there any other contextual considerations that are pertinent to be explored?
13. Is there anyone else you recommend I speak to for additional or alternative insight?

APPENDIX B:

Semi structured interview questions for experts

1. Please share your name, job title and how long you've been with the organisation?
2. In your capacity described above, can you explain what exactly your job entails?
3. What is your view on the rapid development of plant based food innovation that is a global trend?
4. Do you believe that these plant based food innovations can positively impact global sustainability issues and why?
5. What other trends in plant-based food innovations are you aware of?
6. What is your view on companies (Frys & Impossible Foods) who invest in plant based food innovation?
7. Are you aware of any differences or similarities in the adoption and diffusion of plant based foods in the Global North and South?
8. Are you aware of any environmental differences that have arisen due to plant based food production?
9. Economically, is plant based food production a viable tenet of global food production systems?
10. What social impact do you think plant based food has on society?
11. Do you believe there is a place for government involvement in policy development specific to supporting plant based food innovation in meeting a sustainability agenda?
12. Are there any other contextual considerations that are pertinent to be explored?
13. Is there anyone else you recommend I speak to for additional or alternative insight?

APPENDIX C:

Interview consent form

Thank you for agreeing to an interview with me. The purpose of my research is to understand the impact of plant based food innovation on issues pertaining to overall ecological sustainability,

I guarantee that none of this information will be attributable to you in any way. Should I be so fortunate as to be able to publish my research, I will take measures to ensure your anonymity.

I, _____ agree to participate in the research study conducted by Misha Dhupelia in partial fulfilment of a Masters Degree in Innovation Studies through the Wits Business School.

The purpose and nature of the study has been explained to me in writing and verbally. My participation is voluntary and I understand that I can withdraw at any time during the study without any repercussions.

I understand and give permission that the extracts from the interview may be quoted and published in the research report. I also give permission for the interview to be audio- recorded.

I also understand that confidentiality will be ensured in the research report and that no identifying features will be attached.

I understand that a transcript of my interview in which all identifying information has been removed will be retained for a period of time until the research report has been examined and marks awarded.

I understand that under freedom of information legalisation I am entitled to access the information I have provided at any time while it is in storage as specified above.

I understand that I am free to contact any of the people involved in the research to seek further clarification and information.

Signed:_____

Date:_____

APPENDIX D: An example of a transcript

Respondent 8

What is your view on the rapid development of plant based food innovation that is a global trend?

I think it is interesting from a local perspective. I don't know how much traction we will get out of this. I can tell you that you are looking at the restaurant industry from at least a Cape Town perspective. It just occurs to me now because just down the road from our offices is a vegan restaurant. Their claim to fame is that they are a vegan junk food. If you look at it a number of years ago there wouldn't be such a thing. If you look at it five, ten years ago it would really be a novelty and chances are it would be at best a pop-up while right now it is a fully viable restaurant. This is how the market has been shifting in terms of overall acceptance and understanding that there are alternatives to meat based diets.

Do you believe that these plant based food innovations can positively impact global sustainability issues and why?

I think it can, because there is a number of countries that have similar agendas. It is about coordinating some of these activities. What is happening is that everyone is working in an isolated pocket in their respective market. Sometimes you are lucky and you hear stories that are coming out there. So for example in France their grocery stores are incredibly popular. The story behind it is the fact that they have Zero organic waste tolerance. They had to actually come up with a clear plan in terms of what to do with their food wastage. But this is really isolated pockets. Here in South Africa we try to push our retailers into the right direction. But to be perfectly honest with you, there is still a lot of green washing that is still taking place. So we need our consumers to become a lot more educated and aware in terms of the impact. I think that this is happening but purposely is being denied. A lot of the retailers are taking the stance: "we are taking care of things so that you don't have to worry about it. So, what it means

there is a lack of access to information in terms of critical areas that you should be asking questions about as a consumer yourself. So in Cape Town there is a huge topic as far as the drought and water security and so right now ordinary citizens are doing a lot as far as looking at saving water in the house holds. Looking at how much water that they are consuming. But with this is a perfect opportunity to say in addition to this – this is what our water supply chain looks like. This is where most water is being consumed. If we for instance, are using paper plates instead of washing plates as such. For example, if you are consuming these types of foods. So, that-part of that- is not being communicated together with this messaging and this is actually a perfect opportunity to start and really push that kind of movement. Yet it is not taking place.

Last week I attended a co-create event where there was a panel discussion around food sustainability and one of the participants on the panel, I know quite well, he positioned himself very strongly as an expert when it comes to water and water security and yet even in that context the topic around understanding where water was really captive was not discussed at all.

Nobody is looking at sustainability in a more holistic kind of sense

Correct. This is also one of the reasons where in the market where we operate we stopped using the term sustainability. Because it was resulting in a lot of confusion which was wasting time from us getting on to the core topics. We have adjusted our langauge talk about the green economy: The business of sustainability. So now if we go talk, we talk about the business of sustainability in the Green Economy. So if we say to them we want to be able to look at it, you say one of the things that is critical is your water footprint. We say to them this is how you identify what is happening in terms of your water footprint on site. But this is also what you need to consider within your supply chain itself. That is actually different. This is a conversation that is really missing in terms of the general public and I'm quite disappointed about that. Part of it is specifically because the key

stakeholders who were claiming to be experts, as far as this topic are specifically shying away from this.

When it comes to sustainability, its not bad as a soft intangible almost classic topic. One of the things which we are striving towards is to make it tangible to be able to actually say: You know that I'm talking about food sustainability and what does that actually mean. Do I understand what is in my supply chain and can I actually break it down into numbers. If I'm talking about my water footprint exactly the same situation.

What other trends in plant-based food innovations are you aware of?

I think that what for me is really interesting is the step that has come together with that as far as composting. In terms of how to handle organic waste. What I have seen is that it goes hand in hand very nicely in terms of responsible, disposable organic waste or at least it has improved. I've seen that it has become a lot more popular and what I've seen is that if I look at it from residential complexes, I've seen that sometimes certain complexes had been more willing to put organic waste units in place. They have been asking residence to supply mainly plant based items and not to include any meat based kind of things because it takes a little bit longer to decompose and it would also attract rats etc. They can put it in a communal area. So in that case a plant based diet or including plant based options or waste into a system like that is working out better.

What is your view on companies (Frys & Impossible Foods) who invest in plant based food innovation?

I think it is quite important in terms of having options in the market place and tasty options at that. The one specific area that I do have an issue with is as far as that industry as a whole. If I were to take the stance that I want to follow a plant based diet or if I want to actually be a vegan or vegetarian then it means to making a conscious decision and one of the things which always confuses me is a number of these players will make foods that resemble animal based products. So you have your vegan chicken nuggets

or your vegan beef strips and for me that is something I find particularly bizarre. Instead, what I think is that this is a perfect opportunity to get this kind of product to stand up based on its own merits to be able to actually say: Yes this is a vegan burger. Its not a vegan burger that's made to taste like chicken.

Do you think there is a space for that in trying to get people to, from a societal point of view to try and get move them over to something that they are familiar with in terms of taste and texture without the cruelty and all the other sustainable efforts?

It is a Yes and No. Yes, for sure because it makes it a lot more comfortable if you are making this transition. In these early days transition and so you are not 100% confident as far as making the switch and there is certain things you still yearn for in your diet. No, because we should take a hard stance and we can make that. I think we need to make plant based options sexy in their own right. Not to specifically position them as a substitute. I think that there is an opportunity to make it sexy to stand up as its own entity to be able to make it attractive from that perspective. So, that even someone who is following a meat based diet thinks and tries this out then goes on a diet that is amazing and incorporate that in their diet and then so there is less meat that is being consumed from that perspective. I think there is a space for it to stand up in its own right.

I also think that there is space for other types of innovations. So instead of having these expensive products where you can have your own little green house incubator and grow your own salads on a mini scale in your own home. So that way it is not specifically about having these kinds of alternative options but it is simply having access to fresh produce. And it is really about that part than anything else. That could actually be the real game changer that we are looking for.

Are you aware of any differences or similarities in the adoption and diffusion of plant based foods in the Global North and South?

If I were to make a comparison, I think that the way its been done in South Africa is very similar to something I've seen in Hong Kong as an example based in the restaurant culture. So, as an example because I lived in Hong Kong before. I was actually there for about three years and what I found is that there is always these interesting, exciting new restaurants that are out there, that are occupying a specific niche. I see that as a trend also here in Cape Town but really just a hallmark of the restaurant industry as a whole. I know for example in Asia there is this whole thing with the Buddhist monasteries and then it becomes like this trendy thing where people are having lunch in a monastery and then for sure it is a plant based diet.

What I do think is really interesting and I haven't seen a fully crossover it this whole start in the European market as far as responsibility and supply chains particularly amongst retailers. Especially as far as rations go. So I know of some applications in Europe as well as in the US where if you have a function or an office function or your restaurant have these left overs at the end of the function or at the end of your evening or whatever it is, you can actually put it on the app and people can come and collect it for free. You are able to actually disperse it to shelters or orphanages or whatever the case may be. This is something that I have not seen in South African market place. Maybe it is here and that I'm not aware of it but as far as I know it is not here. Aside from that I would also say that here the retailers are not super keen when it comes to that kind of stuff because I know we have approached this topic with Woolworth and they are not keen because their concerns that all of their ready-made meals have their branding all over it and if they would put it out and somebody didn't eat it in the time limit on it and got ill from this. They feel that they could be held liable. So there was this whole thing that they would rather actually dump it than run that risk. At Woolworths, I find it a bit weird because if I check out their shelves and look at the options they have, there is a lot of interesting new stuff that is being put on there or new recipes that are tried out. But when it comes to vegetarian meals – I use the term as a blanket for plant based – it is kind of boring what they put out there. So I don't know if it is something that is

missing in there organisation or someone who is actively championing that part of it, or maybe they don't see an attraction in the market. So there is no justification to go in that direction. I don't know the answer to that. I do know and I've recently heard that they do have with some of their stores, not all of them, but some that they have a plan in terms of food reaching its sell by date, not best by date, that they are doing a donation to old age homes and stuff like that. I don't think it is something like a blanket policy but I could be wrong.

Economically, is plant based food production a viable tenet of global food production systems?

Business need to be innovative. If you are not innovative in terms of trying out certain things and doing limited edition meals or limited edition options, how will you know this for sure. It could just be that you are offering really boring plant based versions and that is why nobody is into it. So we are working on a project right now. It's a project based on converting a community initiative into fully viable business. What we have done, we have approached a number of businesses on behalf of the community to create an awareness of the project. We had a conversation with a company here in Cape Town who just started a bar that uses botanicals in their cocktails. They were excited about this and wanted to explore options. During the discussions it lead to the conversation about why don't we actually try out the botanicals in a limited edition run: Infuse the botanicals in a chocolate slab. So this is something – maybe because they are a small company that they are willing to be innovative just to try it out and just to see how market responds. Maybe Woolies thought they can't really risk something like a limited edition product – I don't know. I do think it's a missed opportunity.

I think plant based food production is economically viable. The turnaround time is definitely much shorter. I think the footprint in terms of the resource footprint is definitely much lighter. I do think we have certain hurdles to overcome and that is that especially in developing markets a meat based diet is often considered as a sign of wealth. So there is a need to fit the

paradigm and why retailers that are considered in a particular light or certain types of restaurants are considered in a certain light if they are much more visible in terms of offering these as additional options. It means that we can create a paradigm shift but as long as meat based diets are synonymous with wealth, it does create issues.

What social impact do you think plant based food has on society?

I think this is really an interesting thing. I would say that if we were having this discussion 20–30 years ago, if people, ordinary consumers were telling their friends that they are vegan or vegetarian it was really looked at as a very specific hipster hippie type thing. Now it is quite a different situation. Now it is becoming more synonymous with being eco conscious. So there is opportunity for a shift from that perspective. But there needs to be more dialogue around it. There needs to be a lot more transparency. There is a focus in terms of accessing fresh vegetables and improved nutritional content and they think this is where a plant based diet really shine. I think that there is not enough information that's available and or people are not aware that looking at something as simple as access to protein in your diet. A lot of times I heard from people that they can't be vegetarian because they need access to protein or there is an issue in terms of maybe iron in their diet and they need to have supplements etc. but if they were educated in terms of how to have a well-grounded diet clearly we will be having a different conversation.

I think that we definitely need a multi-pronged approach. I think if you just have a Frys or an Impossible Foods out in the market place, it feels very much like an agenda a company want to push and therefore obviously are processing certain things. But if you have a multi-pronged approach where you are really encouraging a dialogue, this is a completely different situation because then your get information from quite a number of different sources which put you in a much stronger position to be able to make up your mind as an individual and consequently you as well are able to have social influence to be able to talk about how this has impacted on your life.

Do you believe there is a place for government involvement in policy development specific to supporting plant based food innovation in meeting a sustainability agenda?

For sure. I do think that given the agricultural industry and how the agricultural industry is struggling in South African context. I mean we all know the stories in terms of supply chain that the biggest margins are down where the brand owners and the retailers are very slim. When it comes to the farmers themselves and I think to be able to support this agenda we go a long way but is is very tricky and needs to be very well managed. Last year we did a body of work in Zambia where we backed our big supply chain through key agricultural commodities with a view that these commodities form part of the international supply chains. One of the commodities we looked at is maize and maize is massively propped by the Zambian government. It does so to the detriment of quite a number of other agricultural commodities because a number of commodities are then, basically they stopped growing it and replacing it with maize instead. We need to be careful how these type of things are managed. We need a dialogue between industry, government and farmers to be able to actually come up with a joint agenda in terms of how we will address the growing needs of our society and population.

Population growth is a real thing. The fact that in an African context we have a particularly young community vs other parts of the world; the fact that we are also dealing with certain types of diseases. So consequently we need to have a holistic stance of how we can be able to address this from a wholesale nutritional perspective. For the wholesale nutritional perspective and not necessarily exclusively looking at it in terms of plant based diet but actually looking at it holistically to say how can we be able to increase the nutritional value that people have access to.