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Sustainable development dilemmas and ethics of biofuels research and production in South Africa

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A research report submitted to the Faculty of Commerce, Law and Management, University of the Witwatersrand, in partial fulfilment of the requirements for the degree of Master of Business Administration

Johannesburg, 2014

ABSTRACT

The concept of sustainable development is said to have faced challenges right from its inception, both in interpretation and practical application. These challenges vary from political to administrative barriers in the move towards ecologically and socially acceptable development strategies which seem to threaten profitability, employment and power. The incomplete understanding and perception of the problems of poverty and environmental degradation also adds to this confusion.

The threat of global warming due to greenhouse gas emissions and the ever-growing energy needs of the world, has forced the world into thinking differently about our sources of energy and sustainable development, giving rise to the relatively new field of biofuels. Research and the introduction of new technologies by their very nature, look to bring about positive changes in society. It is almost inevitable however, that these positive changes bring about with them unintended, unexpected, unforeseen, unforeseeable and often unaddressed negative consequences. It often becomes the role of research ethics protocols to militate against these negative consequences. It is in this context that it was important to establish the levels of awareness among South African researchers and producers of biofuels, to the sustainable development dilemmas brought about by their work.

This research focused on establishing the levels of awareness of the dominant sustainable development issues and ethical conflicts that arise from biofuels production and research and whether this translated into how companies communicate the benefits of their products. The aim was also to establish the role that research ethics protocols play in mitigating the negative consequences that may be brought about by work done in this field. The research was carried out on three South African businesses, Matayo Biofuels, Khepri Energy and the Council for Scientific and Industrial Research (CSIR). Data was generated from interviews

with relevant people in the companies and collaborating data was collected from company publications.

Once completed, this report concluded that researchers were indeed acutely aware of the dilemmas that face their industry and that research ethics protocols were seen to play a big role, albeit that most of the researchers were not aware of their existence in their industry. In both the research and the literature review, it was found that the biggest dilemma that the biofuels industry faces is the conflict of producing food versus producing fuel, coupled with concerns over land tenure of vulnerable societies. Other critical issues that came out of the research were protecting the environment and sustainability of the biofuels industry, the lack of communication and communication platforms within the industry, the necessity of setting up industry-specific ethics protocols, the need for researchers to take personal responsibility for the applications of their work and the role that government policy can play in addressing the dilemmas facing this sector. All of these factors were in agreement with what was discussed in literature.

DECLARATION

I, Lwazi Bonginkosi Ngubevana, declare that this research report is my own work except as indicated in the references and acknowledgements. It is submitted in partial fulfilment of the requirements for the degree of Master of Business Administration in the University of the Witwatersrand, Johannesburg. It has not been submitted before for any degree or examination in this or any other university.

Lwazi Bonginkosi Ngubevana

Signed at ……

On the……day of ……..2014

DEDICATION

In the loving memory of

My grandfather Mtutu Pantsi

My uncle Thanduxolo Ngubevana and

My brother Sabelo Pantsi

I will continue to carry the torch

ACKNOWLEDGEMENTS

Without the unwavering support and love of my wife, Ati, I would not have been able to make the many sacrifices I did, and make it through this past year. My daughter Anothando, thank you for trying to understand as best as you could, when daddy told you he had to be away from home so often, to be at school. My son Asiphile, thank you for not giving mommy too many sleepless nights while daddy was away busy with his studies, you made things just a little bit easier.

Prof. Anthony Stacey of the Wits Business School, your guidance during this research is highly appreciated.

A special mention and a very big thank you to Melusi Mthembu of the Wits Business School, our lives would have been that much harder if it were not for your efforts.

Last but not least, my friend and study buddy Muzi Siyaya, thank you for sticking with me and pushing me as hard as you did, especially when I started slacking off. Having you to bounce ideas off and share our common frustrations with, made the graft that much easier.

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CHAPTER 1: INTRODUCTION

1.1 Purpose of the study

The purpose of this research was to assess the state of awareness and understanding at three South African businesses, Matayo Biofuels, Khepri Energy and the Council for Scientific and Industrial Research (CSIR), of the sustainable development dilemmas, ethical implications and unintended consequences of their production and research in biofuels. The report aimed to establish the levels of awareness of the dominant sustainable development issues and ethical conflicts that arise from biofuels production and research and whether this translated into how the companies communicate the benefits of their products.

1.2 Context of the study

Matayo Biofuels (Pty) Ltd is an energy company specialising in the production of biodiesel, consulting services and supply of turn-key decentralised biodiesel processing equipment. The company is headquartered in Pretoria, South Africa, but it also operates offices in Benoni to the east of Johannesburg and in Gaborone in Botswana. Matayo Biofuels is a privately owned non-listed company that currently has a staff complement of just over 60 people.

Khepri Energy (Pty) Ltd is a newly established, privately owned joint venture between a research group at the University of South Africa (UNISA) and a private investment firm. The joint venture was formed as a result of the research group's decision to commercialise biofuels technology they had developed through many years of research. Khepri Energy's main technology offering is biomass to liquid

fuels and municipal waste to energy processes. The company currently has a staff complement of around 20 people.

The CSIR is a government organisation constituted by an Act of Parliament in 1945 as a science council to undertake directed and multidisciplinary research. The CSIR is a leading scientific and technology research, development and implementation organisation in Africa, in technological innovation as well as industrial and scientific development that aims to improve the quality of life of the country's people.

Companies like Matayo Biofuels and Khepri have come into being because of the imminent threat of global warming due to greenhouse gas emissions, which has forced the world into thinking differently about our sources of energy and sustainable development, giving rise to the field of biofuels. In an attempt to slow the rate of greenhouse gas emissions and global warming, South Africa has followed in the footsteps of countries such as Brazil in engaging in an aggressive strategy for biofuels production and research. South Africa's industrial biofuels strategy aims to achieve a penetration level of 2% of biofuels in the national energy supply (400 million litres per annum) by 2013 (Department of Minerals and Energy, 2007).

These types of fuels have however recently taken centre stage in worldwide debate as both a solution to problems and as a creator of problems (the unintended consequences). This debate is centred on the premise that although these fuels have shown promise as a substitute for fossil fuels as the raw material for transportation fuels, they have their pitfalls especially if produced at a scale

large enough to replace a significant proportion of the world's use of petroleum (Gardner and Tyner, 2007). Several ethical issues, such as food security, indigenous people with insecure titles to their land losing their land, reduction in biodiversity, etc. have been raised in the use of biofuels (Eide, 2008). Jordaan (2007); Buyx and Tait (2011); and Tait (2011) also agree that many biofuels policies fail to take consideration of important ethical principles, such as protecting human rights, environmental sustainability, climate change mitigation, just reward, and equitable distribution of costs and benefits.

This particular view on ethics around biofuels production however has its detractors such as Thompson (2012), who argues that to blame a spike in global food prices on the growth of the United States' corn ethanol industry is unwarranted.

It is evident that there are varying views on this issue and in order to establish an adequate ethics foundation for biofuels, it is important that scholars, business and society looks at a framework that most will agree on, such as sustainable development, as envisaged by Brundtland (1987b).

Stacey and Stacey (2012) proposed a research ethics protocol using the five capitals framework, based on the twelve features of sustainable societies. After examining the literature regarding the dilemmas facing the biofuels industry, it was decided that a study would be carried out on the application of this ethics protocol to biofuels production and research in South Africa. This study was aimed at assessing the level of awareness among local entrepreneurs and researchers, of

the dominant ethical issues and assessing the role that research ethics protocols play in the biofuels industry in South Africa.

1.3 Problem statement

1.3.1 Main Problem

The research problem was to evaluate the awareness to the sustainable development dilemmas and the extent that research ethics protocols militate against unaddressed, unintended, unexpected, unforeseen and unforeseeable negative consequences of biofuels research in South Africa.

1.3.2 Sub-problem 1

The first sub-problem was to evaluate the awareness of sustainable development dilemmas of biofuels research in South Africa.

1.3.3 Sub-problem 2

The second sub-problem was to evaluate the extent that research ethics protocols militate against unaddressed, unintended, unexpected, unforeseen and unforeseeable negative consequences of biofuels research in South Africa.

1.4 Significance of the study

This study filled a gap in that there was no available appropriate literature, or a significant number of studies that look at the ethical conflicts and unintended

consequences of our large financial and resource investment into biofuels research in South Africa. This was despite the fact that South Africa has already suffered the unintended consequences of policy decisions informed by what can be termed unethical research, such as the HIV/AIDS debacle.

One of the most documented cases of research or invention gone wrong is that of Alfred Nobel who invented dynamite but it is said that dynamite “had not been developed with the idea of using it in war. However, this did not prevent it from soon being put to use in such a context as well” (Tägil, 1998) .

Stacey and Stacey (2012, p. 61) argued that the “impact of HIV/AIDS in South Africa could have been lessened if there had been greater consideration and engagement with civil society by Duesberg and his colleagues regarding how the publication of their research might ultimately influence the standard of health among individuals, the development of people, and the capacity for communities and society at large to provide safe, supportive living and working environments, not least through influencing government policy and approach”.

This study also filled a gap in that whereas several authors such as Holt (1997), Jordaan (2007), Wiesner and Tonti (2009), Buyx and Tait (2011), Mortimer (2011), Gomiero, Paoletti and David Pimentel (2010) and many others, have studied the ethical implications and sustainable dilemmas of biofuels across the world, there is still no clear ethical guideline in South Africa that speak directly to the South African context, on the understanding of the impact of biofuels production and research, the unintended consequences of this work and how companies should communicate the benefits of their products.

The study also aimed to provide guidance to industry, academics, industry researchers, society and government policymakers to understand the ethical conflicts, implications and unintended consequences (financial, human impact, etc.) of continued research and investment into biofuels research and applications. This study also sought to establish the role that ethics protocols play as a guide in the South African biofuels industry, in mitigating the impact of these unintended consequences, such as those brought about by the HIV/AIDS research of Duesberg or the dilemmas faced by the likes of Logham. Logham, who helped develop pepper spray, is quoted as having said “I have never seen such an inappropriate and improper use of chemical agents” in an interview when he realised how his invention was being used in violation of his original intent (Seelye, 2011).

1.5 Delimitations of the study

- The study did not look at the technical merits of any particular technology.
- The study did not seek to quantify the benefits and/or costs (human, financial, etc.) due to any particular technology.
- The sampling method did not allow for generalisation of the results to all cases, as purposive sampling was used.

In conducting the study at the three companies and reviewing how they communicate their respective messages on biofuels, the study was guided by Stacey and Stacey (2012)’s proposed protocol as shown in Table 1 and available company documents, and not any other available protocol or framework.

Construct	Protocol
Natural capital	Natural capital must be shared fairly between current and future generations - intergenerational equity. Natural capital processes and resources have finite capacities, and protracted timeframes may be required to realise these capacities.
Harmful Effects of Extraction of Substances from the Earth.	Consider and describe how the research and its outcomes may influence the environment's capacity to disperse, absorb, recycle or otherwise neutralise the harmful effects (to humans and/or the environment) of the extraction and use of substances taken from the earth.
Harmful Effects of Artificial Substances.	Consider and describe how the research and its outcomes may influence the environment's capacity to disperse, absorb, recycle or otherwise neutralise the harmful effects (to humans and/or the environment) of the manufacture and use of artificial substances.
Ecological System Integrity and Biological Diversity.	Consider and describe how the research and its outcomes may influence the capacity of the environment to provide ecological system integrity, biological diversity and productivity.
Human capital	The needs of the many must enjoy priority over the wants of the few, for both current and future generations. The limited capacity of specific disadvantaged groups to engage must be addressed.
Standard of Health.	Consider and describe how the research and its outcomes may influence the standard of health among individuals of all ages.
Relationships, Social Participation, Development and Learning.	Consider and describe how the research and its outcomes may influence individuals' relationships and social participation, setting and achievement of personal standards of their development and learning throughout their life.
Work, Personal Creativity and Recreation.	Consider and describe how the research and its outcomes may influence individuals' access to varied and satisfying opportunities for work, personal creativity and recreation.
Social capital	Sustainable social capital requires at a minimum, the same preconditions as sustainable natural and human capital.
Governance and Justice.	Consider and describe how the research and its outcomes may influence trust in and access to systems of governance and justice.
Positive Values and Sense of Purpose.	Consider and describe how the research and its outcomes may influence shared positive values and sense of purpose among communities and society at large.
Stewardship of Natural Resources and Development of People.	Consider and describe how the research and its outcomes may influence the structures and institutions of society to promote stewardship of natural resources and development of people.
Safe, Supportive Living and Working Environments.	Consider and describe how the research and its outcomes may influence the capacity for homes, communities or society at large to provide safe, supportive living and working environments.
Manufactured capital	Limits of current technology and human knowledge must be acknowledged. Consideration must be given to needs versus wants, and the natural, human and social capital expense of creating new technologies, products and services.
Use of Natural Resources and Human Innovation and Skills	Consider and describe how the research and its outcomes may influence infrastructure, technologies and processes to minimise the use of natural resources and maximise the use of human innovation and skills.
Financial capital	The financial cost of human, social, natural and manufactured impacts for current and future generations that are external to the organisation must be acknowledged and disclosed.
Accurate Representation of the value of Capital	Consider and describe how the research and its outcomes may influence the accuracy of the valuation of natural, human, social and manufactured capital in terms of financial capital.

Table 1: Proposed research ethics protocol based on the twelve features of sustainable societies (Stacey and Stacey, 2012)

1.6 Definition of terms

- Biofuels – A fuel produced from renewable biological raw materials such as plants, algae, etc. (Stow and Russell, 2013)
- Sustainable development – "development that meets the needs of the present without compromising the ability of the future generations to meet their own" (Brundtland, 1987b).
- Ethics – A set of rules, ideals, norms, conceptions of right and wrong, which define the "correct" path leading to the "correct" decision as dictated by collective wisdom (Nordenstam, 1968 & Vesilind, 1988).
- Five Capitals – "The five types of sustainable capital from which society derives the goods and services needed to improve the quality of life" (Porrit, 2007).
- 12 Features Model – A model that describes what a sustainable society should look like, using 12 features (Forum for the Future, 2011).
- Unintended consequences – those negative consequences that may be known to researchers, "but with low enough probabilities that associated risks can be ignored" (Stacey and Stacey, 2012).

1.7 Assumptions

The success of this study hinged on the following assumptions:

- Access to company documents that are in the public domain.
- The executives at the chosen companies were able to, willing to and would freely participate in the study.

CHAPTER 2: LITERATURE REVIEW

2.1 Introduction

This section contains a literature review on the key themes of relevance to the study. The first area is sustainable development. The second area of discussion is sustainable development and how this could be integrated into, and should be a guide for, research protocols. The third area of discussion is the key current issues, ethical conflicts and dilemmas that arise in relation to biofuels research and production. The last section concludes with an overview of the key learnings of the literature review.

2.2 Sustainable Development and Critical Issues

2.2.1 Sustainable Development

The United Nations General Assembly, in its resolution 38/161 of 19 December 1983, resolved to establish a special commission that would put together a report on the environment and global development to the year 2000 and beyond, including proposed strategies for sustainable development (United Nations, 2013). The commission was later named the World Commission on Environment and Development (WCED) and was chaired by Gro Harlem Brundtland, who was appointed into this position by Javier Pérez de Cuéllar, the former Secretary General of the United Nations.

The term ‘sustainable development’ has since been largely attributed to Brundtland (1987b), who defined sustainable development as “development that

meets the needs of the present without compromising the ability of the future generations to meet their own". In its report, the WCED was clear on its conviction that it is possible to sustain and expand the ecological basis for development, as these two are intimately linked in the real world (Brundtland, 1987a). Brundtland advocated for the adoption of global interventions in order to achieve sustainable development and that these interventions must be executed by processes that integrate the environment, social and economic considerations.

In addition, development policies must be policies that promote sustainability far into the future and institutions whose policies and actions violate these development policies must be held responsible (Brundtland, 1987a). This implies that the basic needs of all are met, and the opportunities to satisfy the aspirations of a better life are extended to all and into future generations (Vuyani, 2000). Hopwood, Mellor and O'Brien (2005) define sustainable development as "an attempt to combine growing concerns about a range of environmental issues with socio-economic issues" and this is very much in line with the WCED report and other earlier scholars.

2.2.2 Issues in Sustainable Development

Davis (1991) and Lélé (1991) said that the concept of sustainable development in its early days faced challenges in interpretation and practical application. These challenges varied from political to administrative barriers in the move towards ecologically and socially acceptable development strategies which seemed to threaten profitability, employment and power. Lélé (1991) adds that these challenges include an incomplete understanding and perception of the problems

of poverty and environmental degradation. As a result, countervailing forces such as private corporations emerged, for the status quo to remain (Davis, 1991).

Redclift (1992) stressed the confusion with regards to sustainable development saying that “some writers are concerned with the sustainability of natural resources and others preoccupied with the present or future levels of consumption and production”. According to Redclift, this led to differences in opinions in the way that sustainable development can be achieved. Gow (1992) concurred with Redclift and adds to this discussion by saying that even though there is global interest on environmental issues, there is also increased pessimism on the well-being of future generations. This is because of the “unwillingness or inability of national governments to deal with environmental issues on anything more than a short-term, often piecemeal basis” (Gow, 1992).

In concurrence with Redclift and Gow, Folke, Carpenter, Elmqvist et al. (2002) point out two main issues around the practice of environmental management, those being the assumption that ecosystem responses to human use are linear, predictable and controllable and that human and natural systems can be treated independently. They pointed out that “the goal of sustainable development is to create and maintain prosperous social, economic and ecological systems” (Folke et al., 2002).

Redclift (1992) summarised the eight principles of sustainability as:

- Limit the human impact on the biosphere to a level that is within carrying capacity.

- Maintain the stock of biological wealth through: (a) life support services (b) preserving the variety of life forms, and (c) conserving renewable resources within the capacity for renewal.
- Use non-renewable resources at rates that do not exceed the creation of renewable substitutes.
- A more equitable distribution of the benefits and cost of resource use and environmental management.
- Promote technologies that increase the benefits from a given stock of resources.
- Use economic policy to help maintain natural wealth.
- Adopt anticipatory and cross-sectorial environmental policies and planning, rather than placing emphasis on *ex post* remedial action.
- Promote and support cultural values compatible with sustainability, through more attention to environmental education and other cultural perspectives on sustainability.

Porrit (2007) further defined five types of sustainable capital from which society derives the goods and services needed to improve the quality of life as illustrated in Figure 2.

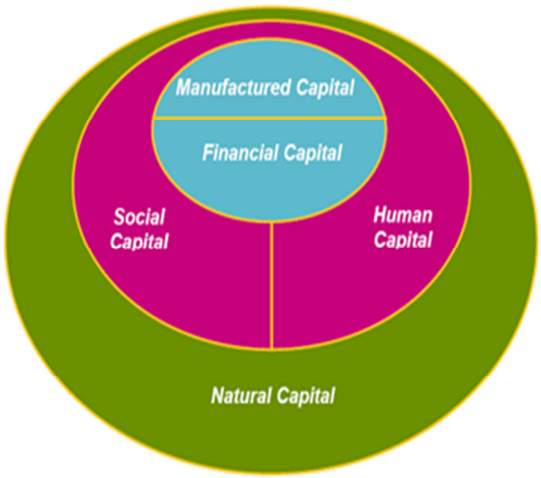


Figure 1: Five Capitals Framework. (Source: www.forumforthefuture.org)

A sustainable society can be described using the '12 features' model (Forum for the Future, 2011) which helps in evaluating the sustainability of projects and these features fit into the five capitals model. The '12 features model' puts forward the following considerations as a model for sustainable development:

- Natural capital
- Harmful Effects of Extraction of Substances from the Earth
- Harmful Effects of Artificial Substances
- Ecological System Integrity and Biological Diversity
- Human capital
- Standard of Health
- Relationships, Social Participation, Development and Learning
- Work, Personal Creativity, and Recreation
- Social capital
- Governance and Justice
- Positive Values and Sense of Purpose

- Stewardship of Natural Resources and Development of People
- Safe, Supportive Living and Working Environments
- Manufactured capital
- Use of Natural Resources, and Human Innovation and Skills
- Financial capital
- Accurate Representation of the Value of Capital

It became evident that the research and production of biofuels needed to be put into the context of sustainable development when taking into account the works of Gardner and Tyner (2007), Jordaan (2007), Eide (2008) and Tait (2011). A parallel can be drawn between research and production of biofuels with the noble intentions of the research and production of genetically modified crops. The issues raised about genetically modified crops are best illustrated in the work done by Moffatt (2000), who argued that the apparent benefits of genetically modified crops are outweighed by the ecological, social and economic costs.

2.3 Research and Development

2.3.1 When research ethics protocols fail

Ryan (2000) says that even though research ethics are the responsibility of the researcher to ensure that the participants of the research are not harmed by the research, the issue is “often included in research reports as an afterthought”. In the context of research that affects not only a few participants, this argument can be extended to the environment, the community, etc. Ryan adds that “ethical concerns have implications at all stages of the research process, from the identification of research questions to the dissemination of findings” and that, in

the sociological context, research findings do matter because policymakers and those that design and deliver services use research findings in their work. A good example of how researchers and policymakers can collaborate is when Albert Einstein wrote to the then president of the United States of America, President F.D. Roosevelt to both update him on new advances in physics research, but also to warn him of the possible disastrous consequences of recent discoveries in nuclear research (Eistein, 1939).

Payne (2000) says that “research ethics in business and the applied social sciences involves ontological, epistemological, theoretical and methodological assumptions embedded within the practice of academic scholarship”. Payne adds that these assumptions are often taken for granted and researchers accept and use them, but are often not discussed, even though they have moral consequences in scholarly practice.

AHRP (2005) quote a study by Dr Jonathan Kimmelmann, that showed the unintended consequences and extreme failures in medical research ethics that led to the deaths of many children in gene transfer experiments that were meant to be life-saving.

In the business context, Lovell (2005) states that the 1960s were a period of growing public articulateness about the social and ecological impacts of corporate activity, leading to the development of the ‘sustainable development’ idea. Lovell looked at the failure of business ethics by quoting recent cases of the corporate impact on the environment, such as Shell’s operations in Nigeria (Newberry and Gladwin, 2002) as underpinning the environmental impact of business operations,

“particularly when senior business people hold the belief that the business sphere operates with different norms from the other spheres of human activity”.

Recent events in Argentina are an example of when protocols can fail with disastrous consequences. In a nutshell, the use of pesticides is now suspected to be the leading cause for an increase in the number of cases of cancer diagnosed in Chaco, a biotech farming area of Argentina. This is said to be due to failings in the guidelines, poor control and use in ways that were never anticipated by regulatory science and were not specifically banned by law (Sapa-AP, 2013).

2.3.2 Guide for Industrial Research

Much has changed in the world of business since Stark (1993) argued that his suspicion was that the area of business ethics was struggling to find relevance with managers. The situation currently is that ethics are high on the agenda of businesses even though different industries are guided by different sets of rules and ethics codes. The health sector will have its own codes, engineering its codes etc. Generally speaking, the principles of all the different codes, though discipline specific, can however be said to be encapsulated by the United Nations Global Compact (UNGC), which aims to fashion a more humane world by enlisting business to follow ten principles concerning, among others, human rights, labour and the environment (Williams, 2004). This is supported by Svensson and Wagner (2012), who say that companies and their business networks’ impact on earth’s life and ecosystems must be seriously addressed and minimised.

In the South African business context, the guidelines and legal frameworks which companies need to abide by are:

- Constitution.
- Companies' Act No 71 of 2008.
- National Environmental Management Act, No 107 of 1998 and Regulations.
- National Environmental Management: Waste Act, Act No 59 of 2008.
- National Environmental Management: Air Quality Act, No 39 of 2004.

These guidelines and legislations are all in agreement with the UNGC framework and aim to achieve the same goals of sustainability, corporate social responsibility, corporate governance, ethical behaviour on the part of business people, etc. (Lewis, Verghese and Fitzpatrick, 2010).

2.4 South African Biofuels Industry

Access to energy is often seen as vital in driving industrial development, providing services and improving the quality of life (Amigun, Sigamoney and Blottnitz, 2008). In attempting to meet its millennium development goals (MDGs) and to reduce greenhouse gas emissions from transport fuels, the South African government came up with an industrial biofuels strategy, which aims to achieve a penetration level of 2% of biofuels in the national energy supply (400 million litres per annum) by 2013 (Department of Minerals and Energy, 2007).

South Africa's energy supply from renewable sources currently sits at only 10%, as shown in Figure 2, but most of this is primarily from unsophisticated methods such as wood burning in peri-urban areas (Maltitz and Brent, 2012).

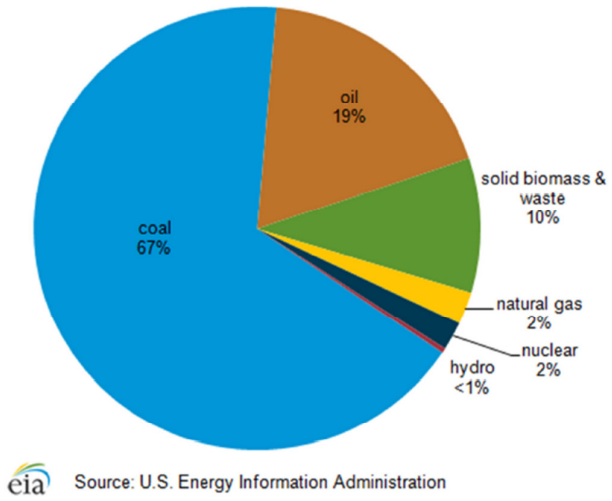


Figure 2: Total Primary Energy Supply in South Africa 2010

There is currently no commercial scale biofuels facility in Africa (Amigun et al., 2008), however the South African Department of Energy is planning to build (project is currently delayed over land issues) a 90-million litres of bioethanol a year plant, creating over 1000 jobs (DOE, 2012).

The biodiesel sector is made up of a number of small-scale producing companies such a Biodiesel SA (Amigun et al., 2008), Khepri Energy, Matayo Biofuels, and many other independent producers, such as farmers who produce for their own consumption. In the research arena, the CSIR is probably the biggest facility in the country; Khepri Energy, through their association with UNISA, also have a long history and capabilities in biofuels research, and other smaller university research groups exist.

2.5 Ethics issues in Biofuels Production and Research

The advent of biofuels promises to deliver large economic benefits, diversification of energy sources, stimulation of agricultural activities and a high percentage of locally produced, decentralised energy (Amigun et al., 2008). However, several ethical issues such as food security, indigenous people with insecure titles to their land losing their land, reduction in biodiversity, etc. have been raised in the use of biofuels (Eide, 2008). Eide (2008, p. 6) contends that "liquid biofuel production has contributed and is in the near future likely to continue to weaken the access to adequate food or to the resources by which vulnerable people can feed themselves". Reduction in biodiversity, marginalisation of vulnerable groups, competition for water, particularly in Africa, and an excessive Net Primary Production from ecosystem, are also cited as some of the biggest concerns (Bontemps, Burel, Dragomir et al., 2009 & Gomiero et al., 2010).

The serious nature of this debate is highlighted by Jumbe, Msiska and Madjera (2009), who make a call to national governments in Sub-Saharan Africa to develop strategies and regulatory frameworks not only to reap the economic rewards of biofuels development, but to also protect the environment, natural resources and rural communities from the adverse effects of land alienation from mainstream agriculture. Jordaan (2007); Buyx and Tait (2011); and Tait (2011) also agree that many biofuels policies fail to take into consideration important ethical principles, such as protecting human rights, environmental sustainability, climate change mitigation, just reward, and equitable distribution of costs and benefits. It has also been shown that without certain conditions such as efficiency improvements, the use of biofuels can in fact be detrimental and an environmental and socio-economic threat (Melamu and Blottnitz, 2011 & Maltitz and Brent, 2012).

Gamborg, Millar, Shortall et al. (2013) also add to this debate by raising the two main ethical problems posed by biofuels production mainly in relation to land use: food security (social aspects) and deforestation (environmental concerns). They argue that biofuels may compete directly or indirectly with food production, thereby adversely affecting poor people, and they also argue that biofuels may lead to deforestation and therefore having a negative effect on greenhouse gas emissions.

This particular view on ethics around biofuels production however, has its detractors such as Thompson (2012), who argues that to blame a spike in global food prices on the growth of the United States' corn ethanol industry is unwarranted. Thompson argues that this critique is "based on an unsophisticated portrayal of the ethical issues at stake in the food security implications of biofuel" and that the critique reflects an inadequate understanding of the way that rising food prices and changes in agricultural technology affect the food security of the poorest people. He also argues that rising food prices are "unlikely to materialise in the absence of concerted programs to deliberately select biofuel development strategies that are targeted to strengthen food security for poor and small-holding producers" (Thompson, 2012). Thompson (2013) further adds that although market drivers of biofuels indeed skew consumption of agricultural grains, the problem is not unique to biofuels.

Based on the above discussions, the key themes that are prevalent in the biofuels debate are clearly the food versus fuel issue and the issue of land ownership for poor communities.

2.5.1 Food Security

Dufey (2006) is one of the detractors of current biofuels practices and concludes in a 2006 study that large-scale biofuel production will lead to food security problems, especially in the poorest developing countries. The argument is that greater demand for biofuels will lead to land being drawn away from other purposes including food production, leading to food shortages and higher food prices for consumers. Reports in China and Malaysia are cited as an example that food security is already under threat due to biofuels. This position is supported further by Cotula, Dyer and Vermeulen (2008), who found that rapid biofuels programmes will lead to more problems in terms of food security.

Schreiner (2009) points to the fact that most of the United States' biofuels are produced primarily from corn and that fuel prices are consistently higher that food prices, that food security is under threat from the production of biofuels. Mangoyana (2009) however, is more positive and says that the challenges are surmountable, concluding that biomass energy production could be "an effective way to achieve sustainable development for bioenergy pathways that are less land and provide local socio-economic and environmental benefits".

2.5.2 Land Issues

A Cotula et al. (2008) study found that biofuels can be instrumental in bringing rejuvenation of agriculture and bring about positive change in the livelihoods of those who live in rural areas. If the scale is large enough, Cotula et al. (2008) concluded that biofuels cultivation can also provide benefits in the form of employment, skills development and secondary industries. They do stress however, that all of these possibilities depend on security of land tenure. The

study found that if there is competition for resource claims, and where appropriate conditions are not in place, the rapid spread of commercial biofuel production can result and is already resulting in poorer groups losing access to the land on which they depend. The conclusion of this study pertaining to land use is that commercial biofuel crop cultivation can have major negative effects on the economic, social and cultural dimensions of land use.

When considering the issues raised by scholars specifically referring to land use in biofuels, it is important to also put it into the context of currently available and uncultivated land. This is important because detractors of the land debate will argue that there is no problem in using available uncultivated land to produce biofuels. However, Stephenson, Blottnitz, Brent et al. (2010) showed, from a purely technical point of view, that using newly cultivated land that requires substantial irrigation, the global warming potential (GWP) of biodiesel is significantly higher than South African fossil-fuel based diesel.

Hall (2011) argues that even though African states are finally getting the foreign investment they have so long sought, this is “exposing fractures and division among African societies, within communities, and between citizens and states”. The argument is that in Southern Africa, mounting pressure towards the commercialisation of land has led to widespread leasing or sale of public lands to foreign companies and governments in particular for biofuel production, causing rifts within communities.

The issue of land regarding the cultivation of biofuels is such a thorny issue to the extent that some communities is South Africa have made it clear that they reject

the establishment of biofuels facilities on their land, as the land is their identity (Amigun, Musango and Brent, 2011). This is not only an ethical issue about whether the use of this land for biofuels production will harm the community or not, but it is also an ethical issue in that the community is against the idea and this may damage relations with and within the community.

Given the backdrop of the above discussions, it is important then that South African biofuels researchers establish an ethical protocol and framework to guide their research to militate against these highly contentious dilemmas.

2.6 Integrating Sustainable Development

2.6.1 Sustainable Development and Ethics

In relation to the current study on biofuels, Dufey (2006) concluded that understanding the impacts on sustainable development is complicated by the fact that many of the expected development gains associated with biofuels depend on whether they can be traded internationally. This international trading of biofuels then complicates the sustainable development discussion because the people that benefit (environmentally and perhaps economically) from the production of biofuels are not necessarily the ones that suffer the negative consequences associated with these fuels.

The United Nations Global Compact (UNGC) framework, among others aims to promote the concept of sustainable development by holding business, countries and individuals accountable for their actions and impact on the environment

(Williams, 2004). The principles of the UNGC take a holistic approach to business, human rights and the environment.

Research ethics protocols are not a new phenomenon (Steneck, 2006), but the idea of integrating sustainable development into research ethics protocols was brought forward by Stacey and Stacey (2012). They argue that by using the five capitals model of sustainable development, it can be shown that although it may be well-intentioned; research almost inevitably leads to unanticipated, unintended, or unforeseen consequences in one or more of the capitals than where the research is being carried out or is intended to address. The paper continues to propose a protocol based on the twelve features of sustainable societies and argues that this protocol, if applied diligently, would militate against the negative unanticipated consequences of research, and therefore would contribute to more sustainable societies.

2.7 Conclusion of literature review

The literature review revealed that sustainable development remains a critical issue in today's business world and that even though there is general agreement on fundamentals of sustainable development, there is still a lack of agreement on the interpretation and implementation thereof. The literature review also revealed that there is general agreement on biofuels playing a role in the sustainable future of this planet; however several ethical issues have been raised. The major ethical issues that were raised consistently in the literature in relation to biofuels production were the food versus fuel debate and land tenure for poor communities.

The role of ethics protocols in mitigating the negative unintended and unforeseen consequences of biofuels research thus becomes critical in the course of doing business. It remained unclear however from the literature review, whether or not South African researchers in biofuels have an understanding of the major sustainable development dilemmas and ethical issues in their field and to what extent they are guided by ethical protocols in their research practices.

2.7.1 Research question 1

Given that food security and land tenure are the major ethical dilemmas raised by scholars and practitioners in the production of biofuels, to what extent are South African researchers and businesses aware of these issues?

2.7.2 Research question 2

To what extent do ethics protocols guide South African researchers in mitigating the risks of unaddressed, unintended, unexpected, unforeseen and unforeseeable negative consequences of biofuels research?

CHAPTER 3: RESEARCH METHODOLOGY

The aim of this chapter is to outline the methodology used to conduct this research and investigate the problem statement discussed in section 1.3. Literature around the research methods will be discussed, followed by a short review of the research design, population, sample and the research instrument to be used. Issues of data collection and analysis in relation to this study are presented, followed by a discussion on the limitations of the study in relation to the methodology, analysis methods, etc. This is followed by a discussion on the validity and reliability of the study.

3.1 Research strategy

This research used a qualitative research approach in order to gather the data necessary to answer the research questions. Jones (1995, p. 2) describes qualitative research as research that takes an interpretivist approach to the subject matter. Newman (1998, p. 2) says that qualitative research is founded on the phenomenological perspective which assumes that multiple realities exist and that multiple interpretations that are available from different individuals are all equally valid.

Due to the nature of the subject area, this research method was found to be ideal for gathering the required data as the researcher needed to gather in-depth information rich data.

The data was collected in a series of relatively unstructured interviews with the respondents lasting 30 minutes each. Company data such as marketing material

and/or research publications was also used to increase the rigour and relevance of the study, a similar approach to that taken by Ahn, Gray and Collier (2010) in their study of innovation, technology transfer and commercialisation in New Zealand.

3.2 Research Design

The research design was a “cross-sectional”, which allowed for the collection of qualitative data at a single point in time (Bryman, 2012). The interviews were relatively unstructured in order to gain valuable information using interview techniques as recommended by Leedy and Ormord (1997).

The biggest weakness of this type of research design is that when using a cross-sectional design, it is possible to examine patterns and relationships only between variables, but this presents a problem if relationships are found, as one cannot draw causal relationships between them (Bryman, 2012).

3.3 The Research Instrument

The research instrument to be used was a semi-structured interview guided by the proposed protocol by Stacey and Stacey (2012). The advantage of a semi-structured interview is that it allows for adaptation and for the researcher to explore interesting insights as they arise. The semi-structured interview was chosen because, as Barriball and While (1994) argue, this type of interview is “well suited for the exploration of the perceptions and opinions of respondents regarding complex and sometimes sensitive issues and enable probing for more

information and clarification of answers". Also cited is that the varied professional, educational and personal histories of the sample group precludes the use of a standardised interview schedule, fitting well within the context of this current study. The basic questions for the interview are attached in Appendix A and the letter requesting participation in Appendix C.

3.4 Population and Sample

3.4.1 Target Population

Zikmund (2003, p. 415) defines a population as "the total set or collection of potential units for observation". The population targeted for this research was the people at the chosen companies who are engaged in production and research activities in biofuels at Matayo Biofuels (Pty) Ltd, Khepri Energy (Pty) Ltd and the Council for Scientific and Industrial Research (CSIR).

3.4.2 Sample and sampling method

Sampling

Sampling, is described as the process of selecting "a portion, piece, or segment that is representative of a whole" (The American Heritage College Dictionary, 1993, p. 1206). Sampling "helps to inform the quality of inferences made by the researcher that stem from the underlying findings" (Onwuegbuzie and Collins, 2007).

Purposive Sampling Method

The sampling method chosen for this study was purposive sampling. Johnson and Christensen (2012) define purposive sampling as when a "researcher specifies the characteristics of a population of interest and then tries to locate individuals who have those characteristics". Purposive sampling is non-random sampling and Blankenship (2010) says that this type of sampling allows the researcher to focus their efforts in gathering rich data in order to answer the research question. This type of sampling is undertaken specifically to meet the goals of the research and is typically designed to pick a small number of cases that yield the most information about a particular question. The companies that were selected to answer the research questions of this study were suitable because they are active in the biofuels industry, both in research and production.

Morse (1994) recommended the inclusion of a minimum number of six participants in a qualitative research study. The sample was assumed to be productive, as suggested by Marshall (1996). The sample chosen was also diverse in order to allow the researcher to access different interpretations and viewpoints in relation to the research questions (Voss, Tsikriktsis and Frohlich, 2002).

Teddlie and Yu (2007) quote Kemper, Stringfield and Teddlie (2003) to illustrate the use of purposive sampling as shown in Table 2 and they show that purposive sampling is most frequently used when the aim is to generate qualitative data, which makes it relevant to this particular study.

Type of sampling Technique	Generation of Quantitative Data Only	Generation of Qualitative Data Only	Generation of Both Qualitative and Quantitative Data
Probability sampling techniques	Happens often (Cell 1)	Happens rarely (Cell 2)	Happens occasionally (Cell 3)
Purposive sampling techniques	Happens rarely (Cell 4)	Happens often (Cell 5)	Happens occasionally (Cell 6)
Mixed methods sampling strategies	Happens occasionally (Cell 7)	Happens occasionally (Cell 8)	Happens often (Cell 9)

Source: Kemper, Stringfield and Teddlie (2003, p.285).

Table 2: Theoretical Matrix Crossing Type of Sampling Technique by Type of Data Generated

Sample

The senior members (Directors) and senior technical staff (researchers, scientists and engineers) of the companies were targeted for the interviews for their in-depth knowledge of their respective companies and relative experience in dealing with complex business issues. The participants were:

- Matayo Biofuels – CEO, and 3 senior technical staff
- Khepri Energy – 3 Directors and 3 senior technical staff
- CSIR – 4 senior technical staff

Interviews were requested by telephone and e-mail and the marketing and publication information was requested via e-mail and searches in the public domain.

Demographic profile of respondents

Table 3 presents a matrix of the respondents who were actually interviewed in this study, according to the sector in which they operate in the biofuels industry. The respondents have also been classified according to their job level, whether they are at Director/CEO level or senior technical staff, such as senior engineers and scientists. The number of 16 participants in this study was 2 more participants than originally planned.

Biofuels industry sector	Number of respondents	Job Level	
		Director/CEO	Senior Technical
Biodiesel	5	2	3
Waste to Energy	7	3	4
Bio-Ethanol	4	0	4
Total	**16**	**5**	**11**

Table 3: Matrix of industry sector and job description

3.5 Data Collection

Prior to the interviews, contact was made with the relevant individuals at both companies via e-mail and the telephone to establish their willingness to participate

in the study. A brief outline of the study was sent to the respondents in order to encourage their participation, as suggested by Darke, Shanks and Broadbent (1998, p. 282). Additionally, an informed consent letter and ethics letter from the school was prepared and issued to the interviewees (see Appendix C for an example of informed consent letter).

Once willing participants were found, the interviews were held, recorded (Darke et al. (1998, p. 283), and then transcribed. The researcher personally conducted all the interviews to ensure data reliability. Interview questions were structured in an open-ended manner to allow the respondents to expand on their responses. Anonymity was also granted to all the respondents to ensure that the respondents felt free to express their opinions without fear of reprisal.

Darke et al. (1998, p. 283) note however, that tape recording can inhibit the respondents and relying solely on recordings can prevent the researcher from fully participating in the interview. To mitigate this risk, audio recording was used concurrently with taking notes, which were also transcribed into formal data immediately after the interview.

3.6 Data Analysis and Interpretation

Hsieh and Shannon (2005) say that content analysis is a widely used qualitative research technique that shows three distinct approaches - conventional, directed, or summative. They describe conventional content analysis as when the coding categories are derived directly from the text data; a directed approach starts with theory as a guide for the codes and a summative analysis as that which involves counting and comparisons of keywords, followed by the interpretation of the underlying context.

The data analysis and interpretation process that was followed in this study followed a general inductive approach. Thomas (2006) describes the reasons for using a general inductive approach as:

- Condensing raw textual data into a brief summary format
- Establishing clear links between the research objectives and the summary findings
- Developing a framework of the underlying structure of experiences

The process followed five steps, as shown in Table 3 (Thomas, 2006):

- Preparation of raw data files (data cleaning) - transcribing the audio data and the notes from the interviews.
- Close reading of text - develop a coding frame.
- Coding and creation of categories - identify and define categories or themes.
- Overlapping coding and uncoded text - conceptualise the categories into broad themes.
- Revision and refinement of category system - summarise and interpret the categories within the context and attributes of the research questions.
- The legitimation step followed by the drawing of conclusions will involve contacting some of the respondents again to check the trustworthiness of the data.

The Coding Process in Inductive Analysis

Initial reading of text data	Identify specific text segments related to objectives	Label the segments of text to create catergories	Reduce overlap and redundancy among the categories	Create a model incorporating most important categories
	Many segments of text →	→	→	→
Many pages of text		30 to 40 categories	15 to 20 categories	3 to 8 categories

Source: Adapted from Creswell (2002, p. 266, Figure 9.4) by permission of Pearson Education, Inc. (© 2002, Upper Saddle River, NJ).

Table 4: The Coding Process in Inductive Analysis (Thomas, 2006)

In summary, the responses from all the interviews were placed into categories as they presented themselves. The categories were then reduced to a few important categories (eliminating overlap) and this entire process was driven by the data itself in what is called inductive thematic analysis (Boyatzis, 1998). This was done to collect all opinions from the interviewees and reduce any bias in the process.

The results were then presented, summarised in the form of graphs addressing each of the major themes that emerged from the study.

3.7 Limitations of the study

As mentioned, Bryman (2012) says that the limitation of using a cross-sectional design is that even though it is possible to examine patterns and relationships between variables, it presents a problem if relationships are found, as one cannot draw causal relationships between them.

Blankenship (2010) noted that in purposive sampling methods, the researcher's judgement in selecting the sample can be flawed or biased. Blankenship (2010)

however contends that error in the selection method by having the team check and double-check the sampling criteria. Johnson and Christensen (2012) also add that purposive sampling methods are limited in that they do not allow for the generalisation of the results to a population.

The sampling technique that was employed in this study is limited in that the sample does not necessarily represent the entire population of the biofuels research industry in South Africa. This situation was exacerbated by the risk of attrition, which could have eventually led to convenience sampling. Fortunately, attrition did not become a problem in this study.

3.8 Reliability and Validity

3.8.1 External Validity

Johnson and Turner (2003, p. 300) define validity as the idea of conducting research such that experts, academics and practitioners consider the research to be well done and trustworthy. External validity is often described as the generalisation of research findings, either from a sample to a larger population or populations other than those studied, inferring across persons, settings, and time (Hultsch and Hickey, 1978 & Lucas, 2003). The current study is relevant for other researchers and producers of biofuels in South Africa who are keen on 'doing the right thing'. Business people who are interested in going into the biofuels industry will also find the study useful and so will government policymakers, as it will also assist in their policy formulation. Other nations may also find the insights derived from this study useful, as they continue their endeavours of producing renewable energy and climate change mitigation initiatives.

3.8.2 Internal Validity

Internal validity refers to the generalizability of a conclusion within the underlying setting or group (Onwuegbuzie and Collins, 2007) and ensures that the data collection process is uniform. In this study, internal validity will be ensured by keeping the same structure for all the interviews. Triangulation, in other words seeking convergence and corroboration, was done by checking with company marketing documents to establish how each company communicates its products, in support of the internal validity of the study (Scandura and Williams, 2000 & Onwuegbuzie and Leech, 2007).

3.8.3 Reliability

The most common thread to the definition of 'reliability' in research among scholars seems to be the degree of 'reproducibility' of a result (Winter, 2000). To ensure reliability in this study, the qualitative interview data was cross-checked against company data in what is called 'triangulation' (Bryman, 2012, p. 636). 'Between methods' triangulation as was used in this study, is "largely a vehicle for cross validation when two or more distinct methods are found to be congruent and yield the same result" (Jick, 1979, p. 602).

CHAPTER 4: RESEARCH FINDINGS

4.1 Introduction

This chapter presents the results in the form of significant factors that were identified from the research data. The main aim of the literature review was to establish what the main sustainable development and ethical dilemmas facing the biofuels industry in South Africa are. In addition, the role of research protocols in mitigating the unintended consequences of research was to be established.

Interviews were conducted to determine the awareness of South African researchers and business in the biofuels sector, to the major ethical dilemmas (food security and land tenure) as raised by scholars and practitioners, in the production of biofuels. The interviews were also to establish the extent to which research protocols guide South African researchers in the biofuels sector in mitigating the risks of unaddressed, unintended, unexpected, unforeseen and unforeseeable negative consequences of biofuels research.

4.2 Sustainable Development and Ethical dilemmas

The participants were asked to talk about their understanding of “sustainable development” and their understanding of the major ethical issues and concerns that have been raised about the biofuels industry both in South Africa and worldwide. Two major themes emerged from these conversations and these were *food and land tenure against fuel/energy security* and *protecting the environment while ensuring the long-term sustainability* of the biofuels industry.

4.2.1 Food security and land tenure

The issue of ensuring that the food security of the country is not undermined by the production of biofuels was certainly a very common theme among the respondents and most of them saw this as a major ethical consideration when they do their research. This common feeling was expressed in various forms but a typical example is of one respondent saying that “we cannot claim to have a sustainable biofuels industry if this threatens the food security of the country, which can easily happen if we allow for the use of food crops or land that could be used to produce food, to produce biofuels. The issue here is that fuel almost always fetches a higher price for every ton, than food products”.

This theme also came out very strongly when the respondents were asked about their knowledge of the existence of any industry protocols, where quite a few of the respondents mentioned that it is common acceptable practice to ensure that food crops or land meant for producing food cannot and is not used to produce fuels.

Alongside the food security theme, land tenure security for vulnerable societies was also a fairly common theme that emerged from the interviews. The respondents also seemed to be quite concerned about the use of fertile agricultural land and/or communal land to produce biofuels due to the financial incentives brought about by biofuels. Other issues that were raised were possibilities such as people, particularly in the rural areas, possibly losing their land that is generally under the control of tribal authorities, due to greedy community leaders who see personal benefits from this industry.

The respondents also raised a mix of other issues such as the true environmental impact of producing biofuels in terms of lifetime greenhouse gas emissions and possible threats to the country's biodiversity. A number of the respondents felt that not enough attention had been paid to these issues and no true long-term studies had been carried out by academia, the industry and/or government. This theme also came out strongly when the respondents were asked if and why they felt that industry ethics protocols were necessary.

Figure 3 presents a summary of the opinions of the participants in the study with most of the respondents mentioning food security, about half of them mentioning land tenure security and a smaller percentage also mentioning other issues as the major ethical dilemmas facing the industry.

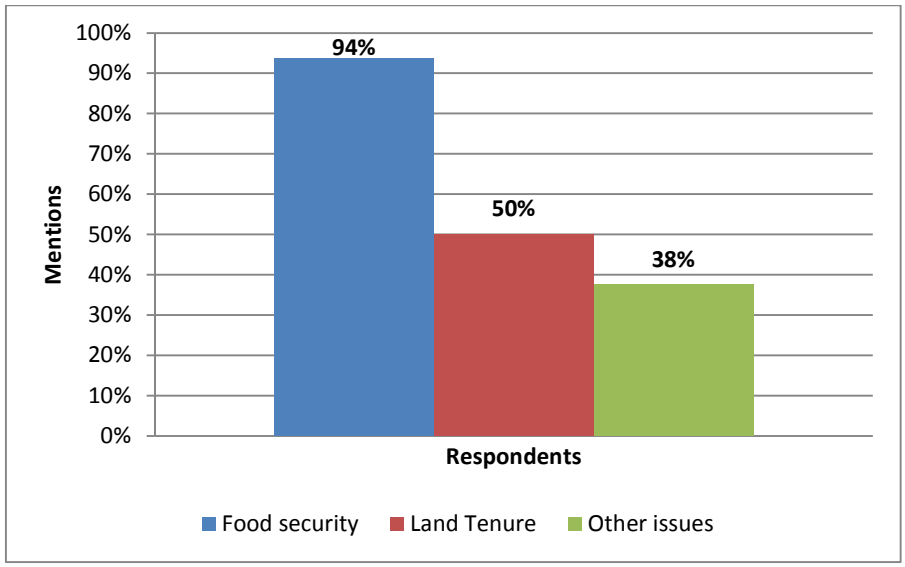


Figure 3: Major ethical dilemmas

4.2.2 Environment and Sustainability

In discussing their understanding of what sustainable development is, all of the respondents mentioned that it was critical for them to ensure that the environment was always protected and does not suffer negative consequences as a result of the pursuit of their academic and economic activities. This was expressed in many ways but a typical expression can be best illustrated by one respondent who said that “my understanding of sustainable development is that we must ensure that our resources do not get depleted, and that our industrial processes do not cause harm to the environment and that we recycle”.

The above statement not only spoke about protecting the environment but also addressed another common theme that emerged in discussing sustainability and that was that researchers understood it to mean that the feed materials they use in their processes needed to be recyclable in order to avoid depletion. Specific examples of this that were mentioned included ensuring that the plants that were used in this industry were plants that grew very quickly and could be replaced in a short space of time.

One respondent expressed this by saying that “once fossil are gone they’re gone and it takes millions of years to replace them but biofuels can be for one farmer a year’s crop, and so when I talk about sustainability I’m referring in particular to the rate of replacement”.

Another typical example of the challenge of sustainability that was mentioned several times was ensuring that there was enough waste material available, for those processes that look to produce biofuels from waste materials.

Figure 4 presents the various opinions of the respondents on the other major theme, which was the protection of the environment and using sustainable sources in the process of producing biofuels.

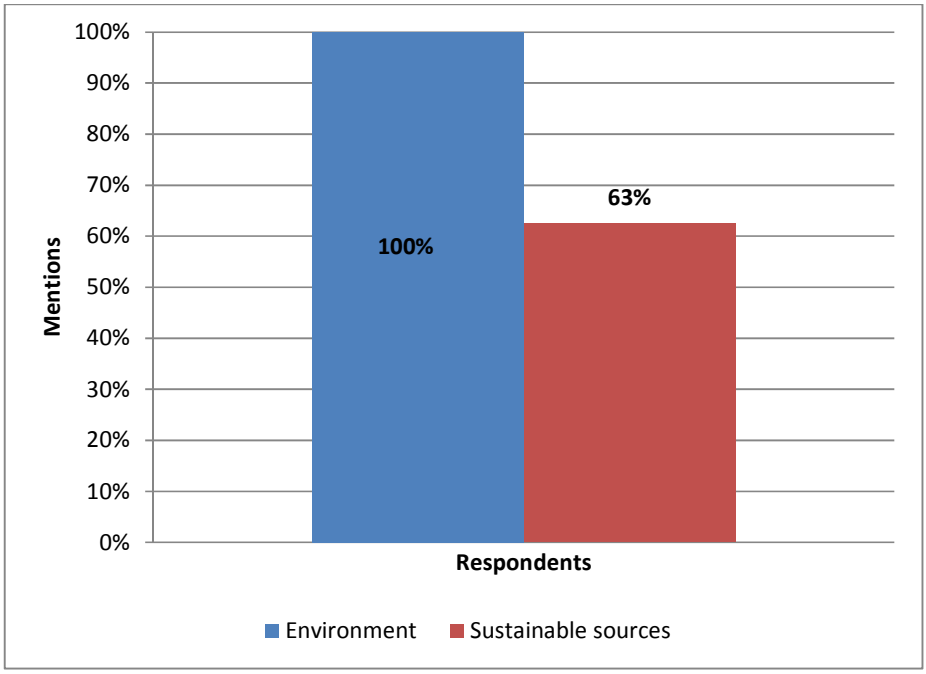


Figure 4: Environment and industry sustainability

Based on the themes developed from the responses of the participants, the first research question has clearly been answered and that South African researchers and businesses in the biofuels industry are clearly aware of the major ethical issues that have been raised regarding their industry.

4.3 Research Protocols

Key to answering the second research question was establishing whether the respondents were aware of the existence of research ethics protocols in their industry or whether their conduct was only governed by professional codes of practice and statutory bodies such as the engineering council. It was also crucial to establish whether they actually bought into the concept of ethics protocols and how much personal responsibility they took for the applications that result in the work that they do.

The participants were asked to talk about their knowledge of research protocols or professional conduct rules specific to their industry. A number of questions were asked in order to establish the role that ethics protocols play in guiding South African researchers in mitigating the risks of unaddressed, unintended, unexpected, unforeseen and unforeseeable negative consequences of biofuels research. The questions were also intended to establish the extent to which researchers themselves subscribe to the idea of protocols being developed and how they feel about taking personal responsibility for how their research outputs are interpreted and implemented by governments and society at large.

Four major themes emerged from these conversations:

- The importance of improved communication and communication platforms
- The necessity of establishing industry-relevant ethics protocols
- Researchers taking personal responsibility for the implementation of their work
- Government policy playing a major role in building a sustainable industry

Following the interviews, company marketing brochures were obtained in order to compare what was said at the interviews and the message that the companies actually communicate to the public.

4.3.1 Communication and communication platforms

Communication was perhaps the one theme that stood out the most when addressing the issue of research protocols. Not only was communication brought up by most of the participants as a major issue in their lack of awareness of the existence of research ethics protocols, but it was also raised as a way to ensure that any possible negative consequences of research can be mitigated. This mention of the importance of communication covered communication within the industry, communication with government legislators and, probably most importantly, communication with society as whole, as most of the respondents felt that society was most affected by the actions of researchers. The respondents generally felt that researchers needed to take communities into their confidence, especially when it came to the implementation of any new technological breakthroughs.

Another major theme that emerged from the interviews was that most of the researchers felt that there were not enough communication platforms within the industry, outside of journal publications. As a consequence of this, the respondents felt that this left the majority of the industry stakeholders out of the loop and only those with academic interest could really be said to be actively involved and understood the industry properly.

Figure 5 presents a summary of the respondents' opinions on their awareness of the existence of industry-specific protocols. The results are presented as percentages of respondents holding a particular view on their awareness of the existence of some protocols in the industry.

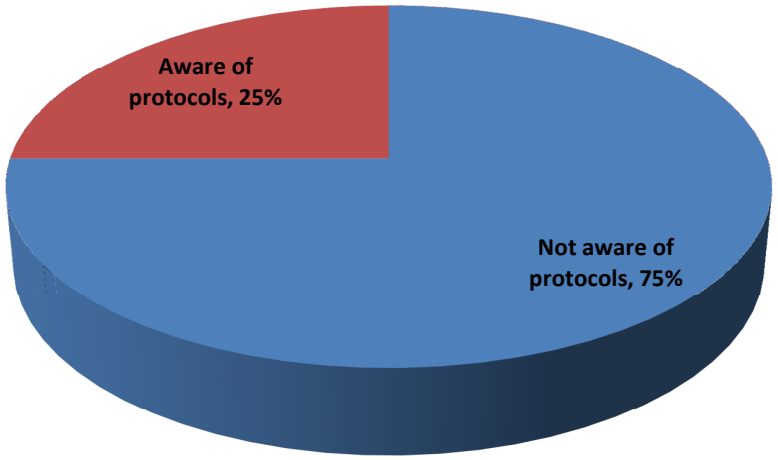


Figure 5: South African biofuels industry protocols

Following up on the respondents' awareness of the existence (or not) of protocols in the biofuels sector, it was then attempted to establish whether or not the respondents felt there was a need to establish new communication platforms for the industry; and the results are presented on Figure 6 below. The responses could be classified as either, that more communication platforms are needed in the industry, or that the existing platforms are adequate to address this issue.

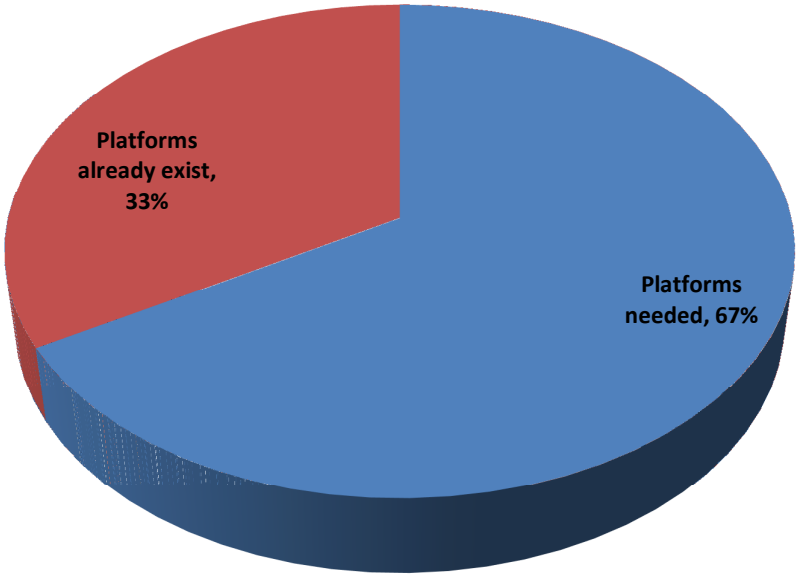


Figure 6: Communication platforms in biofuels industry

4.3.2 Necessity of Protocols

Further following up on the respondents' awareness of the existence of protocols in the industry and the availability of communication platforms, the second major theme that emerged for this research question was the necessity of establishing ethics protocols specifically aimed at the biofuels industry. The questions around this particular issue were aimed at establishing the extent to which researchers in this industry buy into (and by extension establish what the acceptance levels would be, should these be established) regulation of the industry via research ethics protocols.

This theme brought out of the respondents two (in the main) polar opposite feelings. One end of the spectrum felt that it was absolutely essential to have ethics protocols and the primary reason brought forward was to ensure that everyone operated on the same standards and had the same responsibilities. These respondents generally felt that without protocols in place, business in particular would most probably end up being guilty of chasing the bottom line and operate with impunity. On more than one occasion, the example of the problem of Acid Mine Drainage that South Africa faces was quoted as being a typical situation where there were no guidelines and business went about chasing profits with no regard to the consequences.

The opposite end of the spectrum was researchers feeling that it was unnecessary to set up protocols that aim to speak specifically to the industry as a whole and as one respondent put it: "…my personal opinion on the matter is that as a technical researcher I would let business worry about the other stuff. Those peripheral things are the ambits of people with other fields of expertise". Interestingly, the general feeling was that professional ethics codes were enough of a deterrent for researchers from conducting unethical research.

There were, of course, some respondents who were sitting more in the middle and said things like "yes it is important to have ethics protocols, as long as they do not interfere with the creative and research process and end up holding back development".

Figure 7 presents a summary of the findings on this theme, as a percentage of the number of respondents having a particular view.

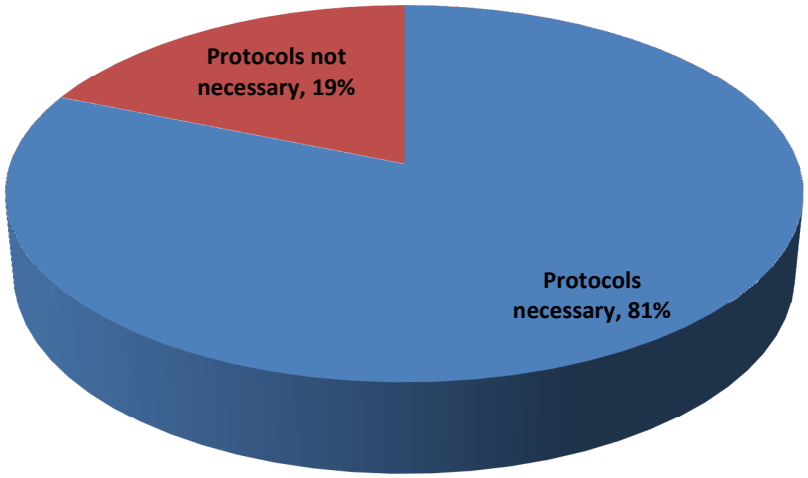


Figure 7: Necessity of protocols framework in biofuels industry

4.3.3 Personal Responsibility

Another common theme that came up when analysing the results was whether researchers and business people in the industry felt the need to accept any personal responsibility for how the results of the work that they do get interpreted and implemented by legislators and society in general. Together with the necessity of protocols, the questions that led to the emergence of this particular theme were aimed at establishing the 'buy-in' of the respondents into research

ethics protocols and perhaps to establish the possible levels of compliance to ethics protocols if they were to be developed.

This was a rather contentious issue as it was a very personal matter and concerned the individual's personal ethics and this was evident in the intangible changes in the body language of the respondents when this issue was addressed. These results are summarised in Figure 7 below, and opinions varied among the respondents, with some researchers feeling that they should take full responsibility, some feeling that they should not take any responsibility at all, while some researchers felt that they should shoulder at least some of the responsibility.

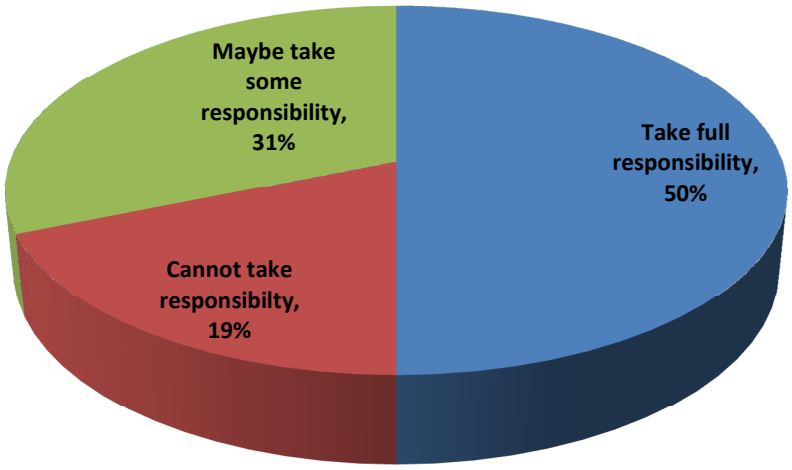


Figure 8: Researchers taking personal responsibility for research applications

4.3.4 Government Policy

The last major theme to emerge from this research was the perceived importance of government policy, not only to establish protocols for the industry, but also in ensuring a sustainable industry versus technical solutions to achieve the same. The emergence of this theme was a complete surprise but this was common not only across the different industry sectors but also came up frequently when the discussion centred on how to ensure ethical conduct of both researchers and industry.

The results pertaining to this theme are captured in Figure 9 below.

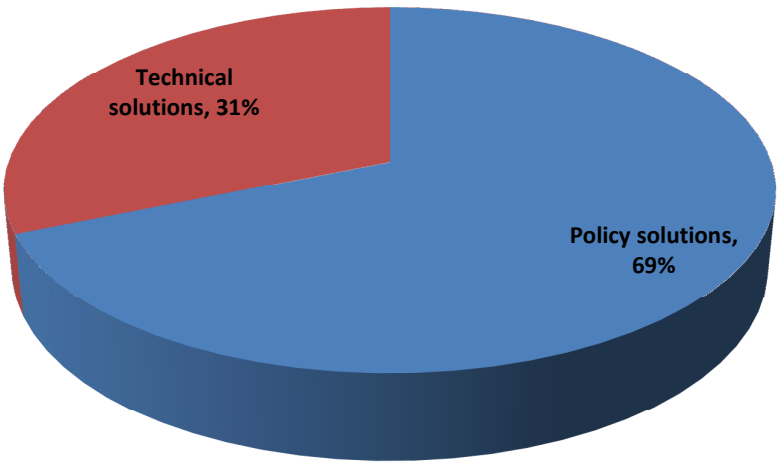


Figure 9: Solutions for a sustainable biofuels industry in South Africa

Looking at the themes developed from the responses of the participants, it can be concluded that the second research question has been answered and that South African researchers and businesses in the biofuels industry feel that research protocols have a large role to play in mitigating the risks of unaddressed, unintended, unexpected, unforeseen and unforeseeable negative consequences of their biofuels research.

4.4 Summary of the results

The study was carried with a sufficient number of respondents to be able to make inferences and generalisations. In fact, the number of respondents that eventually participated was more than that originally envisaged.

The results of this study point to six major themes that speak directly to the research questions asked:

- Food security and land tenure
- Environment and Sustainability
- Communication and communication platforms
- Necessity of Protocols
- Personal Responsibility
- Government Policy

These results also showed no major deviations from the literature reviewed.

CHAPTER 5: DISCUSSION OF THE RESULTS

5.1 Introduction

This chapter discusses the findings that can be drawn from the significant themes of the research data, relating these findings to the literature review. The chapter starts off with a discussion on the demographic profile of the respondents and then addresses each of the two research questions in detail and finally ends with conclusions that can be drawn from the results.

5.2 Demographic profile of respondents

The demographics of the respondents show that:

- 5 of the respondents were at Director/CEO level and 11 were at senior technical level such as senior engineers or senior scientists.
- 5 of the respondents were in the Biodiesel sector, 7 were from the Waste to Energy sector and 4 were from the Bio-ethanol sector.

Looking at the demographics shows that the sample was not only fairly representative in terms of job level but also in terms of the industry sector in which they operate. This diversity was important not only because it represents both the technical and business sides of the industry but also because biofuels is a large industry and therefore it was important to represent views from different sectors in the business.

The seniority of the people chosen to participate in the study was also quite important in that it represents the level of experience and expertise in their respective industry sectors and therefore the participants spoke with a certain level of authority.

All of the above was important in ensuring both the external (Johnson and Turner, 2003) and internal (Scandura and Williams, 2000) validity of the results.

5.3 Sustainable Development and Ethical dilemmas

The discussion on what sustainable development is, gave rise to various responses and this largely reflected the sentiments of Redclift (1992) who said that part of the confusion with regards to what sustainable development is, was that "some writers are concerned with the sustainability of natural resources and others preoccupied with the present or future levels of consumption and production". This was reflected in the results of this study, as the majority of respondents defined sustainable development along the lines of natural resources, while some spoke of the need to cut down on current consumption through initiatives such as recycling, in order to ensure the availability of these resources in the future.

Also very important was that protecting the environment and natural resources and the development and sustainability of new businesses and job creation also came up quite frequently in discussions over what the respondents saw as the benefits of a biofuels industry in South Africa,. This reflected the varied interpretations of sustainable development, but more importantly reflected a

general understanding that is along the lines of how Brundtland (1987b) defined sustainable development.

In assessing the understanding of the respondents of the sustainable development and ethical dilemmas facing the biofuels industry, two key themes emerged, the first being the issue of food versus fuel tied together with concerns over land ownership and the second major theme being protecting the environment and the sustainability of the energy sources. These two themes showing up as key were not only in agreement with the works of Dufey (2006), Cotula et al. (2008), Gamborg et al. (2013) and many others as cited in the literature review, but they also showed that the respondents are on some level aware of the five capitals framework (Porrit, 2007), even though they did not necessarily articulate it in a structured manner.

These two themes not only came up strongly during discussions on sustainable development but also came out very strongly during discussions on research protocols and standards for the biofuels industry, being cited as some of the industry practices and standards of which the respondents were aware.

5.3.1 Food security and land tenure

Using food crops to produce biofuels was indeed a thorny issue for the respondents. Most of the respondents felt that this would push up food prices due to the resulting scarcity of food, in agreement with Dufey (2006). As expected, based on the literature, almost all (94%) of the respondents mentioned the so-called fuel versus food debate as the biggest ethical issue that they are aware of

that is currently facing the industry. In short the debate is about whether or not to allow the use of food crops for producing biofuels or that because of the high prices of fuel compared to food products, farmers may be tempted to abandon producing food and produce crops for fuel production because it makes economic sense. Coupled with this was the issue of farming subsidies, especially in advanced economies leading to the overproduction of food there and promoting the 'biofuels from food' industry, which many deem to be unethical as there are nations struggling to feed their populations.

About half of the respondents in turn also mentioned the possibility of marginalised communities without secure land tenure being forced off their land so that the land could be used for biofuel crop plantations and they viewed this as a pertinent issue in the industry currently. This particular issue being raised as a big concern was in complete agreement with Eide (2008) and Gamborg et al. (2013), showing that in practise the participants in this industry do take this into account in the process of executing their duties.

A fairly large number (about 38%) of the respondents also mentioned other issues that they see as raising serious ethical questions. Issues such as that life cycle assessments (LCA's) on some biofuels show that more greenhouse gases are actually emitted from using these fuels than with some current fossil fuels, in agreement with the views of Gamborg et al. (2013), whose argument was based on the deforestation driven by the biofuels industry.

Water usage, threats to the biodiversity, the adding of value to waste products and unknown long-term effects of this industry were also some of the concerns that

were raised, supporting the views of Bontemps et al. (2009) and Gomiero et al. (2010).

5.3.2 Environment and Sustainability

The other theme that came out very strongly when discussing ethical issues facing the biofuels industry was ensuring that the industry does everything in its power to ensure that the environment is protected and that only sustainable sources of energy are used. The key issues that were highlighted were, for example, ensuring that protected species and/or protected areas are excluded in the fuel mix and some of the contaminated by-products of the fuel production process were also seen as a major threat to the environment. Virtually all the respondents in the study mentioned protecting the environment while producing biofuels as a major ethical concern.

On sustainability, the issue of using waste as a fuel also brought out some strong reactions as some researchers saw this as an unsustainable source of energy as it would encourage the production of more waste just to meet fuel production requirements. Almost two-thirds (just about 63%) of the respondents in the study brought up the sustainability of the fuel sources as a major issue and they highlighted, for example, that some tree species take a very long time to grow to maturity and cutting them down for producing fuel may end up releasing more greenhouse gases and may therefore not be sustainable.

In conclusion, the data showed that not only are South African researchers and entrepreneurs in biofuels aware of the major sustainable development and ethical

dilemmas that plague their industry, but they are also fairly critical of their own industry. Almost all the respondents highlighted the debate around food and fuel as the most critical ethical issue that needs to be dealt with urgently in order to have a sustainable industry and future.

This was all overwhelmingly in agreement with what was presented in literature; covering at least 5 of the 12 (twelve) features of sustainable societies as presented by the Stacey and Stacey (2012) proposed model. The five features that the responses contributed to these two themes seem to cover are:

- Harmful effects of extraction of substances from the earth.
- Ecological system integrity and biological diversity.
- Standard of health.
- Use of natural resources and human innovation and skills
- Accurate representation of the value of capital

5.4 Research Protocols

Ryan (2000) says even though research ethics are largely the responsibility of the individual researcher, in the sociological context, research findings do matter a great deal because policymakers and those that deliver services often use research findings in their work and it is in this context that research ethics protocols are critical.

When assessing the role that research protocols play in guiding researchers in the biofuels industry to mitigate the risks of unaddressed, unintended, unexpected,

unforeseen and unforeseeable negative consequences of their research; four key themes emerged. These four key themes reflected a myriad of problems with the way that the biofuels industry in South Africa is organised in that it lacks any clear industry guidelines and rules. The four key themes identified were: the lack of communication and communication platforms for the industry, the necessity of establishing research protocols, the personal responsibility taken by researchers in the industry for their work and the need for government policy to lead and guide the industry.

These four key themes that emanated from the data analysis showed that South African researchers were acutely aware of the possible consequences of a lack of protocols or poorly communicated protocols, and that a situation similar to that in Argentina (Sapa-AP, 2013), can be avoided through simple communication.

5.4.1 Communication and communication platforms

A major theme that came out of this research was the need for more efficient communication within the biofuels industry and better communication with government and legislators. More interestingly though, was the importance placed by respondents on communication with society which was also interestingly coupled with the need for more education of the public when it comes to biofuels. It became evident that most of the respondents felt that the public is not well-informed about the biofuels industry, both in terms of its benefits, but also the possible negative consequences of this industry.

This theme was interestingly not something that came up to any significant extent in the literature that was reviewed, perhaps revealing a gap between what scholars focus on in literature and what the practitioners in the industry feel and see as important issues. The only instance where this theme was mentioned in literature was perhaps by Payne (2000), who said that "research ethics in business and the applied social sciences often involve assumptions that are often taken for granted and researchers accept and use them, but these are often not discussed".

The respondents also generally felt that researchers needed to take communities into their confidence as communities are the one set of stakeholders most affected, especially when it came to the implementation of any new technological breakthroughs. One respondent put this eloquently and said that "introducing new technologies always introduces new opportunities and problems and I don't think one can get away from that, but hopefully the new problems are different problems and smaller problems than what we're already faced with. For example when producing electricity from garbage for a community: who gets it and how? You can actually cause a problem in society because you're bringing in new drivers the society doesn't currently have and these sorts of things do have to be done very carefully but nonetheless I don't think it should stop it, I think we have to do it with sensitivity and basically try and do this for a win-win for society and involve society".

Another major theme that emerged from the interviews was that most of the researchers felt that there were not enough communication platforms within the industry, outside of journal publications. As a consequence of this, the

respondents felt that this left the majority of the industry stakeholders out of the loop and only those with academic interest could really be said to be actively involved and understood the industry properly. This sentiment was oddly enough in agreement with Thompson (2012), who is one of the biggest critics of the ethical questions raised against the biofuels industry. The agreement however can be said to be limited to that the lack of communication can lead to misinformed or poor legislation.

More than three-quarters of the respondents in this study said that they were not aware of any ethical protocols in their industry, which was a cause for concern considering the calibre of individuals interviewed. This however can perhaps be explained by the fact that it is a highly regulated environment from a fuels standards perspective and also that the professionals that work in the industry are bound by their respective professional ethical codes of practice. Those respondents who said they were aware of industry protocols mentioned common knowledge such as not being allowed to use food as a source of biofuels and not planting foreign invasive plant species for fuel production but none of them could point to a specific piece of formalised protocol. The National Environmental Management Act (NEMA) and the National Water Act also came up, but all of these however cannot be considered to be ethics protocols in the context of this investigation.

In addition, two-thirds of the respondents felt that the industry needs to set up new communication channels that will include both the government and society where all issues affecting the industry, including the possible negative aspects of the industry, can be discussed openly. A third of the respondents felt, however, that the existing channels of communication (academic and industry publications and

scientific councils already set up by the government) are sufficient for scientists to communicate their message and that researchers in this field are already doing enough communicating in this regard.

It was interesting to note that none of the company documents that were reviewed spoke of any possible negative consequences of the products, which was understandable because it was mainly marketing material that was reviewed. None of the companies made available a single document that showed ethics guidelines, except to say that all employees were competent and well-versed in their professional codes of ethics. This however posed the question of researchers actually practicing what they preach.

5.4.2 Necessity of Protocols

One of the key outcomes from the interviews was that there are currently no industry-specific protocols in this sector or that the respondents were not aware of these. It became clear from the research that the respondents felt it necessary for the industry to set up research ethics protocols. This was a good indicator of what the acceptance levels would be, should these be established.

An overwhelming majority of the respondents felt that it was necessary for the industry to set up some kind of ethics protocols. There were varying reasons for this and chief among these was that everyone in the industry needed to be held to the same standards. Also mentioned on several occasions was that standardised protocols would ensure that the industry avoids any possible negative

consequences and the introduction of new problems because of work done in this field.

The minority of respondents who felt that there was no need to establish a separate set of protocols, mentioned existing professional conduct rules as the chief reason for their reasoning. It was also interesting to note that on a couple of occasions, some respondents felt that introducing new protocols could potentially hold back creativity in the industry.

These results were in line with the argument put forward by Lovell (2005), who argued for the establishment of ethics protocols as a deterrent against "senior business people who hold the belief that the business sphere operates with different norms from the other spheres of human activity". These results were also in agreement with Svensson and Wagner (2012) who say that "companies and their business networks' impact on earth's life and ecosystems must be seriously addressed and minimised" and it became clear that South African biofuels researchers are in support of this kind of thinking. As one researcher puts it "I think the regulations are very important and there needs to be those kind of regulations or otherwise it's going to worsen the food problem that we already have".

5.4.3 Personal Responsibility

Another key theme that came out of this research was the issue of researchers and practitioners taking personal responsibility for the way that the results of their work are implemented. This was a very contentious and uncomfortable topic for the respondents to discuss, but with some crafty questioning, it was possible to entice responses. About half of the respondents felt that every researcher should

certainly take personal responsibility for the consequences of the work that they do, they felt that the onus was on the researcher to consider the consequences of their work. One researcher explained this by saying that “we can’t just work without considering the impact that our work may have on the environment, the economy and civil society as a whole, we do not operate in a vacuum and our actions always have to be ethical”. This kind of statement points to the awareness of some researchers to the five capitals framework, at least on an ethical level.

About a third of the respondents felt that the researcher had to take some kind of personal responsibility for the consequences of their work. However this group of respondents felt that it was not entirely up to the researchers and as one researcher put it “I am only responsible for what I do and how I communicate my work but I cannot be held responsible for how this is interpreted”. Most of this group of respondents pointed out that lawmakers had to be responsible in how they interpret research and always aim to seek out independent expert opinion before making decisions based on a particular piece of research.

A minority of the respondents did not see why they should take responsibility for what happens with their work once they have put it out in the public domain. Most of their arguments were centred on the fact that it is legislation and business decisions that drive the implementation of technologies and as researchers they cannot do anything to influence this process. Professional ethics and codes of conduct were another reason that some of these researchers did not see a reason why they should be held responsible because the majority of them felt that they already had to abide by these rules and that they already did enough to communicate their message.

These results seem to agree with literature, in particular Ryan (2000), who contends that research ethics in practice are largely left as the responsibility of the individual researcher, even though this should not be the case because there are many other stakeholders that are affected.

5.4.4 Government Policy

The last major theme that emerged from this research was the involvement of government not only in ensuring that policy exists to make the biofuels industry in the country viable, but also to ensure that protocols are put into place to ensure the long-term sustainability of the industry.

The emergence of this theme was totally unexpected as it did not show up with any significance in the literature surveyed. It was however common across the different industry sectors and it also came up frequently when the discussion centred on how to ensure ethical conduct of both researchers and industry. This was perhaps a gap in literature as scholars may not have extensively studied the importance that researchers place on government policy involvement in guiding the direction of their research, specifically with reference to ethics and research protocols.

To this end, more than two-thirds of the respondents felt that the issue of protocols was a policy one from government and that the industry could only do so much in self-regulating. As one respondent explained it “the business of business is doing business and so business cannot be expected to self-police”.

About a third of the respondents felt however that the issue of protocols in ensuring long-term sustainability of the industry was unnecessary and instead only really needed technical solutions from within the industry.

The major themes that emerged in trying to address the second research question certainly helped in answering the question of what role ethics protocols play in guiding South African researchers in the biofuels industry. It was clear from the research that there does not seem to be in existence a set of standard protocols that govern this industry or that researchers in the industry are sadly not aware of these if they do exist. It also became clear from this investigation that South African researchers in the biofuels industry were in agreement that more needed to be done in communicating both the benefits and possible negative consequences of the work that they do. They generally agreed on the need for the establishment of industry-specific ethics protocols but were split on whether individual researchers should take full responsibility for the consequences of the work that they do.

5.5 Conclusion

This chapter dealt with discussing the results of the research and addressing the research questions. It can be concluded, looking at the results, that the sample of respondents was representative, both in terms of the industry sectors within biofuels and in terms of experience in the industry, indicating both external and internal validity of the data.

The data also clearly showed that South African researchers and entrepreneurs in the biofuels industry were aware of the major sustainable development and ethical dilemmas that plague their industry. Almost all the respondents highlighted the debate around food and fuel as the most critical ethical issue that needed to be dealt with urgently.

It also became clear from the research that there does not seem to be in existence a set of standard protocols that govern the biofuels industry in South Africa or that researchers in the industry are sadly not aware of these if they do exist. It also became apparent from this investigation that South African researchers in the biofuels industry were in agreement that more needed to be done to communicate effectively both the benefits and possible negative consequences of the work that they do. They also generally agreed on the need for the establishment of industry-specific ethics protocols but were split on whether individual researchers should take full responsibility for the consequences of the work that they do.

It can be concluded that the respondents were actually aware of the five capitals framework, albeit in an unstructured manner because the issues they raised are actually encompassed in the framework and that the Stacey and Stacey (2012) model is a reasonable approach to establishing protocols that will accepted industry-wide.

There were however worrying inconsistencies that were identified in the course of this study and the main one being that what the people involved in this industry say and what they do, are not necessarily the same thing. This is based on the

fact that even though they all seemed to be aware of the issues, all but one of them was actively involved in doing anything about the issues. None of the companies involved could produce any processes or procedures that aim to address the same critical issues they identified, the marketing material they produced was standard marketing material that only speaks to the positive aspects of their products, with no warnings of potential problems and there was no action by any of them to raise awareness of these very issues within the industry. In short, they continue with business as usual with no repercussions.

The findings on both research questions clearly agreed with what was presented in the covered literature and also provided further insights that were gaps in literature.

CHAPTER 6: CONCLUSIONS AND RECOMMENDATIONS

6.1 Introduction

This chapter aims to lay out conclusions that can be drawn from the study and make recommendations for future research. The chapter starts with conclusions from the research, followed by recommendations for the stakeholders and finally followed by suggestions for further research.

6.2 Conclusions of the study

The following conclusions were drawn from the analysis of the data collected from companies operating in different sectors of the biofuels industry in South Africa to address the research questions from the problem statement. The research revealed that South African researchers and business people in the biofuels industry clearly understand the issues around sustainable development and their industry, raising the same issues as raised in literature. Almost all the respondents highlighted the debate around food and fuel as the most critical ethical issue that needs to be dealt with urgently, highlighting what was mentioned in the literature and clearly answering the first research question.

Government intervention and support were also seen as critical, not only in ensuring a sustainable biofuels industry, but also in ensuring that standards and protocols for the industry are set and enforced. It was also clear from the research that there does not seem to be in existence a set of standard protocols that govern the biofuels industry in South Africa or that researchers in the industry were sadly not aware of any protocols in existence. It was also clear from this

investigation that South African researchers in the biofuels industry are in agreement that more needs to be done to communicate effectively both the benefits and possible negative consequences of the work that they do. The respondents also generally agreed on the need for the establishment of industry-specific ethics protocols but were split on whether individual researchers should take full responsibility for the unintended consequences of the work that they do.

It can be concluded that the respondents were actually aware of the five capitals framework for sustainable development, albeit in an unstructured manner because all the issues they raised are encompassed in the framework. It can therefore be argued that the integration of sustainable development into research ethics protocols using the model put forward by Stacey and Stacey (2012) is a sensible approach that can be used to develop protocols for the biofuels industry in South Africa.

The research findings revealed that in agreement with their global counterparts, South African researchers in the biofuels industry were aware of the pressing sustainable development dilemmas facing their industry and that ethics protocols were seen as important and should play a significant role in the industry, albeit that there did not seem to be any in existence.

A key finding however, when comparing the messages that these companies send out into the public domain was that, although they have an understanding of the issues, none of them actually communicated the possible negative consequences of their products and/or research. This was, of course, understandable in the business context as most of the documents analysed were marketing materials.

6.3 Recommendations

This research revealed a serious lack of communication platforms in the industry as pointed out by most of the respondents. The respondents not only pointed to a lack of communication platforms but they also pointed to the need for cooperation between academia, researchers, government, society and biofuels producers. It is also clear that people in the industry are in agreement on most of the issues investigated, such as the need for a set of protocols to guide ethical research. It is therefore recommended that government should lead initiatives to get the industry, academics, industry researchers, society and government policymakers talking to each other. From this platform, the desired industry protocols can then be propelled. These protocols should be based on the five capitals framework as this research points to this being a suitable framework.

It is also recommended that the concerned start working on a campaign to bring about awareness of these issues, if they are indeed serious about the issues they raised.

6.4 Suggestions for further research

This research was limited to studying three companies operating in the biofuels space in South Africa. It became clear that there are burning issues that need to be addressed in this industry, within the context of this research and it is recommended that:

- The study can be replicated and spread out to a larger population in the industry.

- Government departments, such as the Department of Science and Technology, Environmental Affairs and the Department of Social Development, could be involved in a further study in order to establish a legislator's point of view on the issues.
- A new study could delve deeper into the second research question and look at exactly what the key issues are that the industry feels should go into research ethics protocols.
- It would also be interesting to replicate the same study but look at contrasting the views of publicly funded researchers against those of privately funded researchers.

6.4.1 Expanded Study

The aim of this study could be to do a comprehensive assessment of the state of awareness and understanding at South African businesses and relevant government departments, of the sustainable development dilemmas and unintended consequences of the production and research into biofuels.

This study would look at including as many companies and different sectors of the biofuels industry as possible, such as companies in the biogas sector in order to paint a more complete picture of this industry, including the role of government as both a legislator and economic player. A possible problem statement could be:

> To evaluate the awareness to the sustainable development dilemmas, the role of government and the extent that research ethics protocols militate against unaddressed, unintended, unexpected, unforeseen and unforeseeable negative consequences of biofuels research in South Africa.

6.4.2 Key industry issues on research ethics protocols

Having established that the South African biofuels industry is aware of the ethical dilemmas facing it and that researchers and producers in the industry are in agreement on the need for research ethics protocols; the aim of this study could be: To identify the critical issues that the industry sees as the pillars that should make up a sound research ethics protocol.

This study would look at including as many companies and different sectors of the biofuels industry as possible, and the government departments responsible for legislation both on a commercial and academic level. A possible problem statement could be:

> To establish the pertinent issues as seen by the South African biofuels industry, as key to a research ethics protocol aimed at militating against unaddressed, unintended, unexpected, unforeseen and unforeseeable negative consequences of biofuels research.

6.4.3 Contrast between publicly and privately funded researchers

The aim of this study could be to contrast the views of publicly-funded researchers with those of privately-funded researchers, on the sustainable development dilemmas and the extent that research ethics protocols militate against unaddressed, unintended, unexpected, unforeseen and unforeseeable negative consequences of biofuels research in South Africa.

This study would essentially be a duplication of the current study but would look at including a larger number of researchers in both publicly-funded and privately-funded research. A possible problem statement could be:

> To assess if the source of research funding has any influence on the views of researchers with regards to the sustainable development dilemmas and the role of research ethics protocols in militating against unaddressed, unintended, unexpected, unforeseen and unforeseeable negative consequences of biofuels research.

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APPENDIX A: ACTUAL RESEARCH INSTRUMENT

Q1: In your opinion, what are the critical issues for a successful implementation of a biofuels program in South Africa?

Q2: What do you see as the benefits of the biofuels industry to business, government and society?

Q3: Lots of questions have been asked regarding the sustainability of biofuels, what is your understanding of this issue?

Q4: Several ethical issues have been raised with regards to the production of biofuels, which do you think are the critical ones and how do you think these should be addressed?

Q5: Talking about ethical issues, are there any protocols that you are aware of within this industry, that deal with the unintended consequences of this field?

Q6: To what extent do you buy into the protocols?

Q7: If there are protocols in place, do you think they are effective and if not, what makes them ineffective?

Q8: What do you think should be done to ensure ethical conduct of both businesses and researchers in biofuels, to minimise the negative impacts that this industry may have on society?

Q9: Do you as a researcher take any personal responsibility for what may transpire as a result of the work that you do?

APPENDIX B: CONSISTENCY MATRIX

Research Problem: Evaluate the awareness of sustainable development dilemmas and the extent that research ethics protocols militate against unaddressed, unintended, unexpected, unforeseen and unforeseeable negative consequences of biofuels research in South Africa.					
Sub-problem	**Literature Review**	**Research questions**	**Source of data**	**Type of data**	**Analysis**
Evaluate the awareness of sustainable development dilemmas of biofuels research in South Africa.	Porrit (2007), United Nations (2013), Brundtland (1987b), Lélé (1991), Redclift (1992), Gow (1992), Forum for the Future (2011), Gomiero et al. (2010), Bontemps et al. (2009), Eide (2008), Tait (2011).	Given that food security and land tenure are the major ethical dilemmas raised by scholars and practitioners in the production of biofuels, to what extent are South African researchers and businesses aware of these issues?	Respondents in interviews.	Qualitative	Data reduction, Data display, Drawing Conclusions
Evaluate the extent that research ethics protocols militate against unaddressed, unintended, unexpected, unforeseen and unforeseeable negative consequences of biofuels research in South Africa.	Eide (2008), Jordaan (2007), Buyx and Tait (2011), Tait (2011), Thompson (2012), Gardner and Tyner (2007), Stacey and Stacey (2012)	To what extent do ethics protocols guide South African researchers in mitigating the risks of unaddressed, unintended, unexpected, unforeseen and unforeseeable negative consequences of biofuels research?	Respondents in semi-structured interviews.	Qualitative	Data reduction, Data display, Drawing Conclusions

APPENDIX C: INTERVIEW REQUEST LETTER

Dear Respondent,

I am completing an MBA at The University of Witwatersrand, Johannesburg (Wits). My thesis is on the ethical dilemmas in biofuels production and research. Towards gathering data on this subject, I would be grateful if I could arrange a 1 hour interview with you to allow me to have an understanding of the critical ethical issues and the role that ethics protocols play in informing research and development in this industry. I understand you are extremely busy and your agreement to contribute towards my research would be greatly appreciated.

The interview questions will be of a general nature and will allow you to expand on your responses and will not be an evaluation of ethics practices in your company.

Confidentiality will be observed throughout the process and the final report will be for academic purposes only.

I will be available to meet with you at a location and time of your convenience.

Thank you for your assistance.

Yours sincerely,

Lwazi Ngubevana

SA Mobile: +27 73 557 0677

E-mail: Lwazi.Ngubevana@icloud.com

APPENDIX D: INFORMED CONSENT

Title of Study: Sustainable development dilemmas and ethics of biofuels research in South Africa

Researcher: Lwazi Ngubevana, Wits Business School, 073 557 0677, Lwazi.Ngubevana@icloud.com

Background: You are being invited to take part in a research study. Before you decide to participate in this study, it is important that you understand why the research is being done and what it will involve. Please take the time to read the following information carefully. Please ask the researcher if there is anything that is not clear of if you need more information.

The purpose of this study is: To assess the state of awareness and understanding of the sustainable development dilemmas, ethical implications and unintended consequences of production and research in biofuels in South Africa.

Study Procedure: Your expected time commitment for this study is: 1 hour

The study method will be in the form of a recorded interview, with a few questions leading the conversation. You will be free to express opinions and expand on your answers to ensure that the results are a true reflection of your views.

Risks: The risks of this study are minimal as this is a study that is looking purely at assessing your opinions. You may decline to answer any or all questions and you may terminate your involvement at any time if you choose.

Confidentiality: Your responses and company names will be completely anonymous.

Every effort will be made by the researcher to preserve your confidentiality including the following:

• Assigning code names/numbers for participants that will be used on all researcher notes and documents.

• Notes, interview transcriptions, and transcribed notes and any other identifying participant information will be kept in a locked file cabinet in the personal possession of the researcher. When no longer necessary for research, all materials will be destroyed,

• Information from this research will be used solely for the purpose of this study and any publications that may result from this study

Person to Contact: Should you have any questions about the research or any related matters, please contact the researcher at Lwazi.Ngubevana@icloud.com.

Ethics Board: If you have questions or concerns about the study and you do not feel you can discuss with the investigator, please contact the Wits Business School at: (011) 717 ....

Voluntary Participation: Your participation in this study is voluntary. It is up to you to decide whether or not to take part in this study. If you do decide to take part in this study, you will be asked to sign a consent form, and you are still free to withdraw at any time and without giving a reason. You are free to not answer any question or questions if you choose. This will not affect the relationship you have with the researcher.

Unforeseeable Risks: There may be risks that are not anticipated. However every effort will be made to minimize any risks.

Costs to Subject: There are no costs to you for your participation in this study

Compensation: There is no monetary compensation to you for your participation in this study.

Consent: By signing this consent form, I confirm that I have read and understood the information and have had the opportunity to ask questions. I understand that my participation is voluntary and that I am free to withdraw at any time, without giving a reason and without cost. I understand that I will be given a copy of this consent form. I voluntarily agree to take part in this study.

Signature _____ Date _____

APPENDIX E: SAMPLE INTERVIEW



CERTIFICATE OF VERACITY

I, the undersigned, hereby certify that in as far as it is audible the aforegoing is a true and correct transcript of the recording provided by you in the matter:

(NAME OF AUDIO: INTERVIEW WITH DIANE)

TRANSCRIBER	:	HRE
DATE COMPLETED	:	21/11/2013
NUMBER OF PAGES	:	8
PROOFREAD	:	☑

INTERVIEWER: This is an interview with Di. Today is the 22nd. Thanks for taking the time to see me and I think we can get started. First, I think, just for the record, can you just tell me a little bit about the work that you can do specifically what you do with the bio fuels industry?

INTERVIEWEE: Okay, I'm a researcher and my research is focused on improving the efficiency of chemical processes. With the idea that if you can improve their efficiency, you can make less carbon dioxide that has the spinoff of a desired product, you need less feed which means you can end up with a plant that is both cheaper to operate and cheaper to build. Once you start going along the thoughts of trying to make more efficient chemical processes, you start realising with this approach, you can start making smaller processes and if you can start making smaller processes, you can access alternative feed stocks that wouldn't be traditionally considered by the chemical industry and the sorts of feed stocks that we're looking at using our wastes and this could be waste from agriculture, waste from industry, waste from shopping malls and looking at converting these to electricity fuels and this would be bio fuels that you're really making. The fuels that we are looking at are synthetic crude. So it's very much the same sort of process such as Sasol makes. So it's not the bio fuel defined by government but nonetheless it is a bio derived fuel and our research is looking at how small we can make these processes, how we can improve the efficiency and how we can set up industries that will create jobs while cleaning up the environment, adding value to the community to industries and farmers, in other words, it's a win for the environment, a win for the economy and a win for the society.

INTERVIEWER: Alright, at this stage, what do you see as the critical issues in South Africa, in particular, to make the implementation of the bio

fuels program a success? I mean this could be strictly in terms of the work you focus on. You don't have to talk about the entire industry?

INTERVIEWEE: I think the issues in South Africa needs support in facilitation from government and from policy and at the moment the bio fuels industry is governed a lot by regulations which is why I don't wish to call what I love doing making bio fuels because bio fuels has a lot of regulations. You find even trying to access garbage is a problem; you'll find there is regulations about that. The system is so highly regulated; it is going to make the development of new technology extremely difficult in the launching of it. What we need is support from government in terms of getting windows maybe where regulations can be relaxed somewhat while new technologies is tried. We need government to realise… well it was a comment from a movie about that Steven Jobs, that he's meant to have said and he said something like, "If something is worth trying, it's worth being able to fail it" and one has to realise when you try new technology, things are going to go wrong, things are not going to work as expected and then there is going to be a long learning and I think we also need support from government when it focuses on these industries that there is long term support even through the rocky patches. Funding encourages learning from the mistakes and understanding how we are doing to have to refine this technology to match both industries' needs, society needs and sort of match technology, too, needs.

INTERVIEWER: Yes, now that you've mentioned society and business, what do you see as the nature benefits, having a driving industry?

INTERVIEWEE: I think one can create new businesses because suddenly the waste from one industry becomes the feed stock for a new industry. So

it's new businesses, cleaning up the environment because much of these wastes just sit in the environment and cause problems long term, not only for us but for future generations and in fact cost us to clean up the environment afterward. It's a win in that these new industries could create jobs for the fairly low skilled people, where we have a huge need in South Africa that we're actually providing jobs for the people who need it and we're also supplying energy to the communities and to industry and to electricity and the way we supplying this energy is the energy that society distribution networks and also society uses electricity. So it is supplying the energy to drive our society in a form that society can already accept.

INTERVIEWER: Okay, there have been questions that have been raised about the sustainability of the whole bio fuels industry. In your opinion… I mean, what's your understanding of this?

INTERVIEWEE: I think if you're looking at bio fuels looks at taking food with crops, the actual food itself. I think in the African context and the South African context, this is definitely a problem. I don't think one should prevent farmers doing that because we need healthy farming industry and if it is more economical, it makes the farmer more profitable, that's good but I don't think it's good for society. I think the bio derived fuel we're looking at is taking the waste so it will be the stalks from the farming, the manure, maybe crops that are grown, but not food crops, crops that are grown on marginal land that the farmer can't use any other way so it could be grasses and things like that. I think in this case, it is sustainable because you're not actually competing with food; you're actually supplementing food crops but supplying an extra income stream from the food crops.

INTERVIEWER: Okay so you're saying is really being the biggest issue in

terms of bio fuels?

INTERVIEWEE: Absolutely and I don't think we should touch food crops. This model arose in Europe, I believe and particularly in German because there is a huge drive to keep the farmers on the land and the German farmers already make more food than what Germany can use and they were exporting at a subsidized rate which doesn't really make economic sense. So in a society like that with a political drive to keep farmers converting food crops into fuels makes perfect sense but we have a different society, different politics, different drivers and we shouldn't take that model and implement it as is in our society.

INTERVIEWER: Okay, in the South African context, do you know if there are any guidelines or protocols addressing specifically the food vessels fuel issue from government. Are you aware of any kind of regulation or industry standards or anything like that?

INTERVIEWEE: No. I am only aware of industry standards for the bio fuel and so on but not what the policy is. I have a feeling it might be in flux.

INTERVIEWER: Okay. Can you just tell me a little bit more about the industry standards?

INTERVIEWEE: Bio fuels apparently has a whole set of standards that the fuel has to meet. Now the problem is the thinking behind this is I believe that these fuels are derived from oily seeds and so they are very specific properties that are required for the fuel because of where the thinking was when the bio fuel was defined when we were trying to legislate. The problem with this there are many other kinds of bio fuels so if you don't

worry about making the bio fuel from an oily seed, you could actually make a bio derived ethanol which would have very different properties to the so called standards for the bio fuel which is this oily seed. You could have the bio, as I say the stuff that we're also making is also bio derived fuel but it's actually synthetic crude which wouldn't meet those standards. So this is why I think one has to be very careful when legislating that you kind of leave the field open for people to explore for the industry to grow but while remembering that the consumer does need some sort of protection.

INTERVIEWER: You said what you're focusing on mainly is the waste product from our cultural waste or whatever. Do you not foresee a problem here in that once you put value to waste that society, in general, may start thinking, well why minimize my waste production because I can get good value for it. Do you not see there is maybe a potential problem going forward?

INTERVIEWEE: I think any time you introduce new technology, it introduces new opportunities and problems and I don't think one can get away from that so yes, it will introduce all sorts of new problems but hopefully they're different problems and smaller problems than what we're already faced with our mountain of rubbish. I think it's not only form the company's point of view that maybe reducing waste is no longer a driver for them but it's even from society, you now creating jobs at who gets the jobs, for example, we're looking at a project in Lanasia, outside an informal settlement which hasn't got any rubbish collection and putting a little plant in there but the issue is, who is going to collect the rubbish? If you make electricity, how do you distribute it? Who gets it and you can actually cause a problem in society because you're bringing in new drivers the society doesn't currently have and these sorts of things do have to be done very

carefully but nonetheless I don't think it should stop it, I think we have to do it with sensitivity and basically try and do this for a win-win for society?

INTERVIEWER: But how do you manage that and how do we, as a researcher, is there anything that you think you can do better or you can communicate maybe differently to ensure that the message actually gets through that we try and avoid these kinds of problems?

INTERVIEWEE: I think one can send that message through but, for example, what we are doing is we are working with as sociologists who will be studying the community. The sort of project that we are looking at, for example, they will go into the community, talk to the project and bind with the community, identify the community's needs. So, for example, if we're supplying electricity, how should we supply it? Who should we supply it to? So in other words, I think what we have to be careful of is taking technology and pushing it into society. I think we have to work with society to identify society's needs and the way society sees things working and this is, for example, pilot study to see how we could go into an informal settlement, create jobs and supply electricity without causing violence in the society and putting extra stresses and tensions in it.

INTERVIEWER: Okay, so, if I am hearing correctly then you think that partnership with the community is quite critical in trying to ensure that you avoid some of these problems?

INTERVIEWEE: Yes and I think to make sure that the technology meets society's needs. I think it's always a difficulty when the technology providers or inventors decide what society's needs are. They may have identified it properly but they may not have and so I think you always have

to work closely with society to make sure that you are actually identifying needs and meeting needs properly so that the technology and the society work hand in hand.

INTERVIEWER: This is just a matter of opinion that I am looking for here. Do you think that researchers and maybe even yourself, personally, should be taking responsibility for what may happen because of the work that they do? The reason I am asking is they've had cases where researchers have put out technologies or put out ideas into the public domain and the example being South Africa situation with the HIV issue when researchers had put out work that seemed to show no direct cause and in fact relationship between HIV and Aids and that ended up in the policy that took away probably a couple of million lives. So do you think that researchers should take some kind of personal responsibility to ensure these kinds of things don't happen? How far do you think they should be taking this responsibility?

INTERVIEWEE: Well that's really a touch question. I mean if you look back, every time new technology has come in, it has tended to cause a revolution and I am talking about technology that is revolutionary. It goes hand in hand with social revolution and if society is not willing to adapt or change quickly enough or adopt it, it does tend to cause a society that struggles. So I think what we have to try and strive for, this society is an innovative society. We have to strive for a society where our policies, our government, our technology and our society can be innovative. If we can do this then I think we will be able to adapt and change as we put new pressures on society, like new technologies because new technologies are new pressures and maybe if we have a society that understands innovation a little bit better, they won't be so keen to take up one paper that says

some results and then believe that completely because the scientific process is a lot of little baby steps, sometimes going backwards, sometimes going forwards. It's very seldom that you kind of get one definite answer. It's a process, I suppose, how scientific knowledge builds up when one sees the opportunities and the problems and perhaps it's with government not understanding why things can go wrong. So I think the researcher can't take full responsibility but I think the researcher can work with society, with government and be a little bit more visible in terms of maybe explaining science, working with government, trying to warn but at the same time I think you can't stop developments because you're scared of what might happen if we did that. We couldn't have really tamed fire in the first place, millions of years ago. It has good and it has bad and it's really how we use it. I don't think it should prevent the researcher or the person who discovered fire, for example, telling society, "Here is fire. It's got good and it's got bad in."

INTERVIEWER: So the real issue is about communicating the message?

INTERVIEWEE: Yes, communicating the message and I think what we also need to do is try and move more people who are Science literate and understand Science and technology into positions of authority which I think would certainly help if people understood that aspect in terms of them interpreting what is happening, facilitate what is happening and trying to put policies in place to help.

INTERVIEWER: Okay, are there platforms that you think are useful for not just scientists to communicate amongst themselves but with government for example to inform policy, in terms of what work they are doing?

INTERVIEWEE: There are structures, for example, the Academy of Sciences where I am helping them draft a report. The government requested looking at the state of green technologies in South Africa. So these do exist but I am not sure if they're functioning as effectively as they could and if as many researchers as possible are actually taking part in this. My feeling in general is the researchers are under a really heavy load at the moment in terms of having to increase research out puts. The money supplies are drying up. The students need a lot of care and I am not sure if researchers at the moment are really spending much time on communicating because they are living in fairly marginal times in a way and I think that certainly could be improved and it would certainly be a winner if government and Science and society if we could improve those but how it's done, I don't know. I'm afraid I suffer the same problem as everyone else, too busy.

INTERVIEWER: Okay, I think that covers just about everything I wanted to talk about. Anything else maybe you want to add?

INTERVIEWEE: I just think that we're standing at cross roads as a society in terms of how we handle supplying energy to our communities, how we create jobs, how we handle the waste that society produces and if we're brave enough, this is a huge opportunity and if we understand we are going to make mistakes and accept we are going to make mistakes but that we're going to learn and that we can do it and have a belief that we can actually do it, I think this is a huge opportunity for Africa and South Africa, in particular and I hope we're brave enough to actually take this challenge on.

INTERVIEWER: Alright, thank you Diane.